

OCR GCSE GATEWAY BIOLOGY A • J247

BIOLOGY



EXAM QUESTION PACK

B2.2 THE CHALLENGES OF SIZE

SCORE

/327

PERCENTAGE

%

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	
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Centre number						Candidate number				
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INSTRUCTIONS TO CANDIDATES

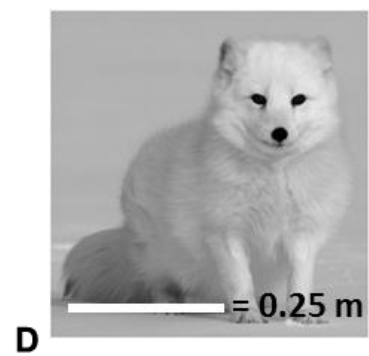
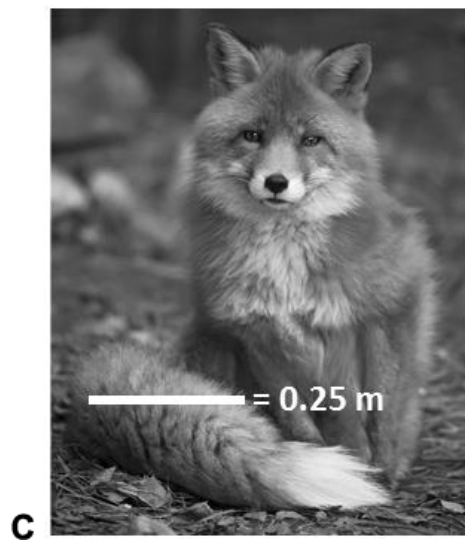
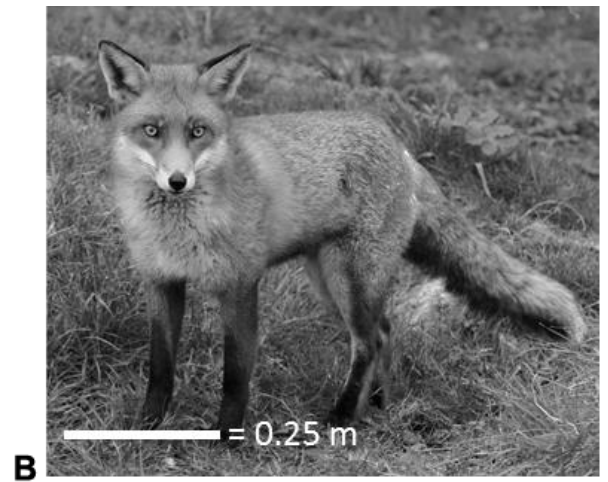
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure 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.

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

Which fox has the largest surface area:volume ratio?



Your answer

[1]

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

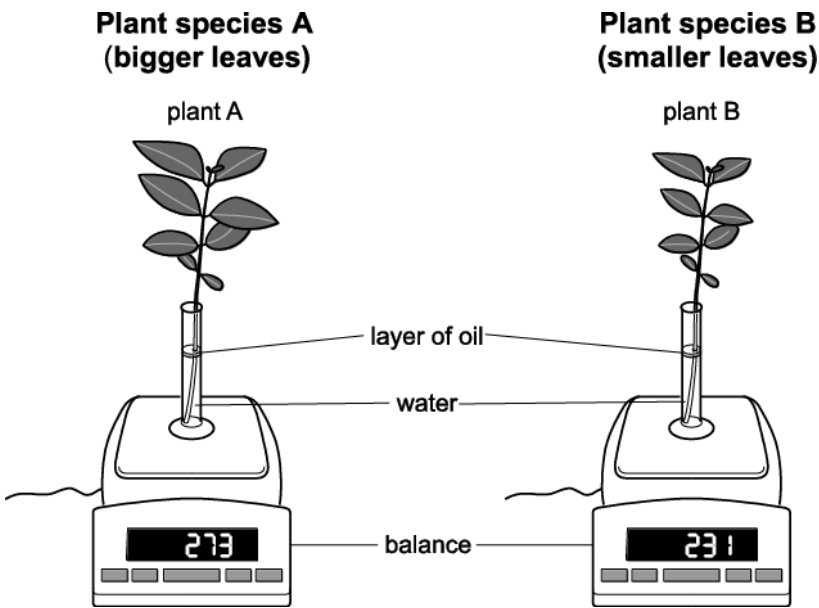
Your answer

[1]

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.

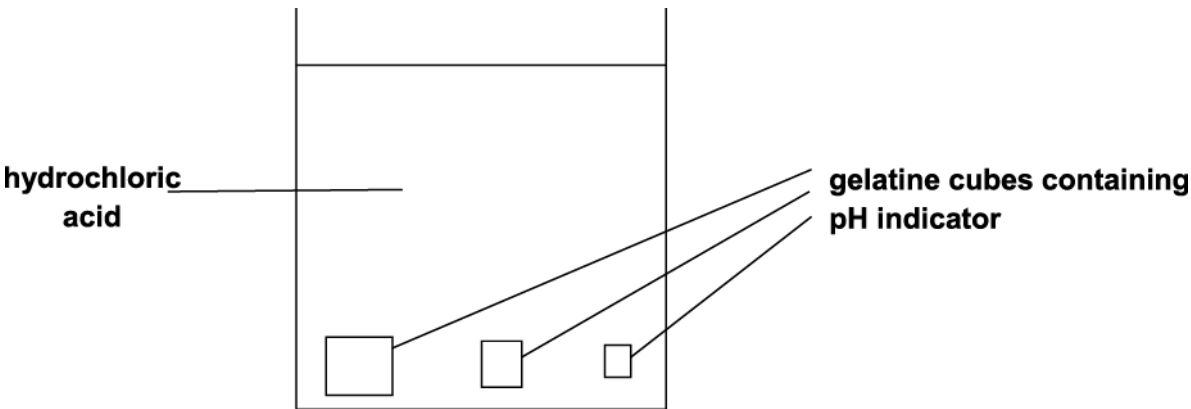
Which other experimental conditions should she keep the same?

----- [3]

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.

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]

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	

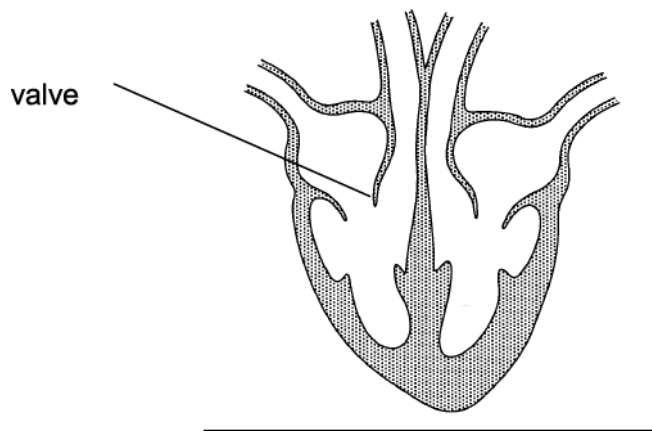
[1]

- (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.



People who have this leaky valve often have these symptoms:

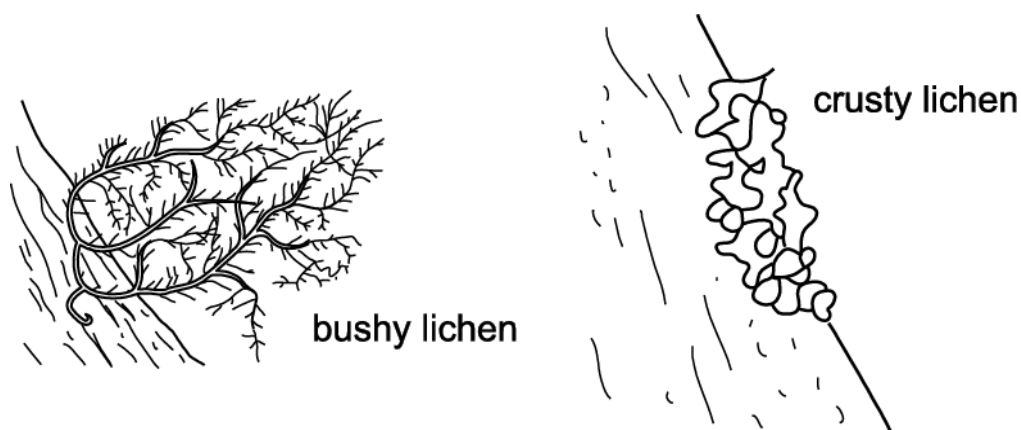
- they get out of breath easily
- they do not seem to have much energy and feel tired.

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.



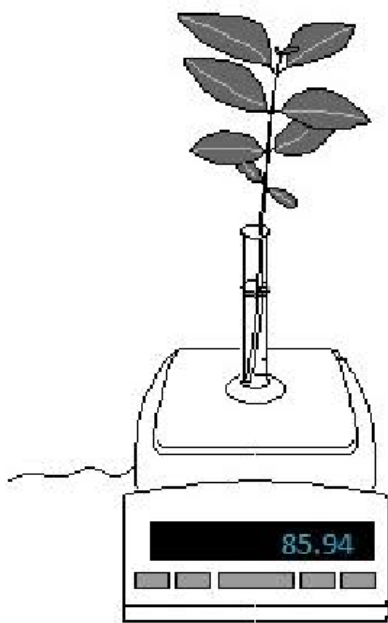
Bushy lichens are usually more sensitive to pollution than crusty lichens.

Use the diagrams to suggest why.

----- [1]

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

The diagram shows how she sets up her experiment.



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]

(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]

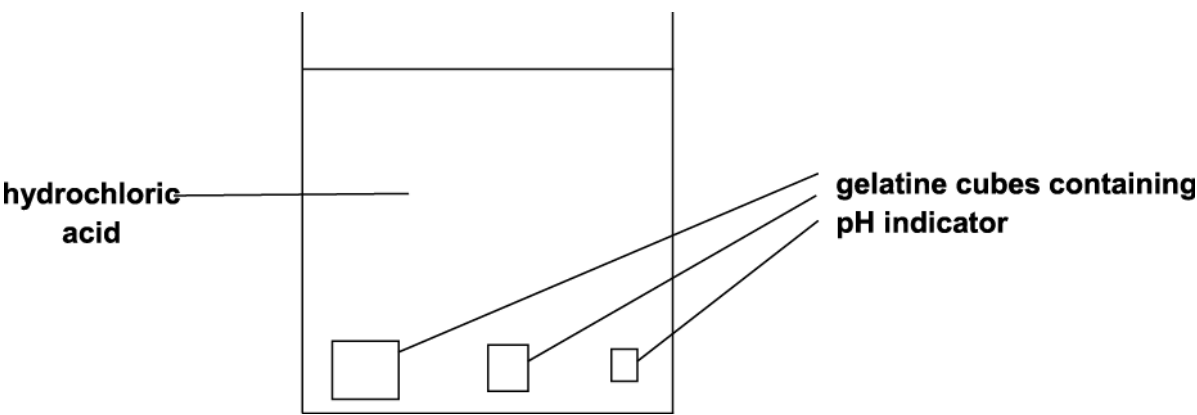
(ii) Why was it important to keep the temperature the same?

-----[1]

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.



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(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.

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]

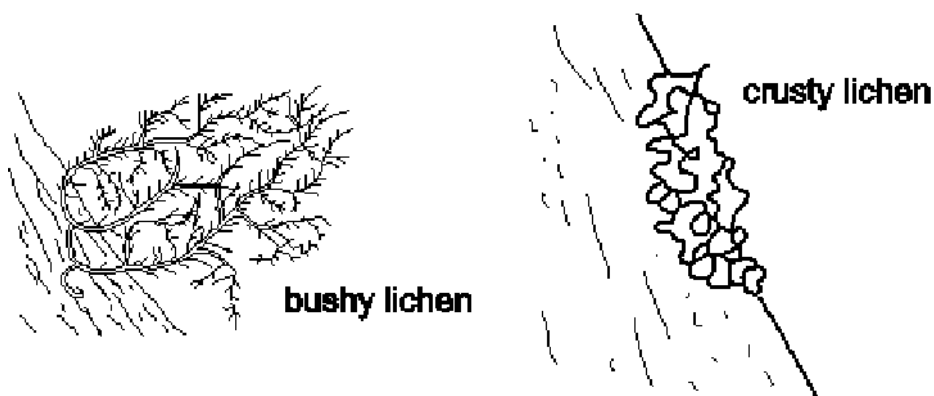
- (b) Oxygen enters red blood cells by diffusion.

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]

11 Strokes are a type of cardiovascular disease.

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

Hemorrhage



Blood bursts through wall

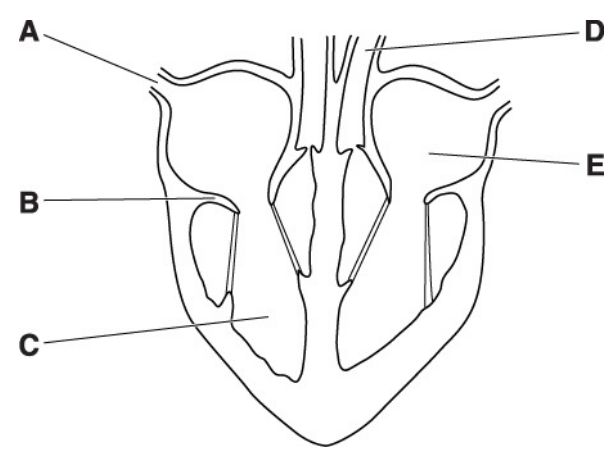
(i) When a person has a stroke, why are arteries more at risk of bursting than veins?

-----[1]

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

-----[1]

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]

(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?

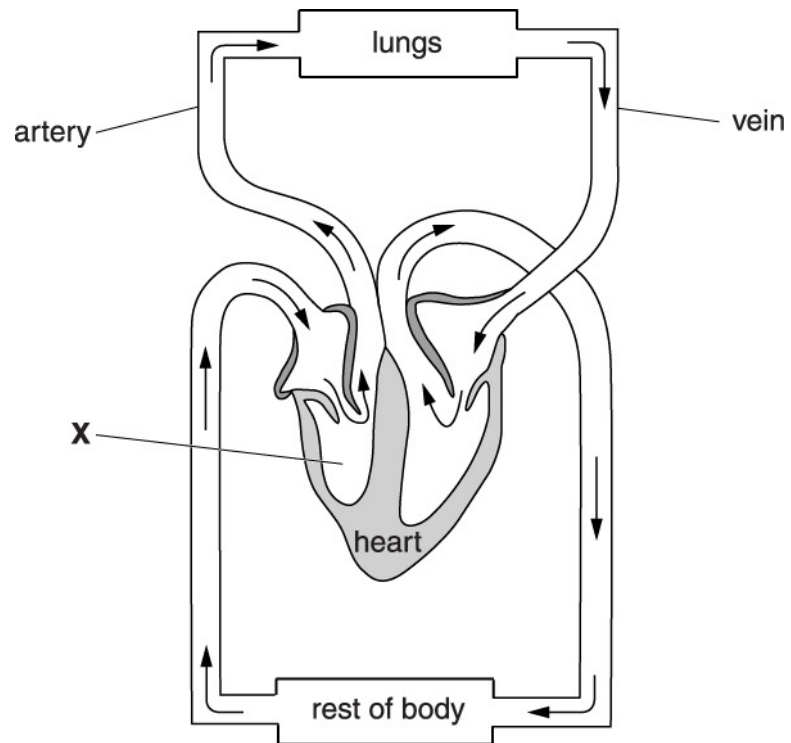
-----[2]

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

What is meant by cell differentiation?

-----[1]

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]

(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.



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.



Why do mangrove roots need to respire?

