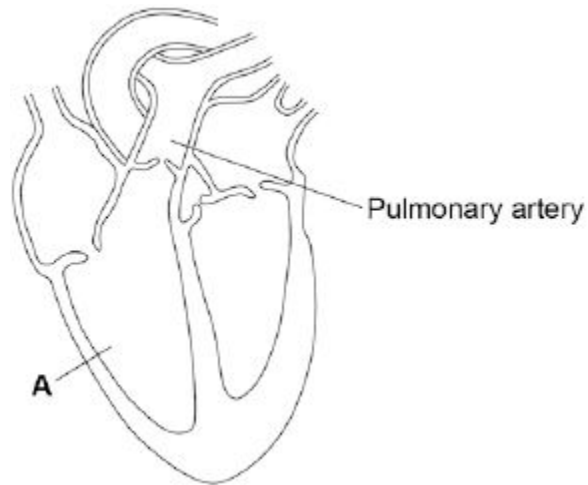


1 **Figure 1** shows a diagram of the human heart.

Figure 1



(a) What part of the heart is labelled **A**?

Tick **one** box.

Aorta

Atrium

Valve

Ventricle

(1)

(b) Where does the pulmonary artery take blood to?

Tick **one** box.

- Brain
- Liver
- Lungs
- Stomach

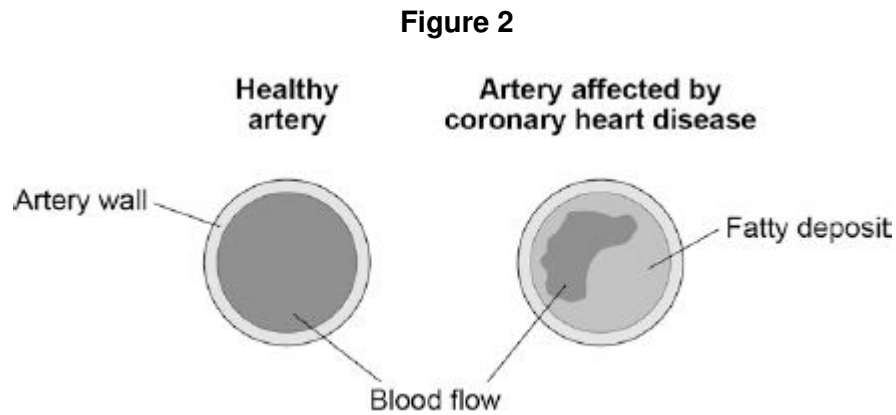
(1)

(c) Circle a valve on **Figure 1**.

(1)

(d) The coronary arteries supply blood to the heart.

Figure 2 shows two coronary arteries.



Describe **two** ways the healthy artery is different from the artery affected by coronary heart disease.

- 1
-
- 2
-

(2)

(e) What can be used to treat people with coronary heart disease?

Tick **two** boxes.

Antibiotics

Hormones

Statins

Stent

Vaccination

(2)

(f) Suggest **two** risk factors for coronary heart disease.

1

.....