-----[3]

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



layer of oil

water

balance

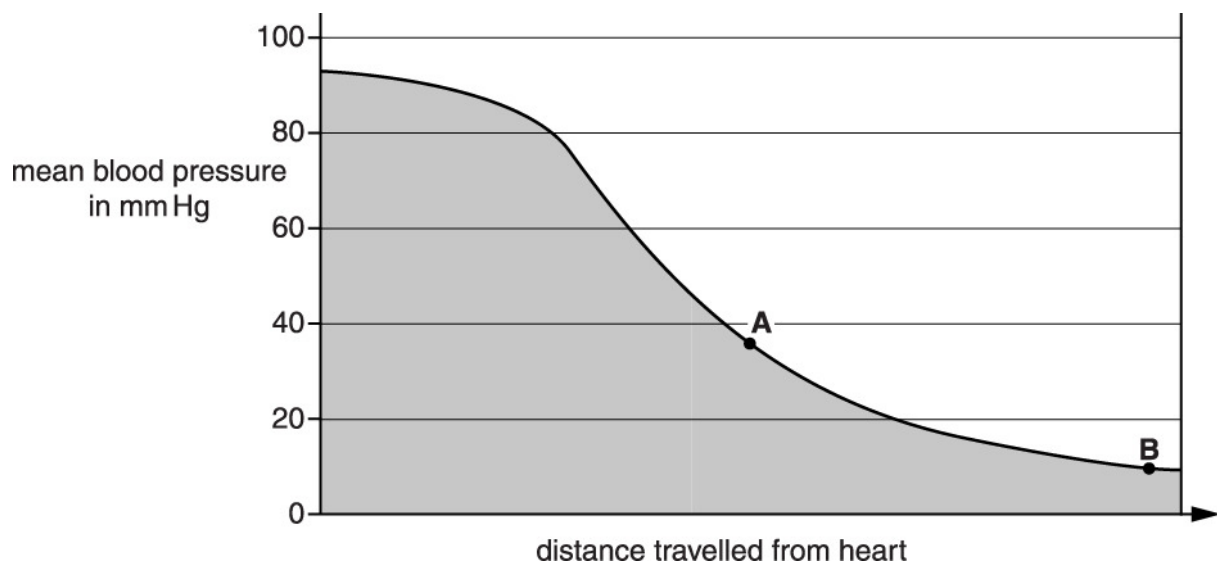
Describe and explain the overall expected results for A and B.



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

[6]

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]

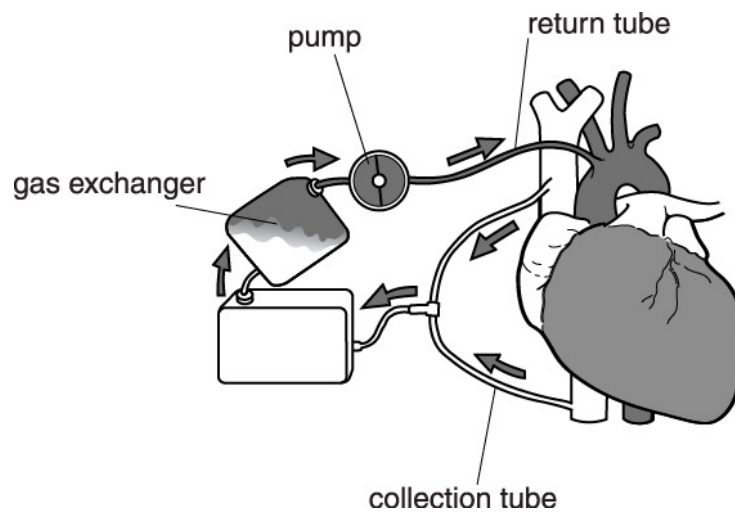
(b) The valves inside someone's heart can become damaged.

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.

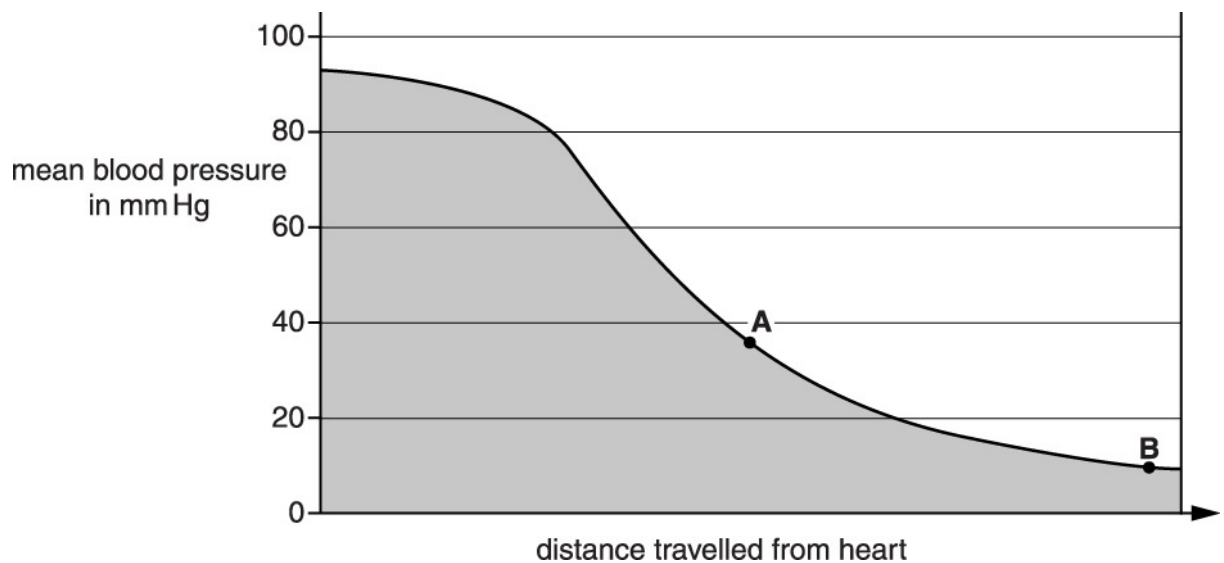
Explain why.

----- [2]

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 _____ %

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(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]

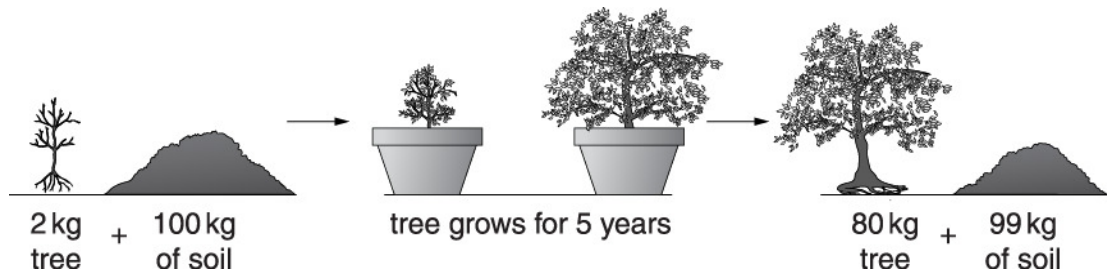
In 1649, scientists thought that plants grew by **only** taking in solid materials from the soil.

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]



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

- (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]

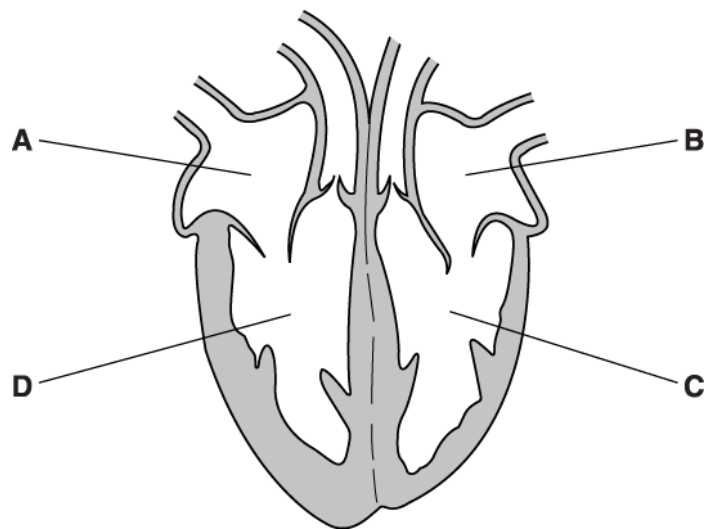
- 26 About 1 in 10 000 people has a condition called situs inversus.

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.



- (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]

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.

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]

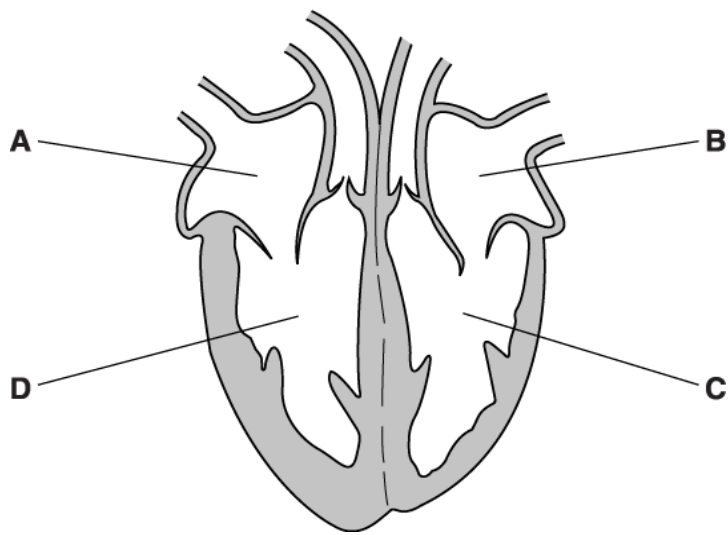
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- (i) Look at the diagram of the heart. Which part pumps blood **around the body**?

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]

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?

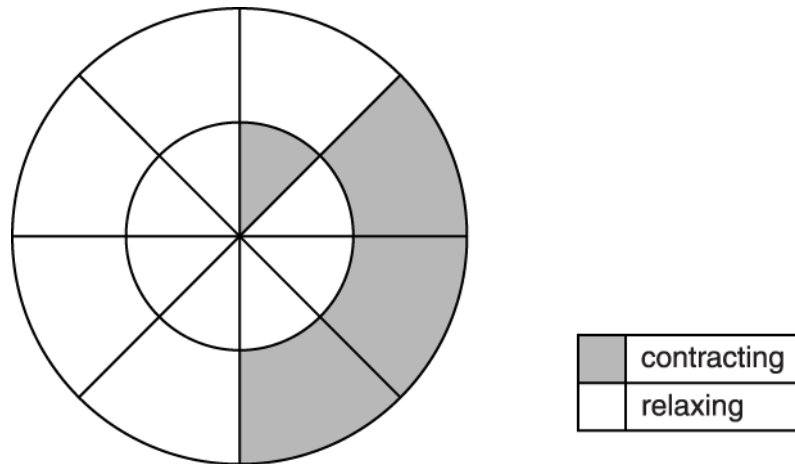
[1]

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]

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]

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

Look at the table.

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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]

- (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 mm³ of camel's blood there are **equal numbers of** / **fewer** / **more** red blood cells compared to 1 mm³ 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 = _____ %

(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.

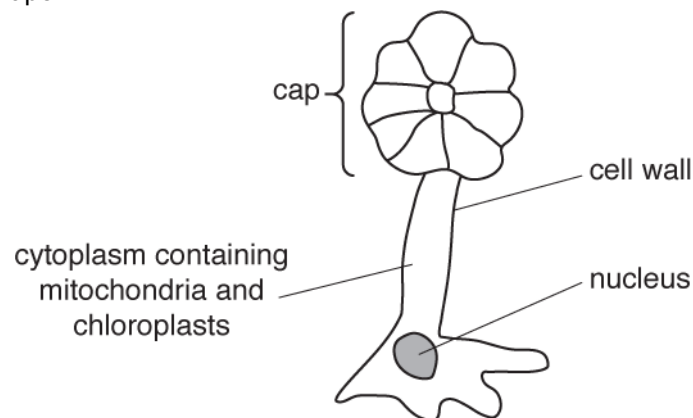
Camels and humans have a different percentage of red blood cells in their blood.

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]

(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]

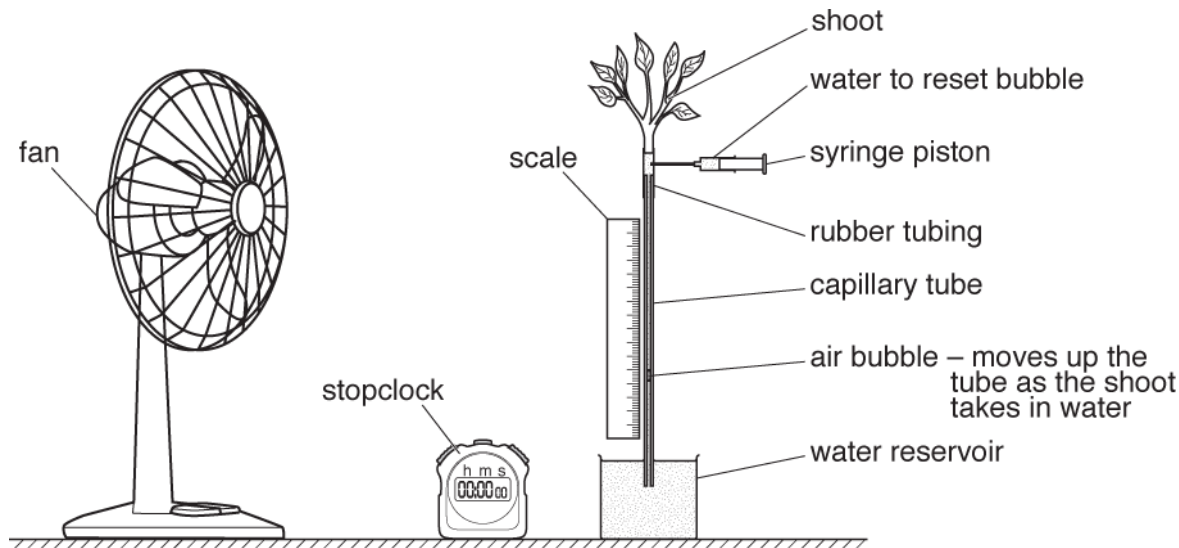
44 Transpiration is the loss of water from the leaves of a plant.
Look at the apparatus in the diagram.

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.

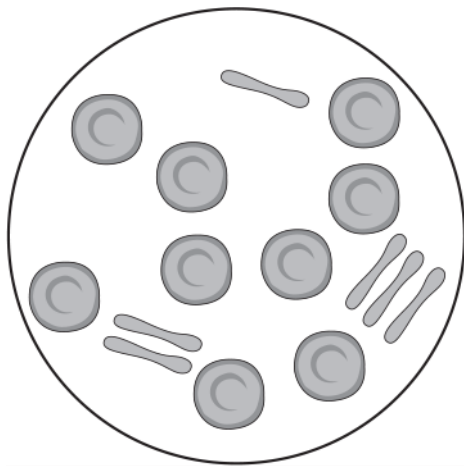
Conditions	Distance air bubble moves in 5 minutes in mm
------------	--

	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.

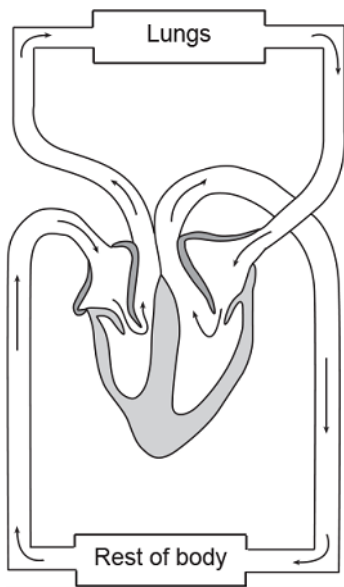
Which statement **best** describes how this happens?

- 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]

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]

(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]

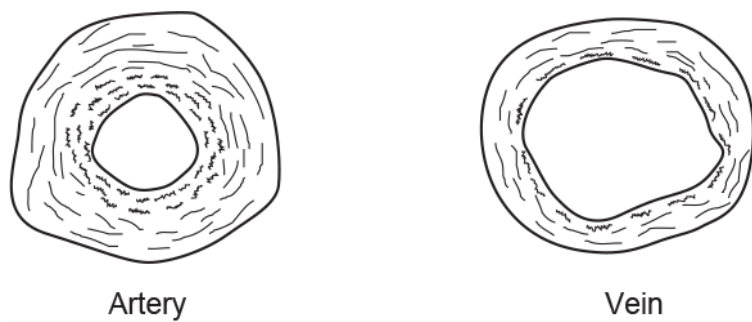
(c) How is the **thickness** of the heart wall on the left side different to the right side?