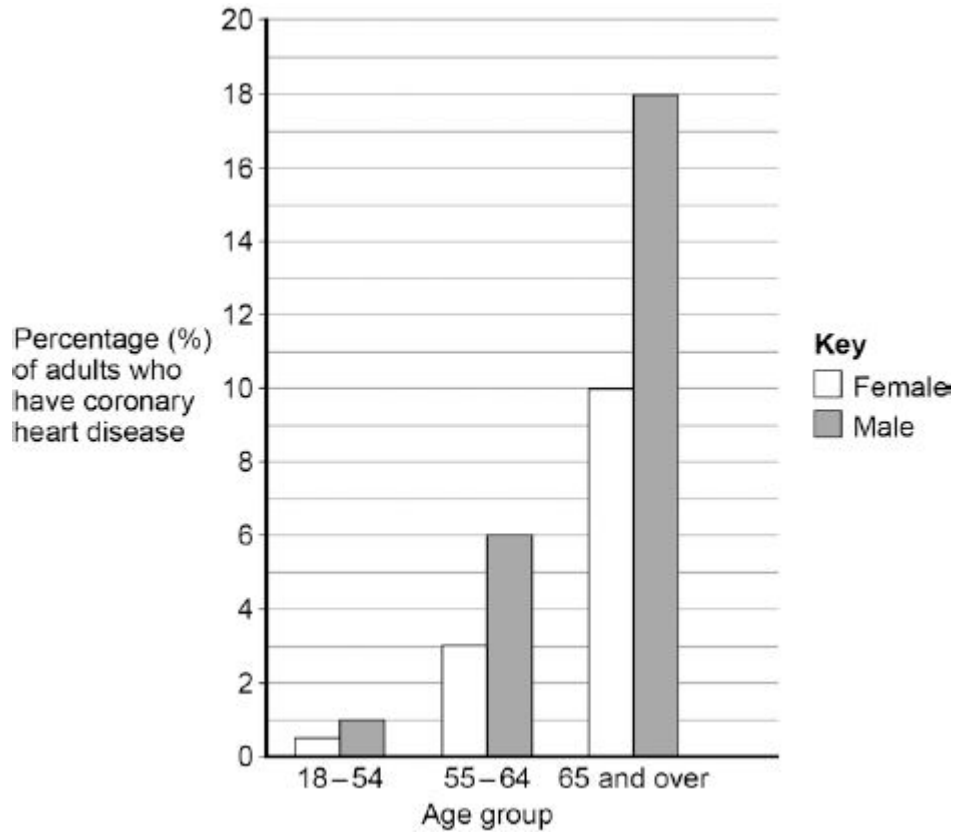
2

.....

(2)

(g) **Figure 3** shows the percentages of adults in the UK who have coronary heart disease.

Figure 3



Calculate the difference in the percentage of male and female adults aged 65 and over who have coronary heart disease.

..... %

(1)

(h) Which is the correct conclusion for the data in **Figure 3**?

Tick **one** box.

Children do **not** suffer from coronary heart disease

More males suffer from coronary heart disease than females

More younger people suffer from coronary heart disease than older people

(1)
(Total 11 marks)

2

Catalase is an enzyme.

Catalase controls the following reaction:

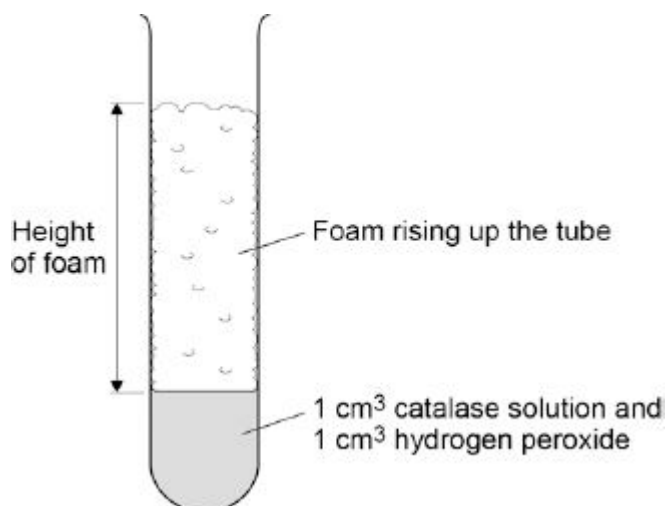


A student did an investigation on catalase activity.

This is the method used.

1. Put 1 cm³ hydrogen peroxide solution in a test tube.
2. Add 1 cm³ of catalase solution.
 - Bubbles of oxygen are produced.
 - Bubbles cause foam to rise up the tube.
3. Measure the maximum height of the foam.

The diagram below shows the experiment.



The experiment is carried out at 20 °C.

The table below shows some results from the investigation.

Temperature in °C	Maximum height of foam in cm			
	Test 1	Test 2	Test 3	Mean
10	1.3	1.1	0.9	1.1
20	0.0	3.3	3.1	3.2
30	5.2	5.0	5.3	5.2
40	4.2	3.5	4.4	4.0

50	2.1	1.9	2.3	2.1
60	0.0	0.0	0.0	0.0

(a) Why did the student carry out the experiment three times at each temperature?

Tick **one** box.

To make the experiment more accurate

To prove the experiment was correct

To show the experiment was more repeatable

(1)

(b) The student thought one result was an anomaly.

Circle the anomaly in the table above.

(1)

(c) What did the student do with the anomalous result?

.....

.....

(1)

(d) Look at the table above.

What conclusion can be made as the temperature increases?

Tick **one** box.

Decreases the rate of reaction up to 30 °C

Decreases the rate of reaction up to 40 °C

Increases the rate of reaction up to 30 °C

Increases the rate of reaction up to 40 °C

(1)

(e) At which temperature was catalase denatured?

Tick **one** box.

10 °C

30 °C

40 °C

60 °C

(1)

- (f) The student thought the optimum temperature for catalase activity was between 30 °C and 40 °C.

How could the investigation be improved to find a more precise value for the optimum temperature?

Tick **one** box.

Do the experiment at 70 °C and 80 °C

Do the experiment at 30 °C, 35 °C and 40 °C

Use less hydrogen peroxide solution

Use more catalase solution

(1)

- (g) Amylase is the enzyme that controls the breakdown of starch to glucose.

Describe how the student could investigate the effect of pH on the breakdown of starch by amylase.

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(4)
(Total 10 marks)

3

After a meal rich in carbohydrates, the concentration of glucose in the small intestine changes.

The table below shows the concentration of glucose at different distances along the small intestine.

Distance along the small intestine in cm	Concentration of glucose in mol dm ⁻³
100	50
300	500
500	250
700	0

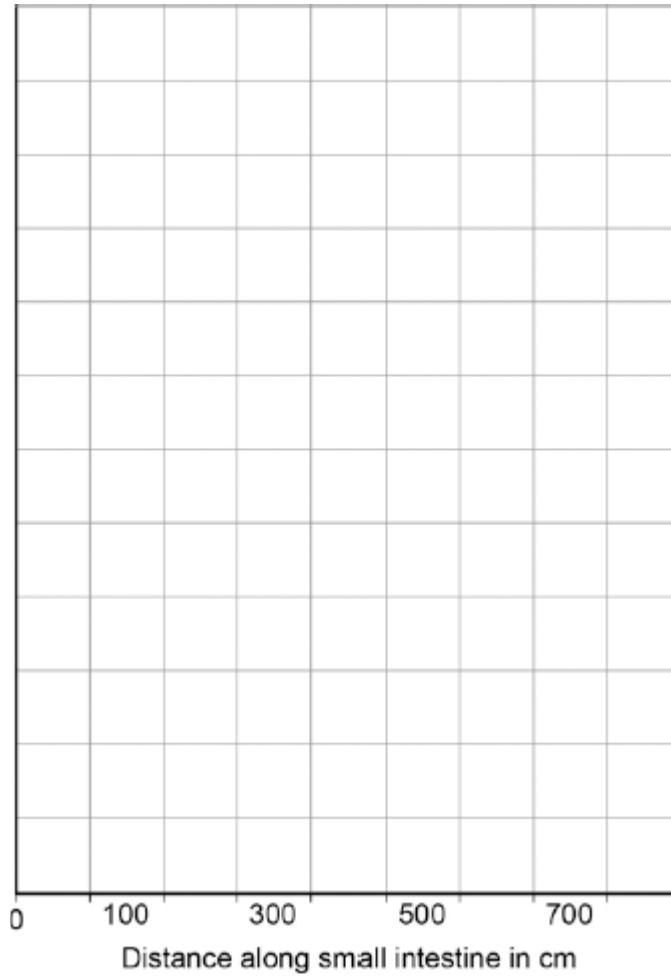
(a) At what distance along the small intestine is the glucose concentration highest?

..... cm

(1)

(b) Use the data in the table to plot a bar chart on the graph below.

- Label the *y*-axis.
- Choose a suitable scale.



(4)

(c) Look at the graph above.

Describe how the concentration of glucose changes as distance increases along the small intestine.

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.....
.....

(2)

(d) Explain why the concentration of glucose in the small intestine changes between 100 cm and 300 cm.

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(2)

(e) Explain why the concentration of glucose in the small intestine changes between 300 cm and 700 cm.