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 -----

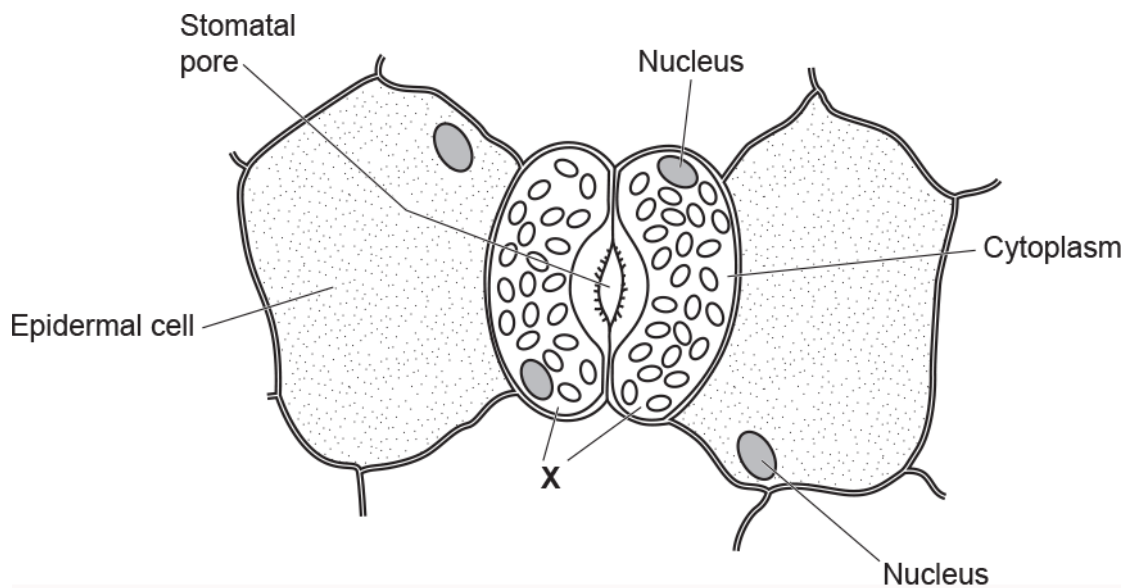
2 -----

----- [2]

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

----- [1]

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



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

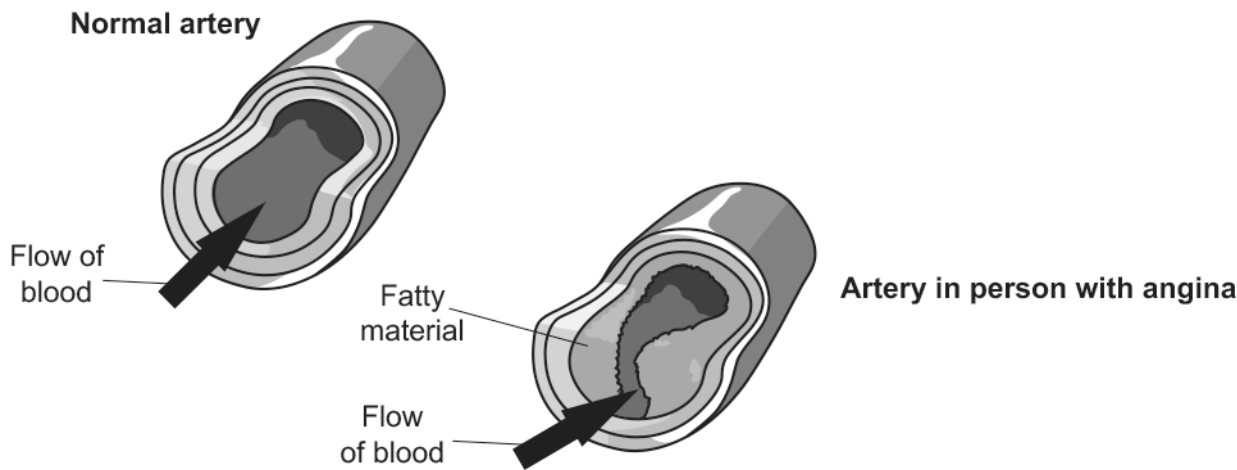
-----[1]

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

-----[2]

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.

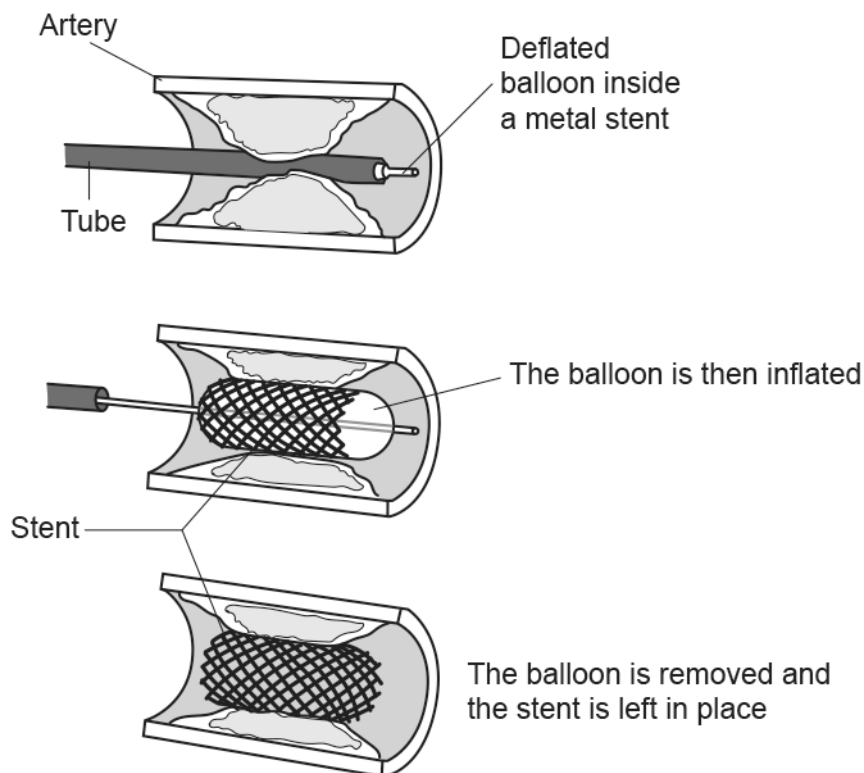
Use the information in the diagram and your biological knowledge.

[3]

(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]

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

The volume is $1 \times 10^{-7} \text{ mm}^3$.

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

A 0.0015 : 1

B 0.7 : 1

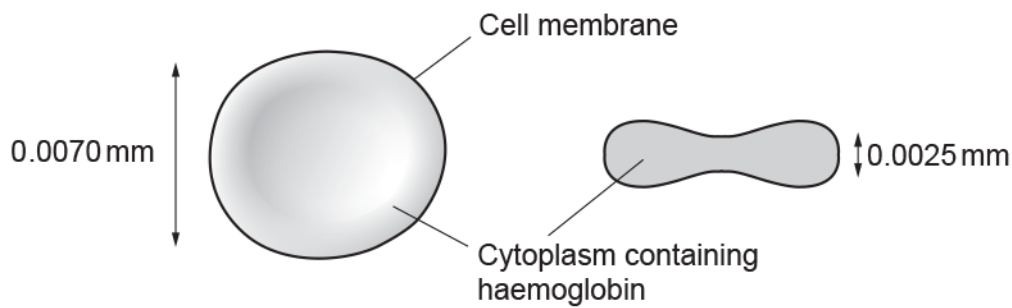
C 1.5 : 1

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

 [

ans
 1

wer
]

53 Sieve plates are structures found in plants.

What is their location and function?

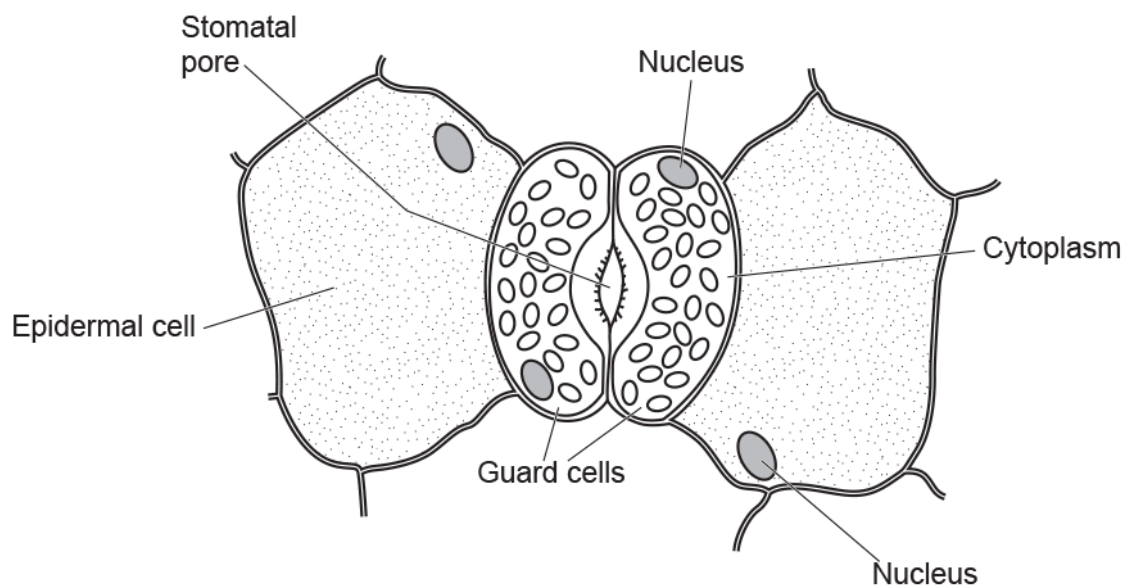
- A Found in phloem and allow movement of sucrose
- B Found in phloem and allow movement of water
- C Found in xylem and allow movement of sucrose
- D Found in xylem and allow movement of water

Your answer

 [1]

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.

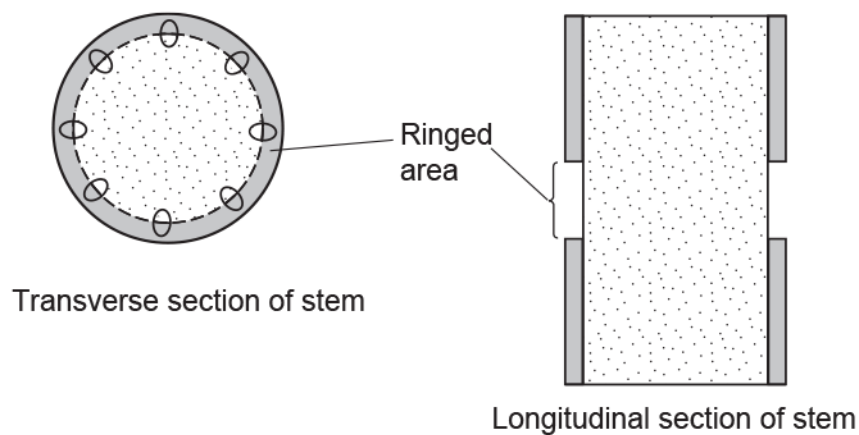
[4]

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

[2]

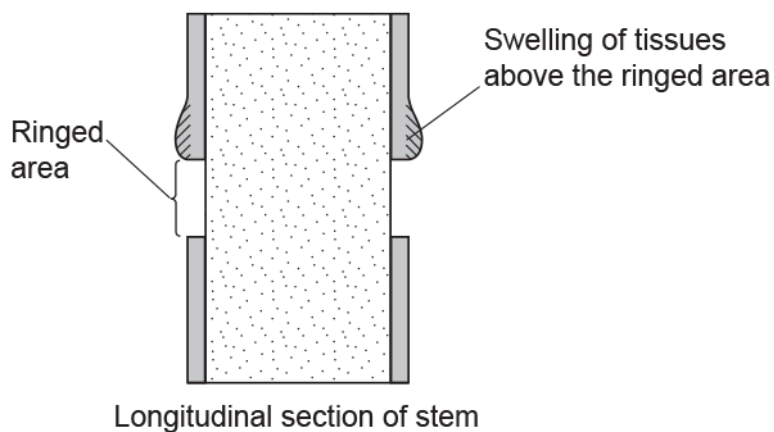
- (b) An experiment was done to look at the effect of ringing on a tree trunk. Ringing removes a strip of plant tissue from around the stem of the tree.

The diagram shows where the stem is ringed.



The results were recorded after one week.

The diagram shows the results.



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 $3 \times 3 \times 3$ 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]

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.

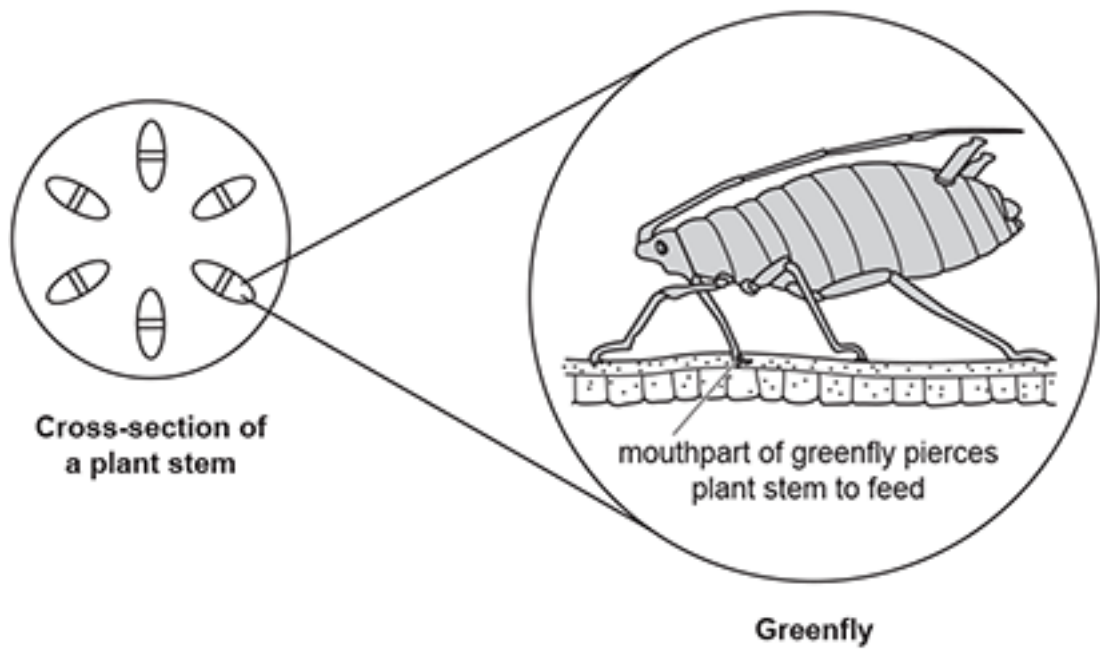
1 -----

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.



(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.

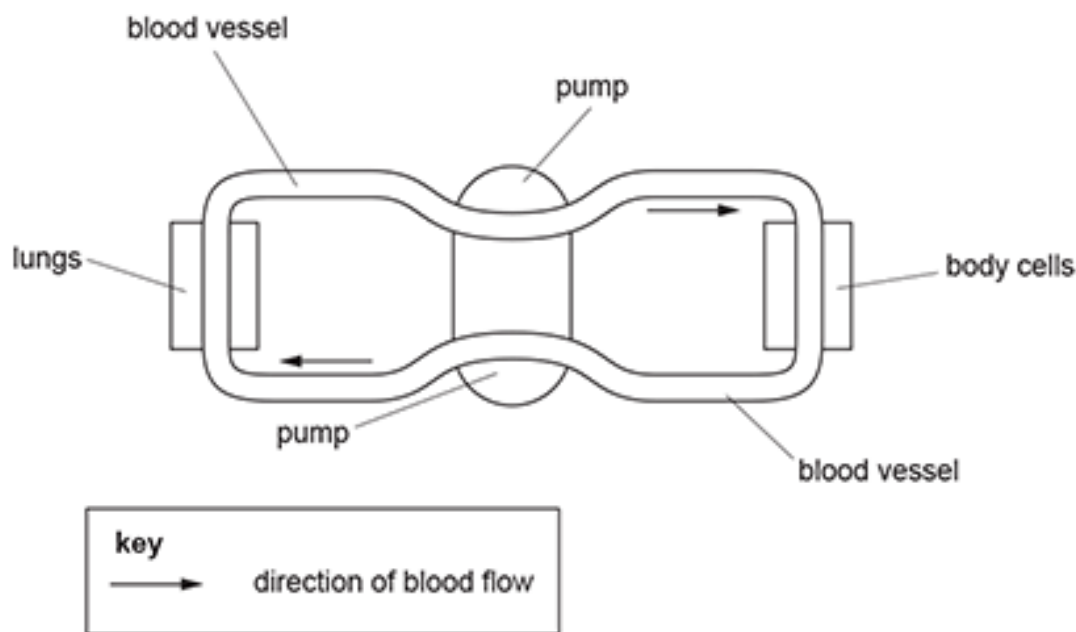
Now they can use modern methods such as MRI and X-ray imaging.

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]

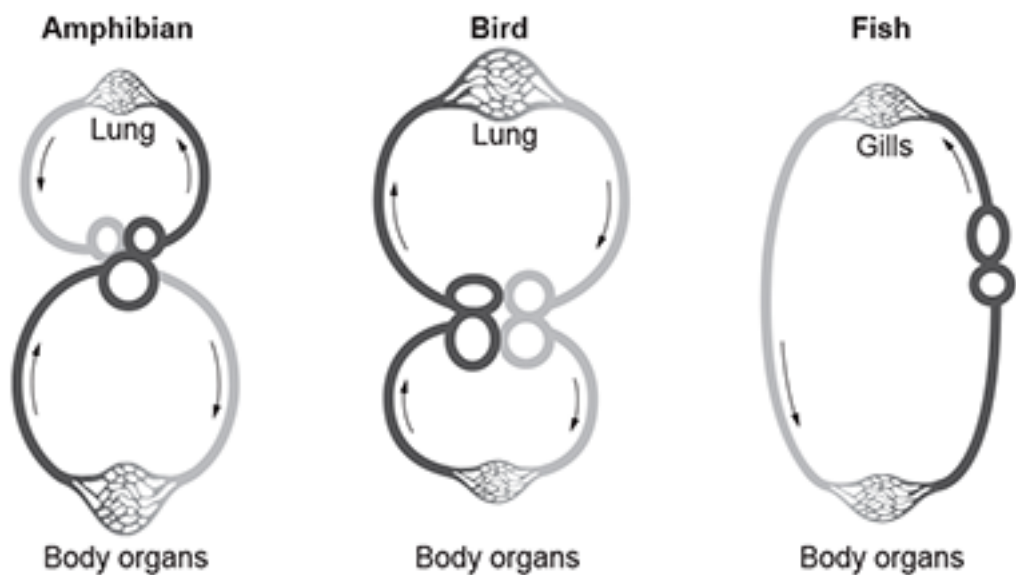
58(a) Look at the diagram. It represents the human circulatory system.



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.



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

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]

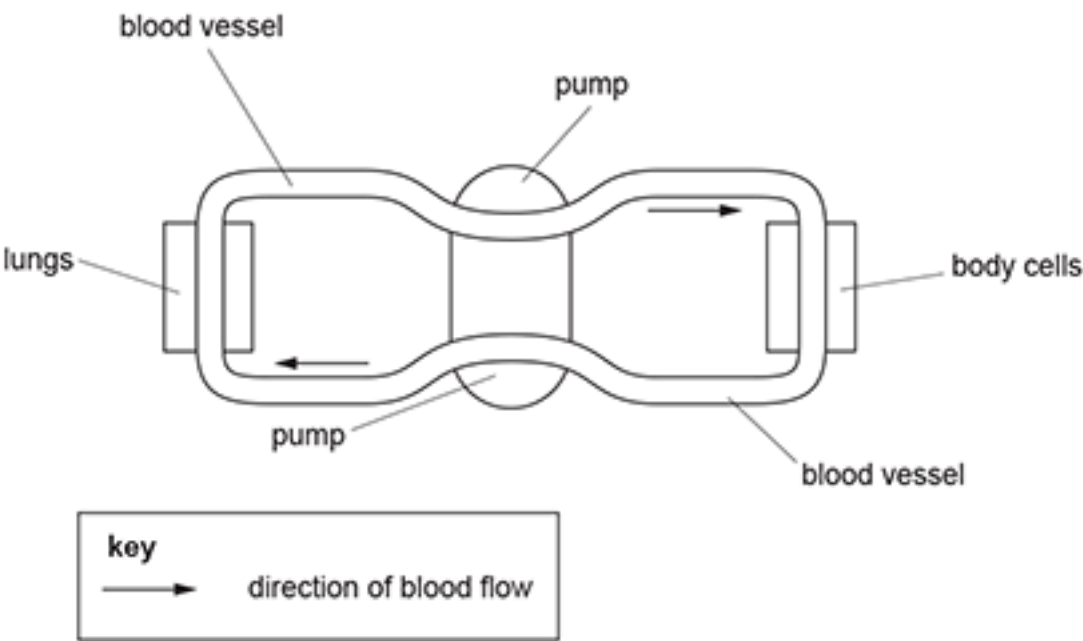
(ii) The table shows that blood flow to other organs has decreased by nearly 5 times when a person is **doing exercise**.

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.

This is their method.

- Ask a healthy person to sit in a room at 20 °C
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Total	5800	25 000
-------	------	--------

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

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

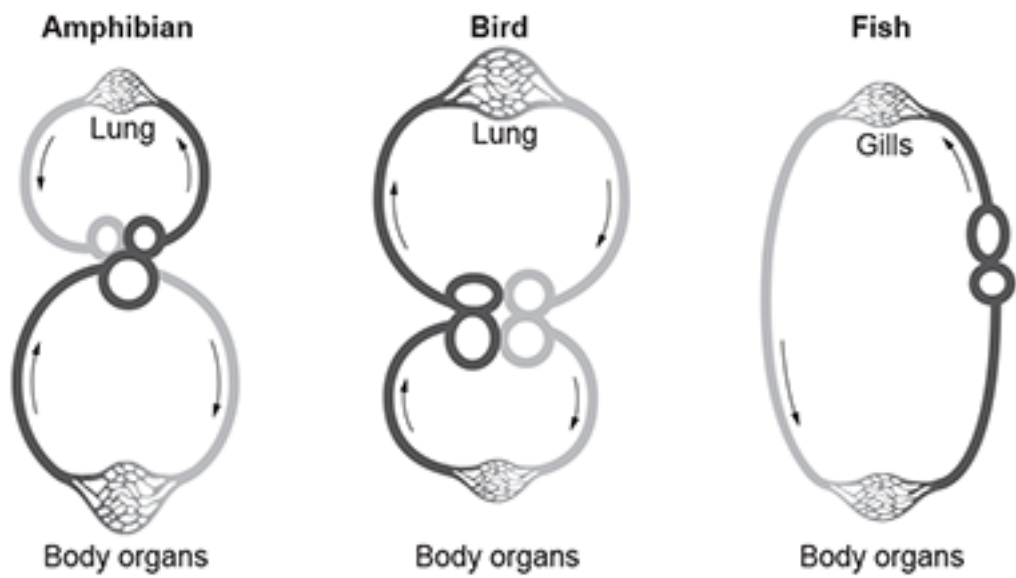
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The blood flow to the muscles has increased by more than eighteen times.

Explain these changes to blood flow rate.

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

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



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]

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]

(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.

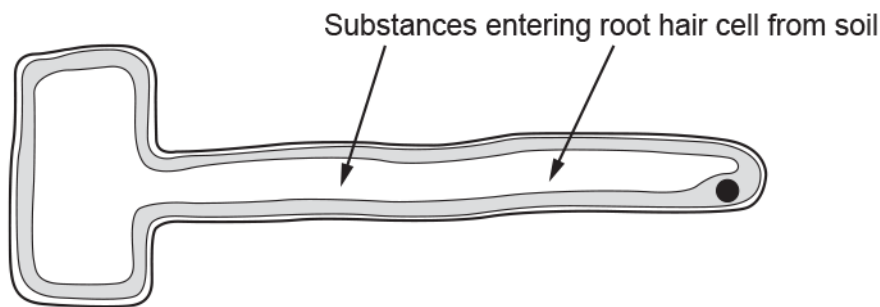
Heterozygous rats are resistant to warfarin but only need slightly increased amounts of vitamin K.

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]

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.

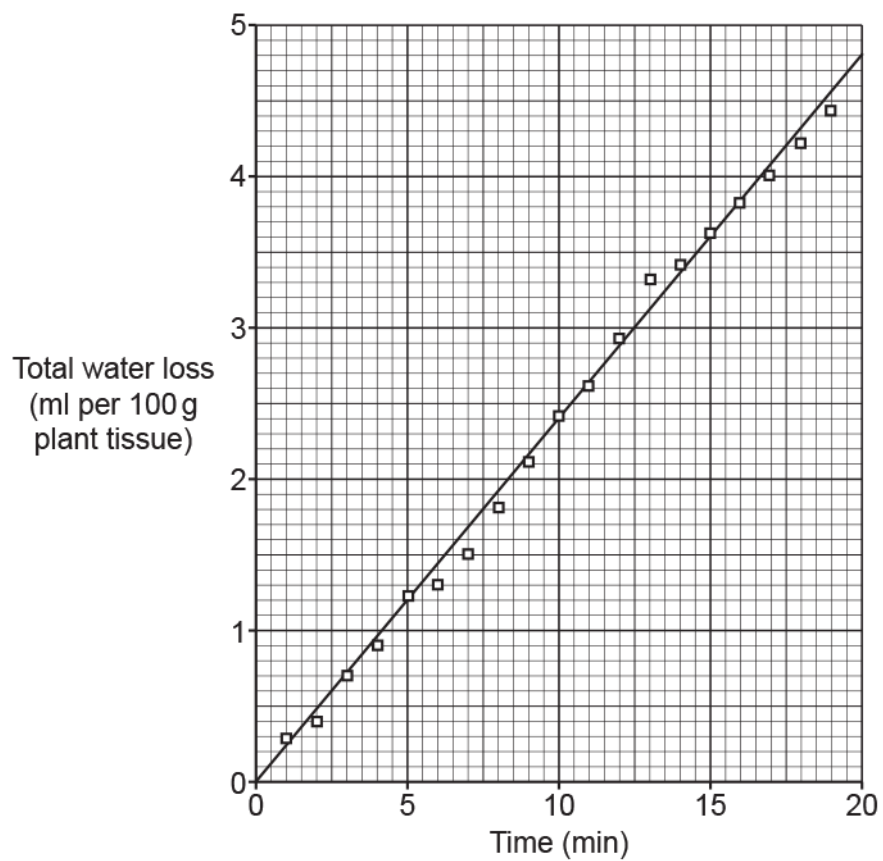
Which conditions make a plant **most** likely to wilt?

- 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.



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]

- 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]

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.

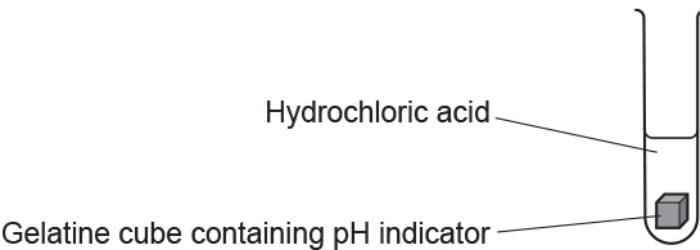


Fig. 21.1

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]

(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]

- (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.



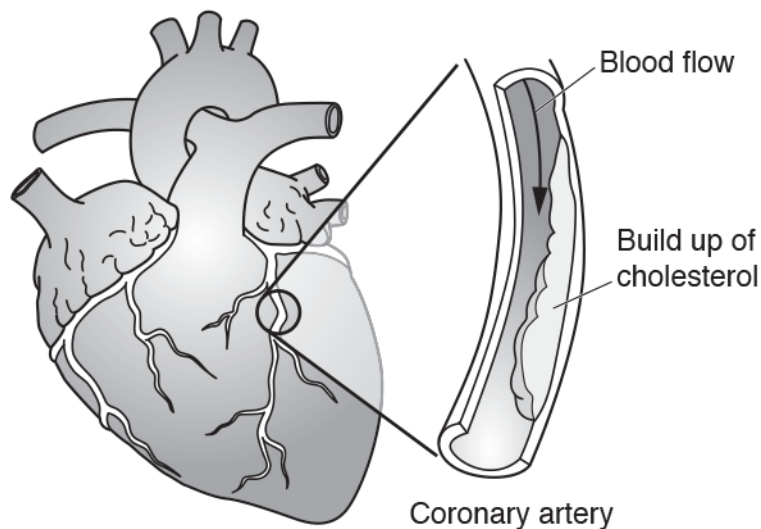
Fig. 21.2

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

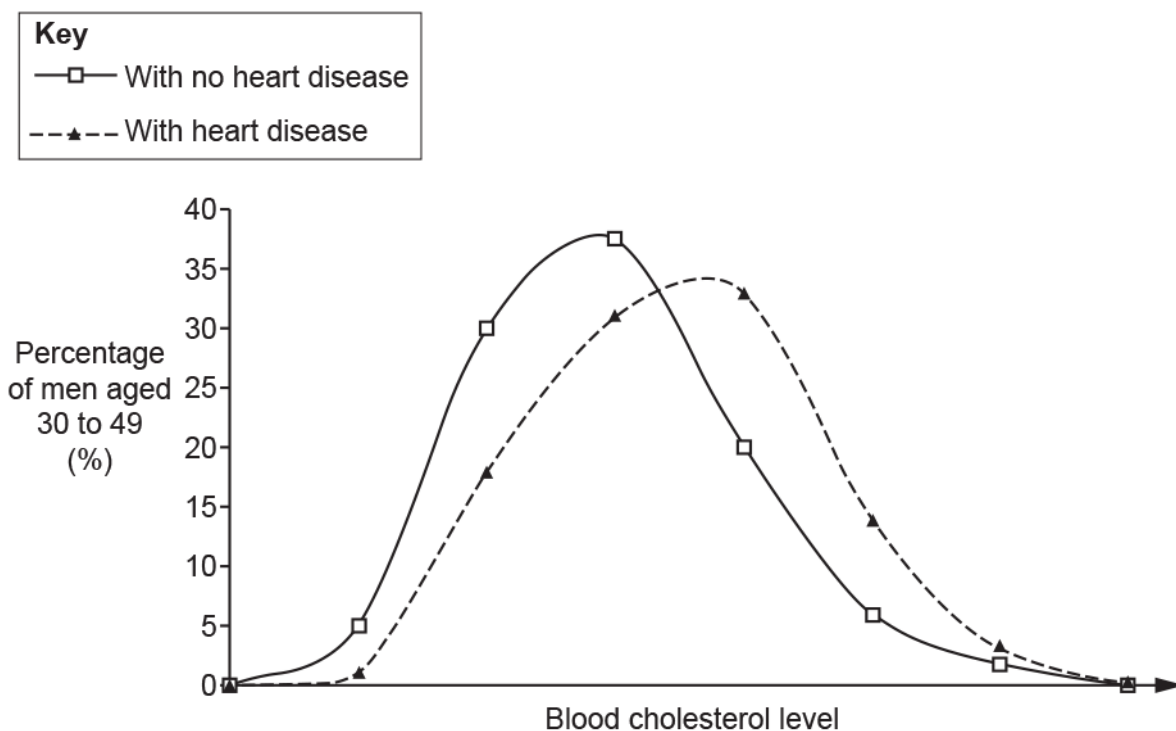
[2]

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.

[6]

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

- Your answer

[1]

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]

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.

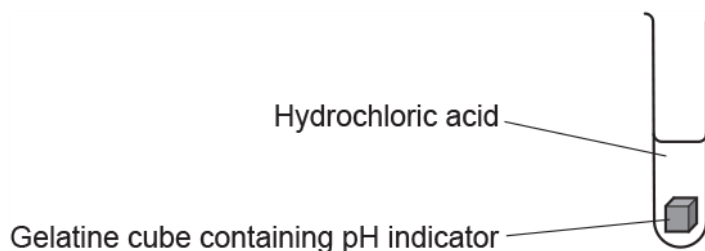


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2		32
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surface area : volume ratio = ... [2]

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

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----- [2]

- (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.



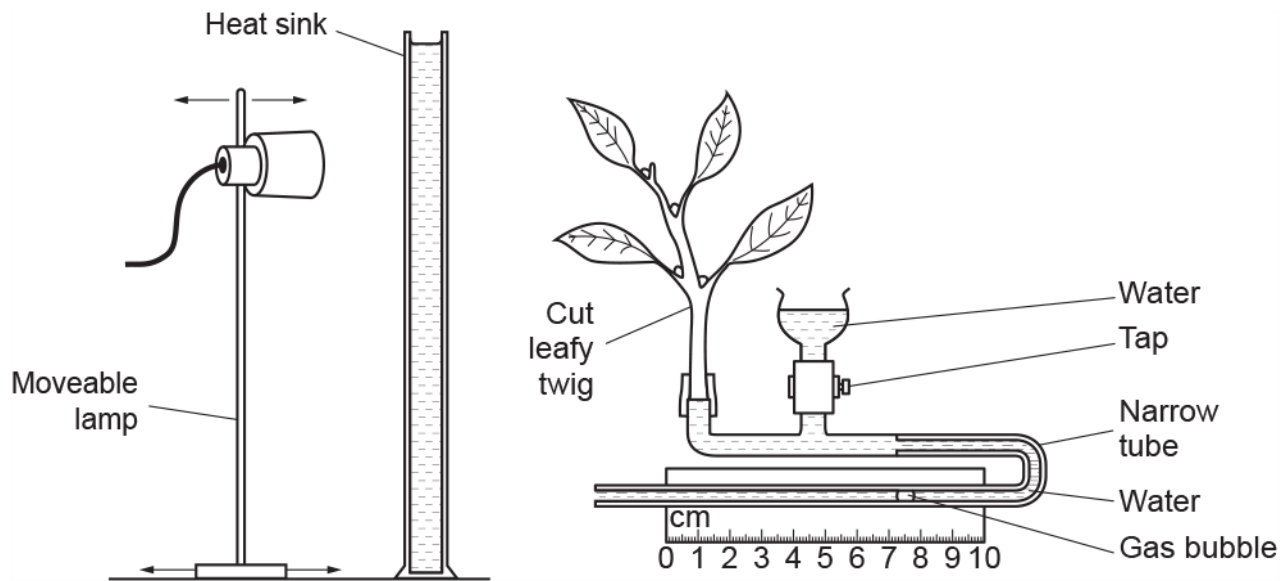
Fig. 16.2

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]

(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: $\text{volume} = \pi r^2 l$

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 = ... mm³ / 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]

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

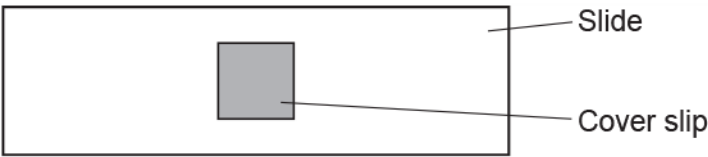
Blood component	Number per mm ³
red blood cell	$4.5 - 6.5 \times 10^6$
white blood cell	$6.0 - 16.0 \times 10^3$
platelet	$1.5 - 4.0 \times 10^5$

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 = ... mm³ [1]

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

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

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.