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(3)

(Total 12 marks)

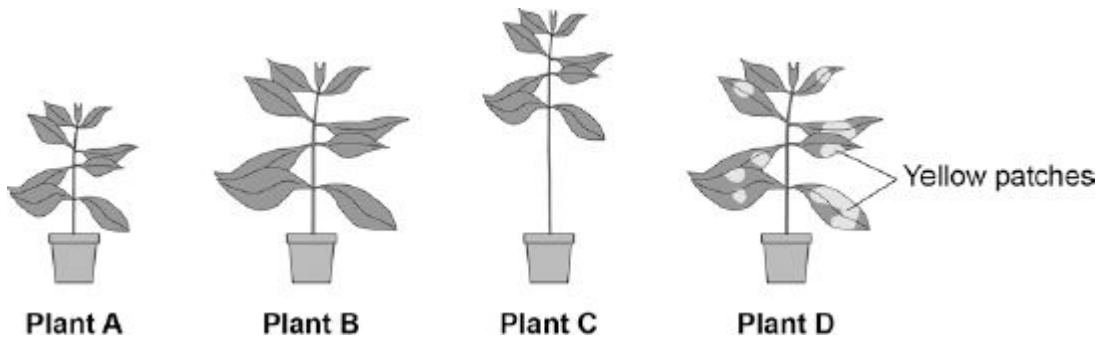
4

To be healthy, plants need the right amount of mineral ions from the soil.

The diagram below shows four plants.

The plants were grown in four different growing conditions:

- sunny area, with nitrate and magnesium added to the soil
- sunny area, with magnesium but **no** nitrate added to the soil
- sunny area, with nitrate but **no** magnesium added to the soil
- dark area, with nitrate and magnesium added to the soil.



(a) Which plant was grown with no **nitrate**?

Tick **one** box.

A B C D

(1)

(b) Which plant was grown with no **magnesium**?

Tick **one** box.

A B C D

(1)

(c) Give **one** variable that was kept constant in this experiment.

.....

(1)

(d) Plants need other minerals for healthy growth such as potassium ions and phosphate ions.

A farmer wanted to compare the percentage of minerals in two types of manure.

- Cow manure from her own farm.
- Chicken manure pellets she could buy.

The table below shows data for each type of manure.

	Phosphate ions in %	Potassium ions in %
Cow manure	0.4	0.5
Chicken manure pellets	2.5	2.3

Suggest **one** advantage and **one** disadvantage of using the chicken manure pellets compared to the cow manure.

Advantage

.....

Disadvantage

.....

(2)
(Total 5 marks)

5

Plants transport water and mineral ions from the roots to the leaves.

(a) Plants move mineral ions:

- from a low concentration in the soil
- to a high concentration in the root cells.

What process do plants use to move these minerals ions into root cells?

Tick **one** box.

Active transport

Diffusion

Evaporation

Osmosis

(1)

(b) Describe how water moves from roots to the leaves.

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(2)

(c) Plants lose water through the stomata in the leaves.

The epidermis can be peeled from a leaf.

The stomata can be seen using a light microscope.

The table below shows the data a student collected from five areas on one leaf.

Leaf area	Number of stomata	
	Upper surface	Lower surface
1	3	44
2	0	41
3	1	40
4	5	42
5	1	39
Mean	2	X

Describe how the student might have collected the data.

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(3)

(d) What is the median number of stomata on the upper surface of the leaf?

.....

(1)

(e) Calculate the value of **X** in the table.

Give your answer to 2 significant figures.

.....
.....

Mean number of stomata on lower surface of leaf =

(2)

(f) The plant used in this investigation has very few stomata on the upper surface of the leaf.

Explain why this is an **advantage** to the plant.

.....
.....
.....
.....

(2)
(Total 11 marks)

6

Tobacco mosaic virus (TMV) is a disease affecting plants.

The diagram below shows a leaf infected with TMV.



Yellow patches where TMV has destroyed chloroplasts

© Nigel Cattlin/Visuals Unlimited/Getty Images

(a) All tools should be washed in disinfectant after using them on plants infected with TMV.

Suggest why.

.....
.....

(1)

(b) Scientists produced a single plant that contained a TMV-resistant gene.

Suggest how scientists can use this plant to produce **many** plants with the TMV-resistant gene.

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(1)

(c) Some plants produce fruits which contain glucose.

Describe how you would test for the presence of glucose in fruit.

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(2)

(d) TMV can cause plants to produce less chlorophyll.

This causes leaf discoloration.