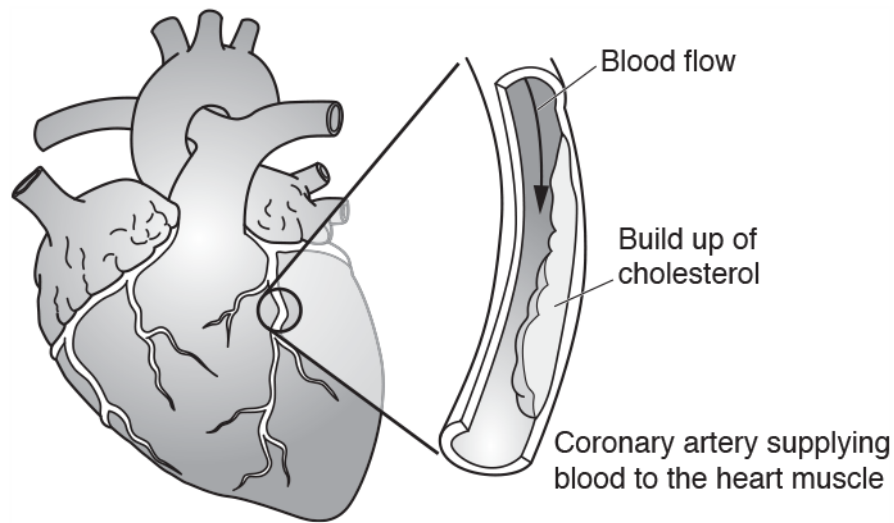


Fig. 21.1

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.

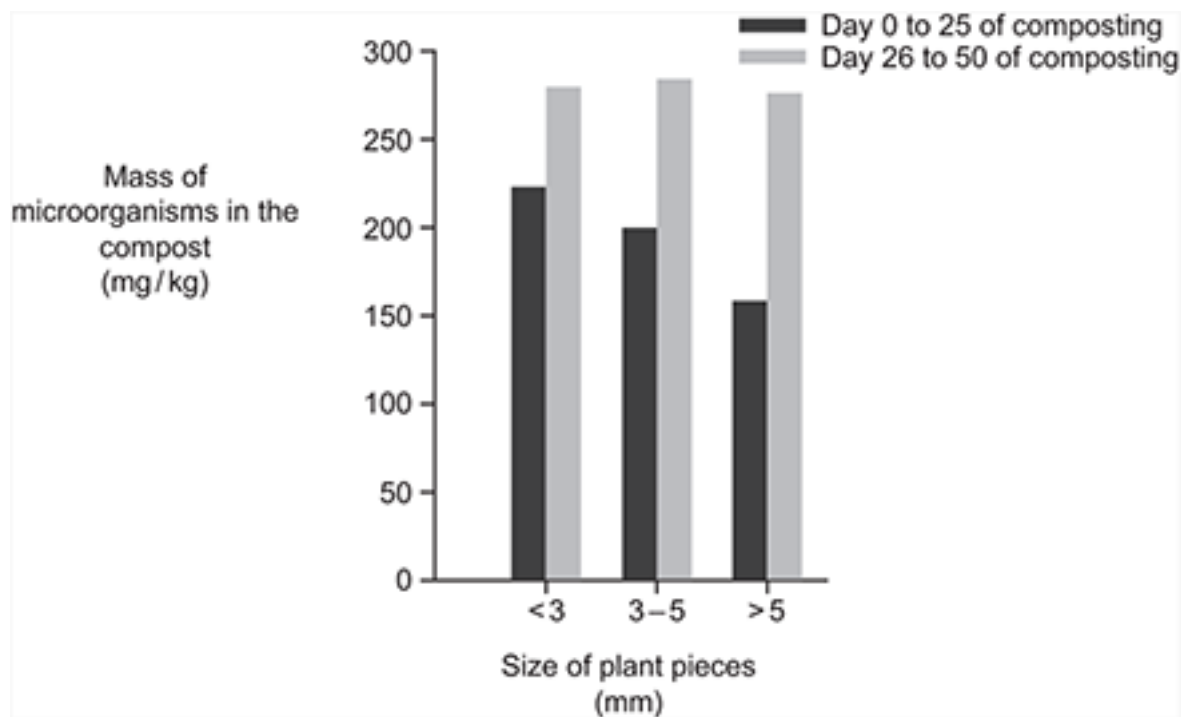
Explain why people who have the mutation in the allele for the LDL receptor are much more likely to develop heart disease.

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

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1			A	1	
			Total	1	
2			C	1	
			Total	1	
3			D	1	
			Total	1	
4	a		stop evaporation of water (1)	1	
			so any loss in mass / water is from the plant (1)	1	
	b		same temperature (1) same light intensity (1) same windspeed / air movement (1)	3	allow same humidity

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c		* Please refer to the marking instruction point 10 for guidance on how to mark this question. Level 3 (5–6 marks) Concludes whether this result would be expected in this experiment and includes scientific reasons in their answer. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Draws a conclusion from the data supported with suitable calculations. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Draws a conclusion from the data without the use of calculations. <i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</i> 0 marks <i>No response or no response worthy of credit.</i>	6	AO3.2a: Analyse the information from the experiment and use judgement to ascertain if the result is as expected • Bigger plants would be expected to lose more mass – because of their larger surface / ora • Smaller plants could have lost more mass in • this experiment – because they may have a higher number of stomata per unit area / ora • Results may be inconclusive as the experiment has not been repeated / there are an insufficient number of repeats AO3.1a: Apply knowledge and understanding of the experiment with respect to the data • Convert from water loss to percentage water loss plant A 12.6% plant B 15.4% and explained • Plant A lost more water / lost water more slowly • Plant A lost $261 - 228 = 33$ g, • Plant A rate of water loss – $33/24 = 1.38$ g/hr • Plant B lost $273 - 231 = 42$ g • Plant B rate of water loss – $42/24 = 1.75$ g/hr • Plant B lost 5 g more mass than plant A AO2.2: Apply knowledge of transpiration to the different leaf sizes • both experiments lose mass • that mass can be because of water loss • that water loss is due to transpiration
			Total	11	
5	a	i	6:1	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	7.6×10^{-3} 3.0×10^{-3} 1.5×10^{-3} correct calculation of $1 / \text{time}$ (1)	1	
		ii	answer in standard form (1)	1	
		iii	Comment on the rate of colour change / smaller block changed faster (1)	1	ORA
		iii	Diffusion alone is sufficient in smaller organisms / smaller organisms have a larger surface area to volume ratio / diffusion alone may not be effective in multi cellular organisms (may require circulatory system) (1)	1	
	b		small size (1) - to travel through capillaries (1) - to get in to small vessels / capillaries (1) biconcave disc shape (1) - large surface area : volume (1) haemoglobin (1) - to carry oxygen (1) lack of nucleus (1) (so) more room (for haemoglobin) (1)	5	can only gain explanation marks (bullet points) if correctly linked to a feature max 4 marks if only given features without explanations
			Total	10	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
6		i	a communicable disease	1	Both correct answers are required for the mark
			a disease that is caused by defective alleles		
			a non-communicable disease		
			a disease that is affected by lifestyle		
		ii	antibodies (1)	1	
		iii	idea that it stops blood flowing backwards (1)	1	
		iii	inefficient circulation to lungs / less blood would go to the lungs (1)	1	
		iii	Increased ventilation required for gaseous exchange (1)	1	
		iii	idea of less oxygen available to the tissues / fatigue / oxygen debt (1)	1	
			Total	6	
7			larger surface area (to take up pollutants) (1)	1	allow sticks out more from bark
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
8	a		(more water / mass lost when fan is on because)		allow reverse argument
			air movement removes water vapour / reduces water vapour concentration outside leaves / increases water vapour concentration gradient (1)	1	
			so evaporation / diffusion happens more quickly (1)	1	
	b	i	(because otherwise) an increase in light intensity would open stomata (1)	1	
		i	increasing transpiration / ORA (1)	1	
		ii	(because otherwise) an increase in temperature would increase evaporation / ORA (1)	1	
			Total	5	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
9	a	i	6(1)	1	
		ii	7.6×10^{-3} 3.0×10^{-3} 1.5×10^{-3}		
		ii	correct calculation of 1 / time (1)	1	
		ii	answer in standard form (1)	1	
		iii	as size increases the rate of diffusion decreases / as size increases the diffusion distance increases (1)	1	ORA
		iii	idea that would take too long for substances to diffuse in and out of large organisms (1)	1	
		iv	spheres are an improvement because animal cells tend to be round shapes not cubes (1)	1	allow the calculations of surface area:volume are easier
		iv	students used cubes because they are easier to cut / prepare (1)	1	
	b		any five from small size (1) flexible (1) - to get in to small vessels / capillaries (1) biconcave disc shape (1) - large surface area:volume (1) haemoglobin (1) - to carry oxygen (1) lack of nucleus (1) (so) more room (for haemoglobin) (1)	5	can only gain explanation marks (bullet points) if correctly linked to a feature max 4 marks if only given features without explanations
			Total	12	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
10			larger surface area (to take up pollutants) (1)	1	allow sticks out more from bark
			Total	1	
11		i	blood in arteries is under higher pressure (1)	1	
		ii	arteries have thicker walls / elastic walls (1)	1	
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance																														
12	a		<table><tr><th>name</th><th></th><th>part</th></tr><tr><td>aorta</td><td></td><td>D</td></tr><tr><td></td><td></td><td></td></tr><tr><td>left atrium</td><td></td><td>E</td></tr><tr><td></td><td></td><td></td></tr><tr><td>right ventricle</td><td></td><td>C</td></tr><tr><td></td><td></td><td></td></tr><tr><td>tricuspid valve</td><td></td><td>B</td></tr><tr><td></td><td></td><td></td></tr><tr><td>vena cava</td><td></td><td>A</td></tr></table>	name		part	aorta		D				left atrium		E				right ventricle		C				tricuspid valve		B				vena cava		A	2	3 or 4 correct (1) less than 3 correct (0) Examiner's Comments The parts of the heart were quite well known but all combinations were seen. The most common error was to reverse boxes 1 and 5. This illustrates that many candidates are still not aware that diagrams are mirror images of the body to identify right and left sides.
name		part																																	
aorta		D																																	
left atrium		E																																	
right ventricle		C																																	
tricuspid valve		B																																	
vena cava		A																																	
	b	i	provides a large surface area to volume ratio (1)	1	allow large SA / V allow squeeze through capillaries ignore arteries / veins / vessels Examiner's Comments Many candidates gained credit for the idea that red blood cells can squeeze through capillaries. Only a very small number gained the mark for a large surface area to volume ratio. The most common errors were 'more of them can travel in blood vessels' or 'they can travel faster'.																														
		ii	any two from: DNA codes for mRNA (1) mRNA moves (from nucleus) to cytoplasm (1) (mRNA passed to) ribosomes in cytoplasm (to make haemoglobin / protein) (1)	2	Examiner's Comments This question did differentiate and only a few candidates knew about mRNA and the ribosomes in the cytoplasm. There were many vague, incorrect answers stating that 'the cytoplasm is where chemical reactions take place' or 'the nucleus is in the cytoplasm'.																														

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	(haemoglobin combines with oxygen to form) oxyhaemoglobin (in lungs) (1) reverse reaction / breakdown of oxyhaemoglobin happens in tissues / cells to release oxygen (1)	2	allow oxyhaemoglobin dissociates releasing oxygen Examiner's Comments The majority of answers failed to mention oxyhaemoglobin at all, even though candidates did state that oxygen combined with haemoglobin. Most attempts at the second marking point simply stated that, in the tissues, oxygen passed / diffused into the cells, with no reference to any reverse reaction or release from the combined molecule.
	c		(bone marrow) contains stem cells / undifferentiated cells (1) (stem cells) have genes / have information to develop into different (red or white) cells (1)	2	allow have genes for either type of cell allow can turn genes on and off as required Examiner's Comments A reasonable number of candidates knew about stem cells, but few went on to gain a second mark. The most common error was to repeat the question and say 'and so they can produce both types of cell'. Other candidates said that stem cells had the potential to become red and white blood cells, without explaining how (e.g. by having the genes). Some candidates gave unrelated answers (e.g. bone marrow is for keeping the body healthy, essential for growth or helps fight off disease).
			Total	9	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
13		i	pump (1) blood (1)	2	
		ii	cells become specialised (1)	1	allow cells become different / develop into different tissues allow cells change Examiner's Comments Most candidates gained both marks in part (i) for saying that the heart pumps blood. Part (ii) proved far more difficult, with a small minority able to explain the meaning of 'cell differentiation'. Of those candidates who appreciated that it was something to do with different cells, many thought it was simply describing the fact that cells are different.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
14	a		right (1) pressure (1)	2	Examiner's Comments Over half the candidates gained both marks.
	b	i	carry oxygen (1)	1	ignore carries carbon dioxide not transports food and oxygen
		ii	DNA (1)	1	allow deoxyribonucleic acid ignore bases Examiner's Comments Most candidates could describe the role of red blood cells in part (i). 'Carry blood' or 'carry food', were misunderstandings seen a few times. A very small minority knew in part (ii) that it is DNA that codes for haemoglobin.
	c		(cell) division / mitosis (1) (cell) differentiation / specialisation (1)	2	Examiner's Comments Although the question was in the context of white blood cells, it was testing whether candidates knew that the formation of new cells involves both cell division and differentiation. Very few candidates appreciated this. Some misinterpreted the question, and wrote about why new white blood cells need to be made.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
15		i	(lack of oxygen causes) fewer / no (aerobic) bacteria / fungi (1) (therefore) no / slow / less decay (1)	2	allow fewer / no decomposers / microorganisms ignore germs / viruses ignore fewer / no detritivores allow no / slow / less breakdown of dead material allow for additional marking point: less / no / slower respiration (by bacteria / fungi / decomposers) (1) allow reverse arguments Examiner's Comments Only about a third of candidates appreciated that low oxygen levels would mean that few decomposers could survive and therefore the rate of decay would be low. Some candidates clearly thought that 'nutrients' were a type of organism that needed oxygen to survive. Some thought that a lack of oxygen would reduce photosynthesis.
		ii	(release) energy (1) to take in minerals / nutrients (1) by active transport / movement against a concentration gradient (1)	3	ignore absorb minerals from the air Examiner's Comments Less than half the candidates knew that respiration was needed to release energy. Very few were able to link this to the context and explain that the energy would be needed to absorb minerals by active transport. Weaker answers commonly explained that respiration was needed to bring in oxygen, or that respiration was needed for photosynthesis.
			Total	5	

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
16	[Level 3] Describes the results AND gives a detailed explanation of the experiment. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Describes the results AND gives a limited explanation of the experiment. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Describes the results of the experiment OR gives a limited explanation of the experiment. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A* Detailed explanation could include: • air movement increases / maintains concentration gradient • air movement increases / maintains diffusion gradient • air movement lowers concentration of water outside plant ignore references to osmosis Limited explanation could include: • (increased) air movement / fan causes loss of water • (water is lost by) evaporation / diffusion of water ignore references to osmosis Description: • loss of mass / water / readings go down in B / shoot • no change in A (allow small decrease) To get full credit for description there needs to be a comparison between A and B. Description of only A or B limits mark to 1/3/5 if no other marks, allow air movement increases transpiration for L1, 1 mark Use the L1, L2, L3 annotations in Scoris;