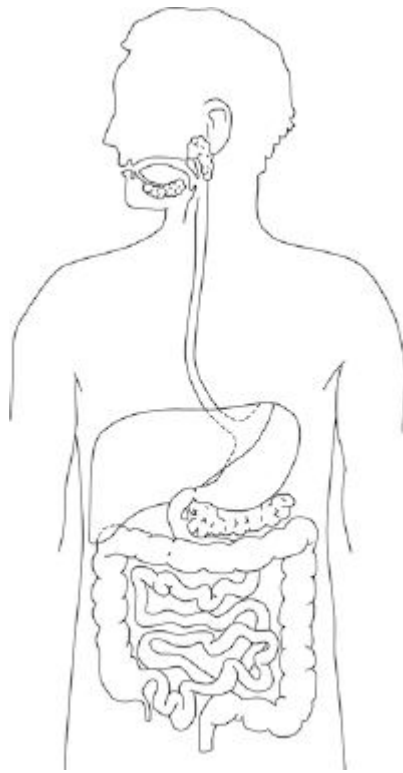
Explain why plants with TMV have stunted growth.

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(4)
(Total 8 marks)

7

The diagram below shows the human digestive system.



(a) Label the stomach and pancreas on the diagram.

(1)

(b) Many people suffer from stomach ulcers caused by a species of bacteria called *Helicobacter pylori*.

The stomach is lined with a protective lining of mucus.

Helicobacter pylori are acid-tolerant bacteria which can damage this mucus lining.

Suggest how an infection with *Helicobacter pylori* might result in a stomach ulcer developing.

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.....

.....

(2)

(c) *Helicobacter pylori* can also cause stomach cancer.

Describe how a person infected with *Helicobacter pylori* could also develop liver cancer.

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(3)

(d) Gluten is a form of protein found in some grains.

Describe the test you would use to find out if protein is present in food.

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.....

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(2)

(e) Coeliac disease is a disease of the digestive system.

It damages the lining of the small intestine when foods that contain gluten are eaten.

When people with coeliac disease eat foods that contain gluten:

1. their immune system forms antibodies to gluten
2. these antibodies attack the lining of the small intestine
3. this causes inflammation in the intestines and damages the villi.

Symptoms of coeliac disease include poor growth.

Suggest why a person with coeliac disease might have this symptom.

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(4)
(Total 12 marks)

8

Explain how the human circulatory system is adapted to:

- supply oxygen to the tissues
- remove waste products from tissues.

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(Total 6 marks)

9

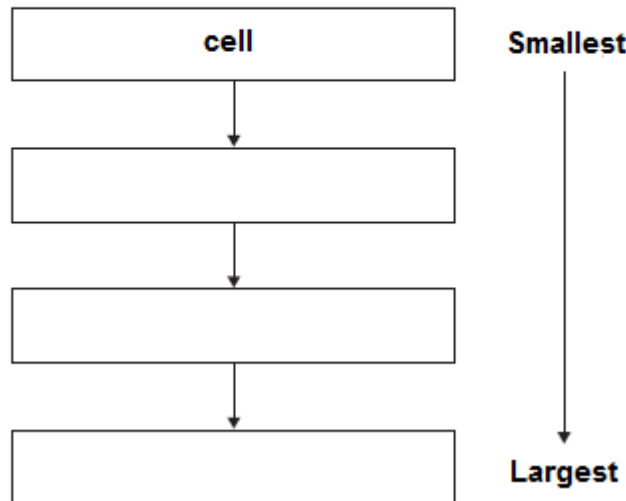
The human body is organised to carry out many different functions.

- (a) Use words from the box to complete **Figure 1** by putting the parts of the body in order of size from smallest to largest.

The smallest one has been done for you.

cell	organ system	organ	tissue
-------------	---------------------	--------------	---------------

Figure 1



(2)

- (b) The stomach is made of different types of tissue.

Draw **one** line from each type of stomach tissue to the correct description.

Epithelial tissue	Allows food to be churned around the stomach
Glandular tissue	Covers the outside and the inside of the stomach
Muscular tissue	Produces digestive juices
	Coordinates nerve impulses

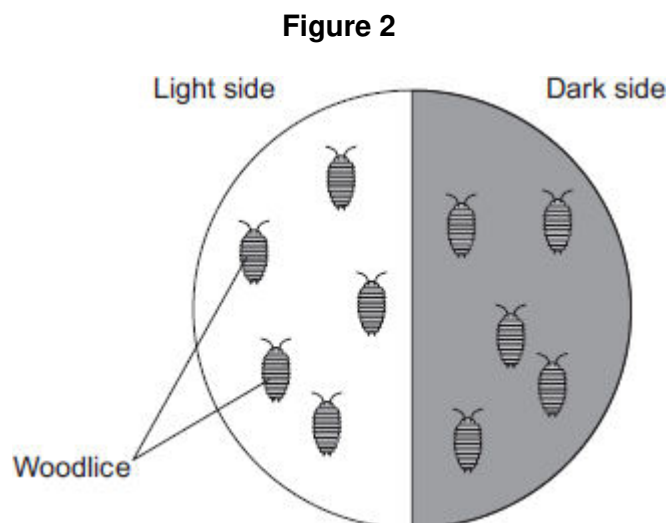
(3)

- (c) Animals can react to their surroundings because they have nervous systems.

A student investigated the behaviour of small animals called woodlice.

The student set up the investigation as shown in **Figure 2**.

- The student covered one half of a Petri dish with black paper to make that side of the Petri dish dark.
- The other side had no cover.
- The student put five woodlice into each side of the dish and then put the clear Petri dish lid back on the dish.



After 30 minutes, all the woodlice had moved to the dark side of the Petri dish.

(i) In this investigation, what is the **stimulus** that the woodlice responded to?

.....

(1)

(ii) In this investigation, what is the **response** that the woodlice made?

.....

(1)

(iii) The student concluded that woodlice prefer dark conditions.

Give **two** ways in which the student could improve the investigation to be sure that his conclusion was correct.

1.....

.....

2.....

.....

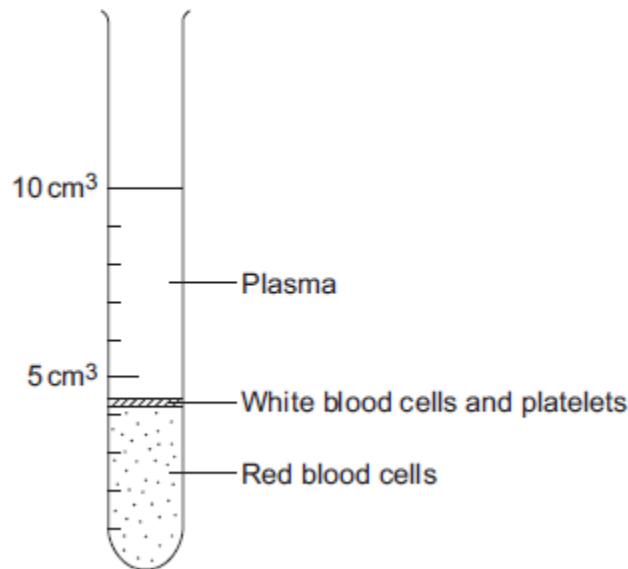
(2)

(Total 9 marks)

10

The parts of the blood can be separated from each other by spinning the blood in a centrifuge.

The image below shows the separated parts of a 10 cm³ blood sample.



(a) Calculate the percentage of the blood that is made up of plasma.

.....

.....

Answer = %

(2)

(b) Name **three** chemical substances transported by the plasma.

1.....

2.....

3.....

(3)

(c) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

White blood cells are part of the immune system. White blood cells help the body to defend itself against pathogens.

Describe how pathogens cause infections **and** describe how the immune system defends the body against these pathogens.