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					do not use ticks. Examiner's Comments To gain full marks candidates must answer every part of a question, in this case by describing the expected results in both flasks and explaining each. Although all possible marks were frequently seen, the most common score was four, which was gained by correctly describing the results and giving a limited explanation, e.g. that water was being lost from the plant by evaporation. To gain full marks a more detailed explanation was needed in terms of the fan lowering the water concentration of the air, so increasing loss by the plant. A minority wrote about water loss from the leaves being by osmosis. Some candidates said that the readings would change, but did not go on to say how.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
17	a	i	90 (%) (1)	1	allow 90.32258 or correct rounding Examiner's Comments About half the candidates correctly calculated the percentage drop in pressure as 90%. The common error was to convert 9/93 to a percentage.
		ii	vessel at A = capillary (1) vessel at B = vein (1)	2	allow capillary bed / arteriole ignore small artery allow venule / named vein e.g. vena cava Examiner's Comments Many candidates could not identify either the vessel at A as a capillary, nor the one at B as a vein. A minority correctly identified both. The most common error was to identify A as an artery.
	b		reduces effective blood circulation / blood could fall back into heart / backflow would happen (1) pressure is not maintained / reduces pressure (1)	2	ignore references to oxygenated / deoxygenated ignore less blood but allow less blood pumped around body ignore job of valves e.g. valves stop backflow allow not enough pressure to push blood around allow oedema / idea of fluid building up in tissues / lungs ignore references to higher pressure e.g. inside heart Examiner's Comments Most candidates gained at least 1 mark, usually for explaining that damaged valves could lead to backflow. A small minority gained both marks, usually for adding that blood pressure would fall. Some candidates seemed to confuse damaged valves with a 'hole in the heart' and wrote about oxygenated and deoxygenated blood mixing.
			Total	5	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
18			links (powerful) pump to the action of the heart (1) links gas exchanger to function of lungs (1)	2	allow idea that pump moves the blood around the body allow idea that in gas exchanger blood exchanges CO ₂ for O ₂ / removes CO ₂ / gains O ₂ inclusion of collecting tube negates mark Examiner's Comments The most simply stated answers to this question were most likely to score. Many candidates tried to assign roles to all the labelled parts of the machine thereby confusing their answers.
			Total	2	
19		i	(water lost in) transpiration (1) idea that only a small proportion is used in photosynthesis (1)	2	allow evaporation from plant Examiner's Comments About half the candidates explained that the plant lost water through transpiration or evaporation. Very few also explained that a small proportion of the water added was used in photosynthesis. Some candidates thought that water left the leaves by osmosis.
		ii	more transpiration (1) idea that wind moves away water vapour (1)	2	allow more water lost through stomata allow more evaporation / more diffusion (out of leaf) ignore simply 'more water lost' Examiner's Comments About half the candidates correctly explained that transpiration increased on windy days. A minority explained this in terms of the wind moving away water vapour.
			Total	4	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
20			[Level 3] Gives a full description of the experiment including the results. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Gives a description of the experiment. or Gives a partial description of the experiment with a description of the results. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Gives a partial description of the experiment or a description of the results Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to C Indicative scientific points about description at level 3 may include: • compare mass loss at different fan speeds / distances • ideas of repeat readings • idea of with and without a plant shoot indicative scientific points about description at all levels • measure transpiration by loss in mass • measure transpiration by loss of water from flask Indicative scientific points regarding results may include: • increasing air movement increases transpiration rate / loss of mass Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments The context of this question was difficult to grasp for many candidates, many referring to respiration and photosynthesis and not to transpiration. Although many answers included changes to fan settings, distance, repeats etc, there were few references to the idea of measuring a difference in mass. Many answers simply stated 'put it on the balance'.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
21		i	90 (%) (1)	1	allow 90.32258 or correct rounding Examiner's Comments Few candidates could calculate percentage drop in pressure. Most candidates did a simple subtraction to give an answer of 9%.
		ii	vessel at A = capillary (1) vessel at B = vein (1)	2	allow capillary bed / arteriole (1) ignore small artery allow venule / named vein e.g. vena cava (1) Examiner's Comments Very few candidates understood that by the time the blood has reached point A it will be in the capillaries. Some candidates did however gain one mark for veins at point B.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
22		i	idea that not enough mass / materials / substances / nutrients lost from soil to supply the mass / material / substances / nutrients gained by the tree (1) correct calculation: soil lost 1kg but tree gained 78kg (1)	2	allow the tree gained (much) more mass than the soil lost allow total mass changed from 102kg ? 179kg (1) allow soil would have been 22kg (if scientists were correct)(1) allow the tree gained 77kg from somewhere else (not soil) = 2 marks allow tree gained 78kg but soil only lost 1kg = (2) (BOD) Examiner's Comments Many candidates realised the soil only lost 1kg of mass and the tree gained 78kg. However a number of candidates failed to use the data to answer the question, simply stating the mass must have come from somewhere else.
		ii	any three from: enters through root (hairs) (1) by osmosis (1) transported up the stem (1) passes through xylem (1) lost from the leaves by evaporation (1) by the process of transpiration (1)	3	allow correct description of osmosis (1) ignore diffusion / active transport for extra marking point allow allow a (small amount) used in photosynthesis (1) Examiner's Comments The majority of candidates gained one mark, normally for the idea that the roots take in water and a second for the water moving up the stem or xylem. Few candidates mentioned that water is lost by evaporation from the leaves.
			Total	5	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
23			a by-pass operation ☒ a valve replacement ☐ inserting a pacemaker ☐ inserting a 'heart assist' device ☐ (1)	1	more than one tick negates mark Examiner's Comments The majority of candidates identified the need for a by-pass operation although a number of them thought a valve replacement was needed.
			Total	1	

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
24	a	[Level 3] Explanation of why rate of photosynthesis is reduced AND Explanation of how and why transpiration is affected. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Description of reduced photosynthesis AND Description of effects on transpiration. OR Explanation of why rate of photosynthesis is reduced OR explanation of how and why transpiration is affected. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Description of reduced photosynthesis OR Description of effects on transpiration. OR attempts one explanation without stating if they are increased or decreased Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A Indicative scientific points on explanations may include: Explanations of reduced photosynthesis • photosynthesis reduced because of fewer collisions • photosynthesis reduced because reduced enzyme activity • photosynthesis reduced because high winds cause stomata to close so less carbon dioxide taken in Explanation of effects on transpiration. • transpiration increased because of increased diffusion (gradient) or increased evaporation • transpiration increased because of decreased humidity • transpiration may be reduced by low temperatures reducing evaporation or diffusion • transpiration decreased as dry soils means there is less water and the guard cells become flaccid Indicative scientific points on descriptions may include: Description of reduced photosynthesis • lower temperatures or high winds decrease the rate of photosynthesis • high winds close stomata ignore effect of dry soil or sunlight on photosynthesis Description of effects on transpiration. • high winds increase rate of transpiration • high winds cause stomata to close so less transpiration • dry soils may reduce transpiration • low temperatures can reduce transpiration

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					allow absolute ideas e.g. no photosynthesis when cold Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments This question discriminated the different levels well, the less able candidates would mention that transpiration and photosynthesis were affected by the different conditions but not actually say that the rates increased or decreased. Only the more able candidates used the correct terminology linked to evaporation from the leaves or enzyme activity. A large proportion of the candidates described the processes of photosynthesis and transpiration without actually linking them to the conditions.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b		xylem (1) (transports) water / minerals (1) phloem (1) (transports) food / sugar (1)	4	Function mark is dependent on cell mark To gain full marks, functions must be clearly linked to correct cells e.g. 'xylem and phloem transport water and sugar' (2) e.g. xylem transports water phloem transports sugar and minerals (3) allow named mineral e.g. nitrate (1) not sugar / food / starch not phylum / phyllem allow named food substances e.g. glucose / sucrose / amino acids (1) not minerals or starch ignore water for phloem ignore nutrients for both ignore direction of movement Examiner's Comments Most candidates identified xylem and phloem although the incorrect spelling of phloem (phylum or phyllem) meant that some lost this mark. A common misconception is that phloem transports minerals.
			Total	10	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
25			any two from: movement from (an area of) low concentration to (an area of) high concentration (1) using energy or respiration (1) using carrier (1)	2	allow moves from a lower concentration (into the root) (1) allow against or up a concentration gradient (1) ignore through or across a concentration gradient allow using ATP (1) ignore uses oxygen allow uses membrane proteins (1) ignore references to osmosis and diffusion Examiner's Comments Candidates often confused active transport with diffusion or osmosis. Only the more able candidates answered correctly in terms of concentration gradients and energy. Some managed to contradict their answer by stating that the movement was against a concentration gradient from an area high concentration to low concentration.
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
26		i	D (1) it has a thick(er) wall / muscle OR it should be C but the heart is reversed (1)	2	2 nd mark is dependent on the 1 st allow more muscular Examiner's Comments Many candidates made links between D and a thicker muscle wall. There was, however, still evidence of some confusion over what each part of the heart does.
		ii	idea that heart would need to be turned round / placed back to front (1) to allow connection to the correct blood vessels (1)	2	allow put the heart in face down / flipped over / reversed / inverted allow idea that would need to extend / reach the blood vessels to the heart (1) to allow them to reach the correct chambers (1) arteries / veins need to be swapped around (1) Examiner's Comments Some candidates struggled with the applied nature of this question. Most who scored did so for the idea of putting it in back to front. Fewer got the mark for linking up the correct blood vessels.
			Total	4	
27			more respiration occurs (1) carbon dioxide is toxic (1)	2	allow poisonous / changes pH ignore harmful Examiner's Comments Many candidates referred to breathing, anaerobic respiration, lactic acid production etc. but few simply said that the respiration rate will increase.
			Total	2	

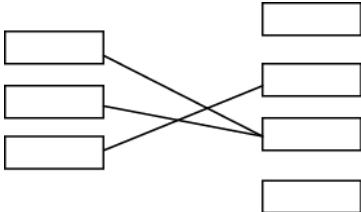
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
28		i	glucose and oxygen (1)	1	Examiner's Comments Although the question clearly asked for two ticks some candidates only ticked one of the correct answers.
		ii	coronary artery (1)	1	Examiner's Comments A minority of candidates could correctly recall the function of the coronary artery.
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
29			[Level 3] Answer includes two adverse environmental condition with at least one fully explained. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Answer includes two adverse environmental conditions coupled with at least one explanation. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Answer includes two adverse environmental conditions. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to C Explanations at level 3 may include: • lower temperatures decrease the rate of photosynthesis • less water uptake or more water loss may reduce photosynthesis as water is required Explanations at level 2 may include: • lack of water in the soil results in lack of water uptake / gets less water • windy so more water lost by transpiration / via stomata / less braches so less photosynthesis Indicative scientific points about the adverse environmental conditions may include: • low temperatures / too cold • lack of water (in soil) (not just dry) • windy so more water loss / damage to branches Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments Most candidates commented on the adverse conditions, lack of water or cold temperatures. A smaller number could go further and link the wind to larger water loss or the lack of water and cold temperatures to a reduction in photosynthesis.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
30	a	i	drooped / wilted (1)	1	ignore drops / dries out flop / shrivel / die etc Examiner's Comments Incorrect answers such as 'dead' were quite common but the idea of wilting was understood by a number of the candidates.
		ii	water it (1)	1	ignore minerals / nutrients / fertiliser / light Examiner's Comments Most candidates appreciated the need to water the plant.
	b		gets enough / more light (1) light needed for photosynthesis (1) for more growth / bigger crop (1)	2	ignore simply 'gets light' ignore to grow allow won't grow as much in the shade Examiner's Comments Answers to this question highlighted the need to make comparative comments with candidates failing to score marks by simply stating that plants in the shade get no light and so do not grow.
			Total	4	
31			 1 mark for each correct line (3)	3	allow oxygen – root hairs as an extra line or as an alternative to oxygen – stomata Examiner's Comments Most candidates scored on this question although the most common error was to link the entry of water to the xylem.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
32		i	D (1) it has a thick(er) wall / muscle OR it should be C but the heart is reversed (1)	2	2 nd mark is dependent on the 1 st allow more muscular
		ii	idea that heart would need to be turned round / placed back to front (1) to allow connection to the correct blood vessels (1)	2	allow put the heart in face down / flipped over / reversed / inverted allow idea that would need to extend / reach the blood vessels to the heart (1) to allow them to reach the correct chambers (1) arteries / veins need to be swapped around (1) Examiner's Comments The two parts of this question were quite challenging for the candidates. Some did appreciate the significance of the thickness of the wall of D and the need to reverse the heart in a transplant.
			Total	4	
33			any three from: get more oxygen / get oxygen more quickly (1) get more glucose / get glucose more quickly (1) to muscles (1) to get rid of extra carbon dioxide (1) for respiration / to release energy (1)	3	marking points referring to glucose, oxygen and carbon dioxide must be comparative Examiner's Comments The main problem here was candidates failing to give comparative answers. Answers which simply stated 'to get oxygen and glucose and to get rid of carbon dioxide' did not score.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
34		i	root (hairs) absorb (1) stem transports (1)	2	allow xylem / vascular bundles / veins ignore shoot <u>Examiner's Comments</u> The majority of candidates correctly answered root and stem although there were some higher level answers that gained credit such as xylem.
		ii	plants / weeds (1)	1	ignore herbs <u>Examiner's Comments??</u> Plants or weeds were equally common correct answers but herbs, herbivores or insects were incorrectly stated by some candidates.
			Total	3	
35		i	0.08 (1)	1	<u>?Examiner's Comments??</u> Most candidates correctly gave 0.08 seconds. Common incorrect answers included 0.04 and 0.16.
		ii	contraction of ventricles is longer / 0.24 v 0.08 (1) need to pump blood further / to the body (1)	2	allow atria only need to pump the blood into the ventricles / do not need to pump as far (1) ignore to generate a higher pressure <u>?Examiner's Comments??</u> Most candidates gained at least one mark and many gained both. One common incorrect answer was that while the ventricles pump blood to the body, the atria pump it to the lungs.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
36			[Level 3] Gives a full explanation that pesticide movement is driven by transpiration and occurs through the xylem and explains why pesticide movement is greater on warm sunny days. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Gives an explanation that pesticide movement is driven by transpiration and occurs through the xylem. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Gives a partial explanation explaining that pesticide movement is linked with transpiration or that it occurs through the xylem. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A Indicative scientific points at level 3 (HD) may include: transpiration is greater when it is warm / sunny because: • (higher temperatures) increase rate of evaporation / diffusion • (on sunny days) stomata open (more widely) Indicative scientific points at levels 1 and 2 (SD) may include: • pesticide moves by transpiration • transpiration involves evaporation / diffusion • transpiration is greater when it is warm / sunny • movement through xylem if refer to stem / veins / vessels / phloem instead of xylem, limit to 5/3/1 marks if refer to just evaporation / diffusion instead of transpiration, limit to 5/3/1 marks if only give L3 indicative points, limit to L1 Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments This question was well answered with very few candidates gaining no marks and many gaining full marks, although the full range of marks was seen. Candidates usually addressed all parts of the question and attempted to use appropriate scientific terminology. All acceptable answers on the mark scheme were seen.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
37			idea that all the blood goes through the lungs (1)	1	allow all the blood needs oxygenating <u>?Examiner's Comments??</u> Some candidates failed to realise that all blood has to go through the lungs. They reverted to more superficial responses.
			Total	1	
38		i	17 500 (ml per minute) (1)	1	<u>Examiner's Comments??</u> Most candidates correctly calculated 17 500 ml per minute.
		ii	heart (1) because pumps harder / faster (1)	2	allow beats harder / faster allow pumps more blood allow increases pressure of blood that it is pumping <u>?Examiner's Comments??</u> Over half the candidates gained full marks. Some thought it was the lungs.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
39			due to contraction of heart (muscle) (1) so that blood reaches all parts of the body (1)	2	allow pushed / pumped / squeezed by heart (muscle) allow needs lots of force to get through the capillaries allow so it gets around the body allow arteries have thick wall / narrow lumen (1) ignore blood travels through small vessels / narrow vessels ?Examiner's Comments?? To gain full marks candidates had to explain both what causes the high pressure in arteries as well as its purpose. Around half the candidates gained at least one mark, usually for the idea that the pressure ensures blood gets around the whole body. Fewer gained the second mark for explaining that the pressure is generated by the heart pumping or contracting.
			Total	2	
40	a		red blood cells – carry oxygen (1) platelets – clotting (of blood) (1)	2	allow stops bleeding ignore heals / forms scabs / blocks wounds
	b	i	more (1) smaller (1)	2	allow answer ringed, underlined or ticked more than one answer= 0
		ii	28% (2) But if incorrect or incomplete $\frac{7 \times 40}{10}$ (1)	2	
		iii	Camels (blood has lower percentage of red blood cells because) often have to go for long periods of time without water ORA (1)	1	
			Total	7	

Mark Scheme

Question			Answer/Indicative content		Marks	Guidance							
41		i	any two from: has a nucleus ora (1) has mitochondria ora (1) has chloroplasts ora (1)		2	not cell wall not cytoplasm not cap							
		ii	<table><tr><td>some genes can be lost from some cells</td><td></td></tr><tr><td>both aerobic and anaerobic respiration can occur</td><td></td></tr><tr><td>cells are able to differentiate and specialise</td><td>✓</td></tr><tr><td>organisms are able to clone themselves</td><td></td></tr></table>	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	more than one answer = 0
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													
		iii	nervous or hormone system to communicate between cells / transport or circulation or cardiovascular system to carry nutrients / oxygen / blood / CO ₂ around the organism excretory or gas exchange system to exchange materials with the surroundings (1)		1	ignore named organs e.g. kidney / heart etc. for system allow explained alternative systems e.g. respiratory system / reproductive / digestive							
			Total		4								
42		i	2.5 (1)		1								
		ii	the shrew needs / uses lots of oxygen (1) shrew red blood cell has a large surface area to volume ratio (1) this means that it can pick up / release oxygen quickly (1)		3	ignore references to shrew's body surface area to volume ratio ignore pick up more oxygen							
			Total		4								
43			root (hairs) (1) leaves / stomata (1)		2	ignore pores							
			Total		2								

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
44			as air movement increases so does the rate of transpiration / ora(1) (rate increases) due to increase in diffusion (through the stomata) /ora (1) identifies valid reason for not increasing further (1)	3	allow idea that increasing speed of fan increases transpiration rate / ora (1) allow idea that increasing wind speed increases transpiration rate / ora (1) allow as air movement increases so does the uptake of water / ora (1) ignore movement of air bubble allow (rate increases) due to increase in evaporation / ora(1) allow idea that increasing wind speed decreases humidity / ora (1) allow more or faster water loss from diffusion / evaporation (1) e.g. limited by number of stomata / temperature / humidity (1) allow limited by another factor / no longer the limiting factor (1) ignore stomata close
			Total	3	
45			B ✓	1 (AO 1.1)	<u>Examiner's Comments</u> This is an AO1.1 question testing recall of cell types. In general, this was successfully done, however, the number of candidates who thought the cells were sperm cells indicates a lack of knowledge of cells.
			Total	1	
46			A ✓	1 (AO 1.1)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
47	a	i	marked correctly on diagram ✓	1 (AO 1.1)	ALLOW centre of X anywhere inside the shaded area  Examiner's Comments The question required candidates to demonstrate a knowledge of the structure of the heart AO1.1. Candidates made responses in all four chambers in almost equal numbers. Lower ability candidates put their response inside blood vessels or in some cases did not respond at all. Candidates should be encouraged to attempt all questions, especially those that can be answered using, for example, a choice of placing a letter on a diagram or completing sentences using words from a list.
		ii	aorta / arteries✓ lungs✓	2 (AO 2 x 1.1)	Examiner's Comments This question targeted knowledge of the circulatory system AO1.1. Generally, the sequence of blood circulating the body was a well understood with many getting maximum marks. In some cases, either the artery/aorta or lungs were identified but not both.

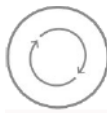
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b	i	double (circulation)✓	1 (AO 1.1)	ALLOW double <u>Examiner's Comments</u> This AO1.1 question assessed if candidates can recall the name of the circulation if blood travels through the heart twice in one circuit. Some candidates correctly identified double circulation but many just referred to blood circulation and seemed to be unaware of double circulatory systems.
		ii	Any two from: increases the pressure of the blood / higher blood pressure✓ increases the flow rate of the blood✓ idea of faster transport of materials✓	2 (AO 2 x 1.1)	ALLOW pushes blood more DO NOT ALLOW pushes more blood unqualified ALLOW to make the blood flow faster IGNORE makes blood flow fast ALLOW more oxygen / glucose to the tissues ALLOW keeps the blood well oxygenated / gets more oxygenated blood ALLOW faster removal of carbon dioxide from blood <u>Examiner's Comments</u> This AO2.1 question required an understanding of the advantages of a double circulatory system. Increased flow rate was the most common correct response. Some candidates were able to identify the increased pressure, or materials will be able to be transported faster/ in greater amounts. Only higher ability candidates gained maximum marks. A common misconception is that it allows more blood to travel around. Candidates do not seem to be aware that it is the same volume of blood but travelling faster.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c		left side thicker (than the right side)✓ left pumps blood further✓	2 (AO 2 x 1.1)	ALLOW it's thicker / it's more muscular ALLOW left ventricle thicker than right IGNORE left is bigger ALLOW left pushes blood all around the (rest of the) body / right only pushes to lungs ALLOW left side must generate more pressure IGNORE left side contains blood at high pressure <u>Examiner's Comments</u> In this AO1.1 question, there were some candidates who mistakenly identified the right side of the heart, however, these were in the minority. The main issue was candidates linking the thickness of the heart wall to resisting pressure, rather than to needing to generate pressure.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	d	i	Any two from: artery thicker walled/ ORA ✓ artery more muscle tissue/ ORA ✓ artery narrower bore/lumen/ ORA ✓	2 (AO 2 x 2.1)	ALLOW artery (more) elastic ALLOW artery has smaller area for blood to pass through Examiner's Comments The AO2.1 diagram specifically directed candidates to consider applying their knowledge of the structures of the blood vessels to the diagrams. The main reason for not gaining marks was candidates not referring to the structure. Many just said the artery was thicker, without identifying which part of the artery. More able candidates were able to refer to differences in the wall and the lumen. Candidates often limit the mark gained in multiple mark questions by repeating their initial response in a different way.  Examination technique can be developed to encourage candidates to avoid this. Exemplar 1 1. Arteries have a smaller lumen ✓ 2. Veins have a bigger lumen [2] This candidate has assumed they have given two separate differences. However, their response covers the same marking point so only scores 1 mark. It is clear with the way the response is set out that the candidate thought they were giving two separate marking points but had just described the difference in size of lumen.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	Any one from: veins have valves✓ arteries take blood away from the heart / veins take blood to the heart✓ blood flows faster / higher pressure in arteries /ORA✓	1 (AO 1.1)	IGNORE valves unqualified ALLOW arteries carry oxygenated / veins carry deoxygenated blood <u>Examiner's Comments</u> This recall AO1.1 question was well answered. Most candidates identified that arteries carried blood away from the heart or veins back to the heart. Some candidates identified veins having valves.
			Total	11	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
48		i	guard cell✓	1 (AO 1.1)	IGNORE stomatal cells <u>Examiner's Comments</u> This AO1.1 question assessing recall of knowledge of guard cells proved challenging. Very few candidates could name the guard cell. Most candidates referenced organelles such as chloroplasts and mitochondria. Some responded with cell membrane and even cytoplasm (already labelled).  The question did ask for the name of the cell and candidates need to check carefully that they have responded to the question.
		ii	allows gaseous exchange (of CO₂ and O₂)✓ allows water evaporation (to help transpiration)✓	2 (AO 2 x 1.1)	ALLOW to release/let water out of the leaf/plant IGNORE to let water enter the leaf/plant <u>Examiner's Comments</u> These two marks were assessing AO1.1. Most candidates seemed to be confused with the role of stomata. The most common misconception was that the function of stomata was to let water into the leaves.  The role of gas exchange seemed poorly understood as only a limited number of candidates were able to show an understanding of the gases that move through the stomata.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
49	a		blood vessels / arteries are blocked/narrowed ✓ (heart muscle) gets less blood ✓ (heart muscle) gets less oxygen ✓	3 (AO 2.1)	ALLOW atheroma / plaque formed IGNORE no blood IGNORE no oxygen IGNORE references to blood circulation to body cells Examiner's Comments Over half of candidates scored at least one mark here mainly for less blood flow (to the heart muscle). A lot of candidates got confused with the blood flow to the heart muscle with blood flow to the body cells, therefore not gaining credit. Exemplar 8 demonstrates this confusion and is not credited any marks. Exemplar 8 Use the information in the diagram and your biological knowledge. The lack of consistent ^{through} patent flow of blood ~~the~~ the body causes the body to have to adapt as less blood flow means and causes a for less oxygen flow. The body induces around this by using anaerobic respiration to ensure enough respiration occurs in the body.
	b	i	idea that it widens/opens the (lumen) of the artery ✓ more blood/oxygen will be able to reach the heart muscle ✓	1 (AO 2.2) 1 (AO 3.1b)	IGNORE expands the artery Examiner's Comments Most common credited mark was for the idea the stent widens/opens up the artery. Few candidates stated that more blood/oxygen would be able to reach the heart muscle.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	advantage: avoids an operation ✓ disadvantage: could be side effects of the drug / must take it on a regular basis ✓	2 (AO 2 × 2.1)	ALLOW named side effect e.g. liver damage/upset stomach ALLOW may forget to take the drug / misuse of the drug <u>Examiner's Comments</u> Most candidates didn't gain the marks for the advantage of taking statins because they just repeated the question and stated it lowers the level of cholesterol in a person's blood. A number of candidates achieved the disadvantage marking point, with the most common answer being that they have to take it on a regular basis. A number of candidates stated that the blood cholesterol would become too low, which wasn't credited.
			Total	7	
50			C ✓	1 (AO 1.2)	
			Total	1	
51			D ✓	1 (AO 2.2)	
			Total	1	
52			C ✓	1 (AO 1.1)	<u>Examiner's Comments</u> This question was the most accessible question in section A, with most candidates correctly answering C.
			Total	1	
53			A ✓	1 (AO 1.1)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
54	a	i	photosynthesis makes sugars in guard cells ✓ epidermal cells (dont photosynthesise so) lower in sugar than guard cell ✓ and any two from: epidermal cells higher osmotic / water potential than guard cells ✓ ORA water enters guard cells (by osmosis) ✓ ORA increasing turgidity of guard cell opens stomata ✓ ORA due to thicker inner cell wall ✓ opening / size of stoma affects transpiration rate ✓	4 (AO 2 × 1.1) (AO 2 × 2.1)	ALLOW correct description of transpiration linked to the size of stoma <u>Examiner's Comments</u> Candidates found this question one of the most challenging on the paper. Few candidates demonstrated a good knowledge of the mechanism of stomatal opening. Many candidates seemed to reverse the question and tried to explain how the rate of transpiration controlled photosynthesis in guard cells.
		ii	they have differentiated ✓ have a specific job to do (in the leaf/plant) ✓	2 (AO 2 × 1.1)	ALLOW they have adapted (to their function) ALLOW no other cells do the same job ALLOW they can open / close stomata they have adapted to a specific job / they are adapted to open and close stomata = 2 marks <u>Examiner's Comments</u> There were some good answers focussing on the structural differentiation of guard cells and the fact that they have a specific role.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b		phloem is removed ✓ swelling caused by a build-up of food/sugar ✓ food/sugar produced in the leaves / moving downwards cannot get past (the ringed area)✓	3 (AO 3 × 3.2b)	ALLOW phloem is on the outside IGNORE nutrients / minerals / ions ALLOW glucose / sucrose ALLOW translocation to roots is prevented <u>Examiner's Comments</u> This was another challenging question for many candidates. They needed to observe from the transverse section, that it was the phloem that was removed from the stem. Candidates needed to apply that information to the build-up of sugar on the pathway down the stem. A number of candidates explained the swelling as a defence mechanism. Others such as exemplar 9, put the swelling change down to xylem and phloem and did not gain marks. Exemplar 9 Ringed phloem. vital parts of the xylem and phloem. The swelling is evidence of this as water and sucrose is being taken for the root hair cells below the ringed area, but can't pass beyond.
			Total	9	
55			B	1 (AO 2.2)	<u>Examiner's Comments</u> This is an AO2.2 question testing the ability to apply knowledge of ratios. Several candidates answered A, with correct workings shown for the surface area and volume. This indicates that the candidate could not apply their knowledge of surface area and volume to producing a ratio.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
56	a		xylem cell ✓	1 (AO 1.1)	<u>Examiner's Comments</u> This AO1 question was targeting candidates' knowledge of plant transport structure, with many candidates opting between xylem and phloem in almost equal numbers.
	b		Any two from: dead cells ✓ thick/strengthened cell wall ✓ hollow (lumen) ✓	2 (AO 1.1)	ALLOW ECF from the cell selected in 16(b) ALLOW lignin present/lignified IGNORE cellulose ALLOW waterproof walls ALLOW forms continuous walls/column for water/ continuous tube IGNORE contain water <u>Examiner's Comments</u> Very few gave 2 correct responses to this AO1 question. Most common responses related to thick cell walls, lignified cells and dead cells. Some candidates did not score due to just referencing normal plant cell features such as a rigid cell wall or cell membrane rather than adaptations shown by xylem. Some candidates who had put phloem for (c) were able to get the ECF (error carried forward), but usually only 1 mark for perforated end or no nucleus but rarely both. This does indicate a need to reinforce the difference between xylem and phloem and the differences in their adaptations.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
57	a	i	phloem ✓	1 (AO 2.1)	<u>Examiner's Comments</u> This AO1 question was targeting candidates' knowledge of the location of plant transport structures. Like in the previous question on adaptations, many candidates opted between xylem and phloem in almost equal numbers.
		ii	idea that sugar / food / nutrients removed (by the greenfly) ✓ Any one from: So less left for growth ✓ So less for respiration / energy / ATP ✓	2 (AO 2.1)	IGNORE xylem / root hair IGNORE water / minerals ALLOW so not enough for growth / so unlikely to grow / difficult to grow healthily ALLOW less sugar translocated/transported to other parts <u>Examiner's Comments</u> This AO2.1 question tested candidates' ability to apply knowledge of plant transport. Many candidates thought the greenfly was feeding from the xylem or that phloem transported water, and therefore focused on the plant having insufficient water for growth. Others thought that the greenfly was damaging the plant and the need for repair of the damage would prevent growth.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b		MRI / X-ray imaging / new technology allows new evidence to be collected ✓ ideas/explanations have changed to fit new observations/technologies ✓	2 (AO 3.1b)	ALLOW idea MRI etc. shows precise position of water whereas older techniques give approximate position ALLOW couldn't see what they can see now with new methods ALLOW tissue easily disturbed by injected dyes / AW ALLOW modern methods give more accurate results ALLOW different techniques give different results so different conclusions drawn <u>Examiner's Comments</u> This AO3.1 question required evaluation. A lot of candidates thought that plants may have evolved in the last 50 years so water moves differently. However, most just restated the question without addressing the idea of collecting new evidence, so did not demonstrate an ability to evaluate.
			Total	5	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
58	a		blood travels through pump/heart twice ✓ on full circuit around body ✓	2 (AO1.1)	ALLOW idea that there are two pumps / idea that blood is pumped twice ALLOW idea that blood passes separately to lungs and body <u>Examiner's Comments</u> In this AO1.1 question many candidates described the diagram but got confused. Some wrote about blood vessels rather than the heart. Candidates that gained credit identified that blood passes through the heart twice but were often unable to identify that this happens on a complete full circuit of the body.
	b		bird ✓ bird has 4 chambered heart ✓ bird has double circulation✓	3 (AO 2.1)	If bird is not ticked or bird not selected in answer, then zero for question ALLOW bird has heart with 4 sections/compartments/named four chambers ALLOW description of double circulation <u>Examiner's Comments</u> In this AO2.1 question many candidates were identifying the bird, and some went on to justify their choice. However, most candidates often repeated similar descriptions to their previous answer, with few clearly identifying birds as having double circulation. It was very rare to see candidates who had recognised both birds and humans as having 4 chambers to the heart. Some did gain credit for this mark for correctly naming all 4 chambers.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 4 award 2 marks $25\,000 \div 5800 = 4.3 \checkmark$ $= 4$ (nearest whole number) $\checkmark$	2 (AO 2.2) (AO 1.2)	ALLOW ECF mark for correct rounding if calculation is incorrect <u>Examiner's Comments</u> This question tested AO1.2 and AO2.2. Most candidates did this correctly although some stated 4.3 and did not gain the second marking point. There were a minority who just subtracted the two numbers.
		ii	Any two from: muscles need more energy / more ATP / more respiration $\checkmark$ muscles need more oxygen / more carbon dioxide to be removed / more glucose / to avoid anaerobic respiration / to avoid lactic acid production $\checkmark$ other organs not needed (in exercise) $\checkmark$	2 (AO 3.2a)	need to include only one comparative word e.g. more, to be able to score the first two marking points, e.g. muscles need more oxygen for energy = 2 marks ALLOW to remove more heat ALLOW other organs not prioritised / blood diverted from other organs <u>Examiner's Comments</u> This AO3.2 question proved challenging. Most responses focused on increased blood flow but gave no indication of why this was needed. Marks were often gained for muscles needing 'more oxygen' or 'other organs not needed', with a few marks being given for the lactic acid/respiration ideas.
			Total	9	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
59	a		blood travels through pump/heart twice ✓ on full circuit around body ✓	2 (AO 1.1)	ALLOW idea that there are two pumps / idea that blood is pumped twice ALLOW idea that blood passes separately to lungs and body <u>Examiner's Comments</u> There were many concise and correct answers, stating that the blood flows through the heart twice on each circuit. Some candidates tried to describe the flow of blood, but their answers did not differentiate between a single or a double system.
	b	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 4 award 2 marks $25\,000 \div 5800 = 4.3$ ✓ = 4 (nearest whole number) ✓	2 (AO 2.2 1.2)	ALLOW ECF mark for correct rounding if calculation is incorrect <u>Examiner's Comments</u> The majority of candidates extracted the correct numbers from the table, completed the calculation and gave their answer to the nearest whole number.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	Any two from: muscles need more energy / more ATP / more respiration ✓ muscles need more oxygen / more carbon dioxide to be removed / more glucose / to avoid anaerobic respiration / to avoid lactic acid production ✓ other organs not needed (in exercise) ✓	2 (AO 3.2a)	need to include only one comparative word e.g. more, to be able to score the first two marking points, e.g. muscles need more oxygen for energy = 2 marks ALLOW to remove more heat ALLOW other organs not prioritised / blood diverted from other organs Examiner's Comments The main error here made by candidates was that they did not give a comparative answer. Exemplar 1 clearly states that more oxygen is required for more respiration and so scores both marks. Only one comparative statement was required but a number of candidates did not give any, simply stating that muscles need more blood because they need oxygen. Exemplar 1 The blood flow to the muscles increases because they are contracting more and hence require more glucose and oxygen for more respiration. The increased blood flow provides the muscle cells with significant amounts of glucose and oxygen.
	c		bird ✓ bird has 4 chambered heart ✓ bird has double circulation ✓	3 (AO 2.1)	If bird is not ticked or bird not selected in answer, then zero for question ALLOW bird has heart with 4 sections/compartments/named four chambers ALLOW description of double circulation Examiner's Comments The majority of candidates chose the correct organism and stated that the fish had a double circulatory system and had a four-chambered heart. A description of the double system was accepted.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			Total	9	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
60	a		clots the blood ✓ prevents bleeding / allows wounds to heal / forms a scab ✓	2 (AO 1.1)	IGNORE clump blood ALLOW prevents pathogens getting into the body <u>Examiner's Comments</u> There was some confusion in the responses describing the role of platelets whereby candidates thought platelets had a role in the specific immune response. Only higher ability candidates gained a mark here.
	b		R r R RR Rr r Rr rr Rr ratio 3 : 1 ✓ ✓ ✓	3 (AO 2.1) 	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c		Any three from: variation with some rats resistant and some who are not ✓ (resistant rats) more likely to survive/less likely to be killed ORA ✓ (resistant rats more likely) reproduce ORA ✓ pass on the allele / gene for resistance ORA ✓	3 (AO 2.1)	IGNORE selective breeding ALLOW mutation for resistance ALLOW offspring produced / breed together ALLOW pass on advantageous gene IGNORE trait is passed on / genes are passed on <u>Examiner's Comments</u> Candidates had to apply their knowledge of natural selection to explain why the percentage of resistant rats was increasing. There were a range of marks given for this question. Most none scoring responses were too vague and not using key terms. Most candidates did not appreciate that there was variation for resistance within the population.
	d		Any two from: (stops/less) respiration ✓ (no/less) energy/ATP ✓ key process interrupted e.g. cell metabolism/protein synthesis/chemical reactions/active transport ✓	3 (AO 2.1)	<u>Examiner's Comments</u> This question was one of the most challenging application of knowledge and understanding questions. The most common awarded mark was appreciation that energy release would be affected. A lot of responses were very general and would say the rat can't breathe or can't get any oxygen.
			Total	11	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
61	a		platelets are needed for blood clotting ✓ the rat would keep bleeding/bleed to death ✓	2 (AO 2.1)	<u>Examiner's Comments</u> Many candidates were able to score both marks on this AO2.1 question although some did not mention platelets. A significant number of candidates, however, linked the poison to clotting incorrectly, saying blood would clot too much or in the wrong place. In that type of response, there were references to heart attacks and strokes. Some candidates referred to wounds clotting.
	b		parents are Rr and Rr ✓ offspring are RR, Rr, Rr, rr ✓ rr identified as being non-resistant ✓	3 (AO 2.2)	ALLOW all marks from a Punnett square ALLOW ECF on offspring <u>Examiner's Comments</u> Many candidates scored on this AO2.2 question. The most frequent way candidates did not get maximum marks was by omitting to identify the correct offspring genotype. Candidates needed to annotate rr. A significant number of candidates only identified the non-resistant rate, not noticing that homozygous dominant rats were also present in that ratio; and therefore only stating 25% were homozygous. Candidates should be encouraged to routinely include the phenotypic ratio.  AfL Some candidates made errors on the Punnett square diagram. The main error was to cross R with r and derive RR. Candidates should be encouraged to check their answers for this type of error.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c		Rr/heterozygous rats more likely to survive than RR/homozygous rats as they need less vit K / ORA ✓ therefore, when two Rr rats mate rr rats will be born ✓	2 (AO 2.2)	ALLOW rats that need less vit K are more likely to survive <u>Examiner's Comments</u> Where candidates successfully answered this AO2.2 question, it was from developing ideas from the previous question and linking the vitamin K survival rate in the heterozygous rat to when two Rr rats mate rr rats will be born. Many responses to this question showed confusion. Candidates referred to a variety of incorrect explanations such as non-resistant alleles becoming dominant and rats finding enough vitamin K to become non-resistant but immune to warfarin. Other incorrect responses included non-resistant rats surviving because they don't need much vitamin K and rats in some areas not getting access to warfarin.
			Total	7	
62			D ✓	1 (AO1.1)	
			Total	1	
63			C ✓	1 (AO1.1)	
			Total	1	
64			D ✓	1 (AO2.1)	
			Total	1	
65			B ✓	1 (AO2.2)	
			Total	1	
66			B ✓	1 (AO2.1)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
67	a	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 3 : 1 award 2 marks 24 : 8 or 3 ✓ 3 : 1 ✓	2 (AO2.2)	ALLOW answer in the table but answer on answer line takes preference
		ii	higher SA:V ratio faster rate of diffusion / ORA ✓	1 (AO3.2b)	ALLOW positive correlation ALLOW reference to less time instead of faster rate IGNORE they are directly proportional
		iii	reduces (total) SA of alveoli/air sacs / reduces SA : Vol ratio of alveoli/air sacs ✓ so diffusion (of oxygen) reduced ✓	2 (AO2 x 3.1a)	ALLOW harder for oxygen to diffuse IGNORE oxygen cannot diffuse into the blood in emphysema
	b		sickle red blood cells release/take up/carry/deliver/transport less oxygen ✓ sickle cells have a smaller surface area (to vol ratio) / tend to get stuck in blood vessels/capillaries / cannot pass through blood vessels/capillaries so easily ✓	2 (AO1.1) (AO2.1)	IGNORE less oxygen binds to RBCs / sickle cells cannot carry oxygen IGNORE references to smaller volume / less Hb / less space on the RBCs
			Total	7	