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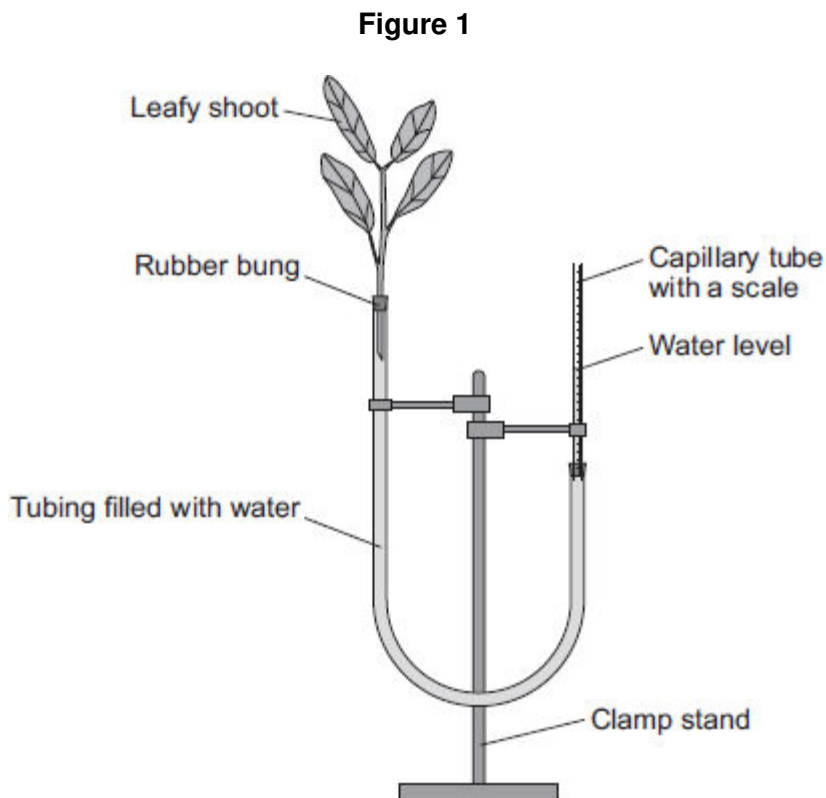
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(6)
(Total 11 marks)

11

A potometer is a piece of apparatus that can be used to measure water uptake by a leafy shoot.

Figure 1 shows a potometer.



Some students used a potometer like the one shown in **Figure 1**.

- They measured the water taken up by a shoot in normal conditions in a classroom.
- As the water was taken up by the shoot, the level of water in the capillary tube went down.
- The students recorded the level of the water in the capillary tube at 2-minute intervals for 10 minutes.

Table 1 shows the students' results.

Table 1

Time in minutes	0	2	4	6	8	10
Level of water (on scale) in capillary tube in mm	2.5	3.6	4.4	5.4	6.5	7.5

The area of the cross section of the capillary tube was 0.8 mm^2 .

- (a) (i) Complete the following calculation to find the volume of water taken up by the shoot in mm^3 per minute.

Distance water moved along the scale in 10 minutes =mm

Volume of water taken up by the shoot in 10 minutes = mm^3

Therefore, volume of water taken up by the shoot in 1 minute = mm^3

(3)

- (ii) The students repeated the investigation but this time placed the potometer next to a fan blowing air over the leafy shoot.

Suggest how the results would be different. Give a reason for your answer.

.....

.....

.....

.....

(2)

- (b) The students repeated the investigation at different temperatures.

The results are shown in **Table 2**.