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
68	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. Level 3 (5–6 marks) Provides a detailed explanation linking cholesterol to heart disease. AND Provides a detailed analysis to explain if this link is supported by the graph. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Provides a detailed explanation linking cholesterol to heart disease. OR Provides a detailed analysis to explain if this link is supported by the graph. OR Provides a basic explanation linking cholesterol to heart disease. AND Provides a basic analysis of the information to explain if this link is supported by the graph. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Provides a basic explanation linking cholesterol to heart disease. OR Provides a basic analysis of the information to explain if this link is supported by the graph. OR Demonstrates knowledge of the importance of the blood supply to the heart muscle. <i>There is an attempt at a logical structure with a line of reasoning. The information is</i>	6 (AO2 x 1.1) (AO2 x 2.1) (AO2 x 3.1b)	AO1.1 Demonstrate knowledge and understanding of the importance of the blood supply to the heart muscle. - coronary artery carries blood to heart/muscle - blood takes oxygen/glucose to the heart/muscle - heart/muscle carries out aerobic respiration/needs energy - energy is needed for the heart/muscle to contract AO2.1 Apply knowledge and understanding of the requirements of the heart muscle - cholesterol build up (partially) blocks the blood flow in the artery - this reduces blood/oxygen/glucose carried to the heart/muscle - heart/muscle carries out less aerobic respiration/less energy released - heart/muscle can't contract as forcefully AO3.1b Analyse information and ideas to interpret the results on the study Support the link: - men with heart disease had (on average) a higher blood cholesterol level. - Men without heart disease had (on average) a lower blood cholesterol level. - build-up of cholesterol can lead to heart disease Doesn't support the link: - considerable overlap between the two groups - men can still have heart disease with low blood cholesterol levels - Men without heart disease can still have high blood cholesterol levels

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			<i>in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit</i>		
			Total	6	
69			A ✓	1 (AO1.1)	
			Total	1	
70			C ✓	1 (AO1.1)	
			Total	1	
71			C ✓	1 (AO1.1)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
72	a	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 3 : 1 award 2 marks 24 : 8 or 3 ✓ 3 : 1 ✓	2 (AO2.2)	ALLOW answer in the table but answer on answer line takes preference
		ii	higher SA:V ratio faster rate of diffusion / ORA ✓	1 (AO3.2b)	ALLOW positive correlation ALLOW reference to less time instead of faster rate IGNORE they are directly proportional
		iii	reduces (total) SA of alveoli/air sacs / reduces SA : Vol ratio of alveoli/air sacs ✓ so diffusion (of oxygen) reduced ✓	2 (AO2 x 3.1a)	ALLOW harder for oxygen to diffuse IGNORE oxygen cannot diffuse into the blood in emphysema
	b		sickle red blood cells release/take up/carry/deliver/transport less oxygen ✓ sickle cells have a smaller surface area (to vol ratio) / tend to get stuck in blood vessels/capillaries / cannot pass through blood vessels/capillaries so easily ✓	2 (AO1.1) (AO2.1)	IGNORE less oxygen binds to RBCs / sickle cells cannot carry oxygen IGNORE references to smaller volume / less Hb / less space on the RBCs
			Total	7	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
73	a	i	water evaporates (on surface of spongy mesophyll) ✓ water (vapour) passes/diffuses through the stomata/pores ✓	2 (AO1.1)	Need evaporate or a description of the process
		ii	measure distance gas bubble moves ✓ over certain time / specified time ✓ vary distance of lamp from potometer ✓	3 (AO1.2)	ALLOW measure position of bubble before and after time taken for bubble to move a certain distance = 2 marks
		iii	absorbs heat/thermal energy (from lamp) / keeps (plants at) constant temperature ✓ heat/temperature would affect transpiration ✓	2 (AO2.2)	IGNORE references to photosynthesis
	b	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 57 (mm ³) award 3 marks $\pi \times 0.5^2 \times 72$ ✓ = 56.52 ✓ = 57 (mm ³) ✓	3 (AO3 x 2.2)	ALLOW one mark for an answer of 226.08 and 2 marks for an answer of 230 (1.0 has been used as r) ALLOW one mark for clear evidence of incorrect answer correctly rounded to two sig figs.
		ii	42 (mm) / Trial 1 at 40cm ✓ reading taken too quickly after moving the lamp / error in measurement (distance bubble moved/time) / heat sink not in the way/radiating heat / change in room temp/air movements / potometer/light not at correct distance ✓	2 (AO2 x 2.2)	
		iii	Idea that they should remove/ignore the anomalous result (before processing) ✓	1 (AO1.2)	ALLOW repeat that reading
		iv	the mean is 73 mm ✓ the range of values is 71 to 75 / range is 4 mm / 2mm is half the range ✓	2 (AO2 x 1.2)	ALLOW adding or subtracting 2 from 73 covers all the readings this is the mean $\pm$ half the range = 2 marks
			Total	15	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
74	a		Any two from: anaemia / tiredness / lack of energy due to lack of red blood cells ✓ inability to fight off infections / prone to infections due to lack of white blood cells/WBC ✓ slow blood clotting due to lack of platelets ✓	2 (AO2 x 1.1)	DO NOT ALLOW incorrectly matched symptom to blood cell type ALLOW less immunity / reduced immune response / weakened immune system due to lack of white blood cells/WBC ALLOW (recurring) nosebleeds / bruise easily due to lack of platelets
	b	i	people may be ill with infection / have a pathogen / just recovering from infection ✓ therefore have produced more white blood cells to destroy the pathogen/produce antibodies ✓ OR weakened immune system/cancer/cancer treatment reducing white blood cell number so less white blood cells to defend against pathogens/produce antibodies	2 (AO2 x 2.1)	IGNORE fighting(off) pathogens
		ii	Area = $10 \times 10 = 100(\text{mm}^2)$ Volume = $100 \times 0.001 = 0.1 (\text{mm}^3)$ ✓	1 (AO2.2)	
		iii	No (no mark) $1000 \div 0.1$ OR 1000×10 ✓ number of white blood cells/mm^3 is 10×10^3 / 1.0×10^4 / 10000 ✓ within the range of $6.0 - 16.0 \times 10^3$ ✓	3 (AO2 x 2.2) (AO3.2b)	ALLOW ECF from (ii) ALLOW number of white blood cells /mm^3 = 10 000 ALLOW within the normal white blood cell range/ 6000 – 16000

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c		(Fanconi anaemia) (no mark) (3×10^6 is a) low red blood cell count ✓ must be Fanconi anaemia because: caused by recessive allele ✓ obtained from heterozygous/carrier parents who don't have a blood disorder ✓ OR cannot be D-B anaemia because: neither parents have a blood disorder ✓ it is caused by a dominant allele ✓	3 (AO3x3.2 b)	if incorrect disorder then no marks IGNORE low numbers of all cells
			Total	11	

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
75	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. Level 3 (5–6 marks) Demonstrates a knowledge of the importance of the blood supply to the heart. AND Applies knowledge to explain why a failure of this blood supply can lead to heart disease. AND Analyses the information to explain the link between a lack of LDL protein and heart disease. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Demonstrates a knowledge of the importance of the blood supply to the heart. AND Applies knowledge to explain why a failure of this blood supply can lead to heart disease. OR Demonstrates a knowledge of the importance of the blood supply to the heart. AND Analyses the information to explain the link between a lack of LDL protein and heart disease. OR Applies knowledge to explain why a failure of this blood supply can lead to heart disease. AND Analyses the information to explain the link between a lack of LDL protein and heart	6 (AO2 x 1.1) (AO2 x 2.1) (AO2 x 3.1a)	AO1.1 Demonstrate knowledge and understanding of the importance of the blood supply to the heart muscle. • blood in the coronary artery supplies heart muscle • oxygen / glucose is supplied to the muscle • this is needed for the muscle to contract/for respiration AO2.1 Apply knowledge and understanding of the requirements of the heart muscle • without oxygen / glucose the heart muscle cannot <u>respire</u> • <u>energy</u> from respiration is needed for the muscle to contract AO3.1a Analyse information and ideas to interpret the effects of lack of LDL receptor protein. • without LDL receptor protein there will be more cholesterol in the blood / cholesterol levels will be too high to be removed/broken down • increased build up of cholesterol in the coronary artery will increase the risk of heart disease / decrease blood flow to the heart muscle

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			disease. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Demonstrates a knowledge of the importance of the blood supply to the heart. OR Applies knowledge to explain why a failure of this blood supply can lead to heart disease. OR Analyses the information to explain the link between a lack of LDL protein and heart disease. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit</i>		
			Total	6	
76			Any two from: (small pieces means) there will be a larger surface area of dead plants ✓ therefore, decomposers will be able to reproduce faster / feed faster ✓ therefore, decomposers will be able to respire faster ✓	2 (AO 2 × 2.2)	<u>Examiner's Comments</u> In this AO2 question, few candidates linked size to area and a number incorrectly thought large pieces had large surface area. Very few candidates were able to link the size to rates of respiration or reproduction.
			Total	2	