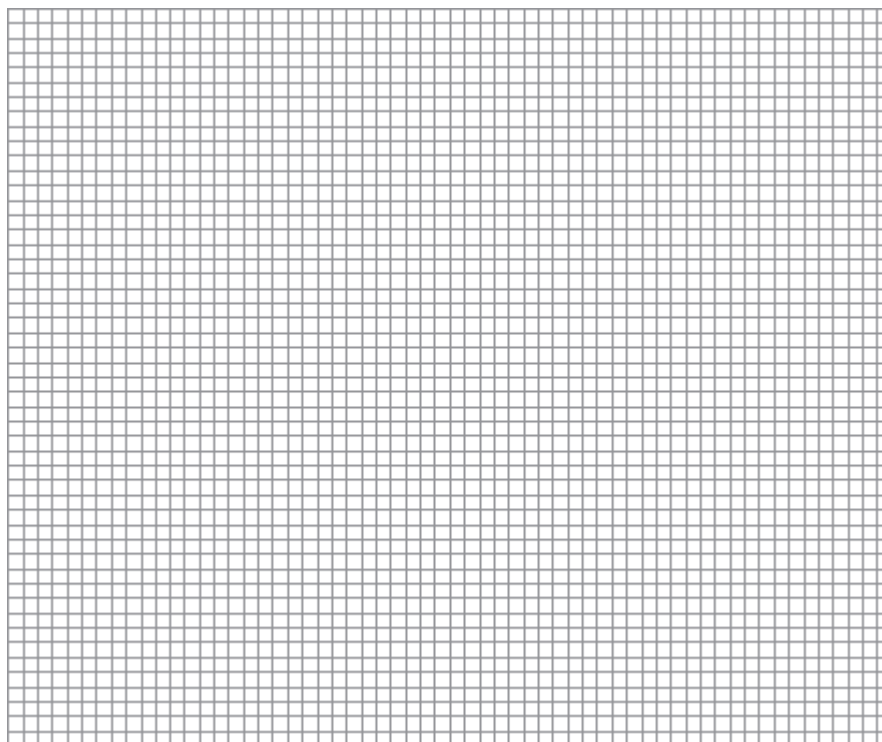
Table 2

Temperature in °C	Rate of water uptake in mm ³ per minute
10	0
15	0.4
20	1.0
25	2.1
30	3.2
35	4.0
40	4.4

Plot the data from **Table 2** on the graph paper in **Figure 2**.

Choose suitable scales, label both axes and draw a line of best fit.

Figure 2



(5)

(c) What would happen to the leaves if the potometer was left for a longer time at 40 °C?

Explain your answer.

.....

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(3)
(Total 13 marks)

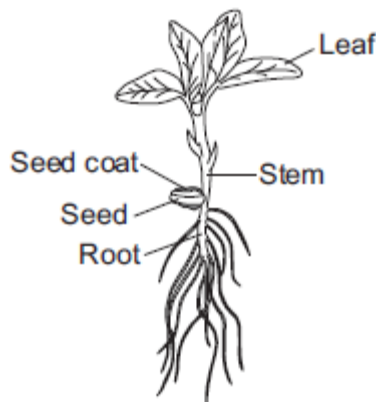
12

Catalase is an enzyme found in many different tissues in plants and animals. It speeds up the rate of the following reaction.



Figure 1 shows a 25-day-old broad bean seedling.

Figure 1



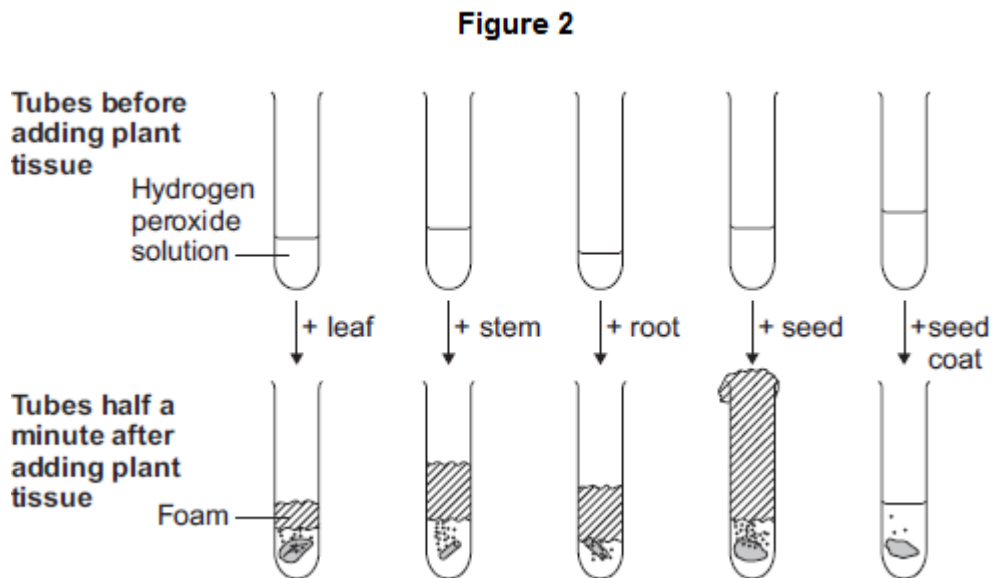
Some students investigated whether different parts of bean seedlings contained different amounts of catalase.

The students:

- put hydrogen peroxide into five test tubes
- added a different part of a bean seedling to each tube
- recorded the results after half a minute.

If there was catalase in part of the seedling, oxygen gas was given off. When oxygen gas is given off, foam is produced in the tubes.

Figure 2 shows the results.



The students made the following conclusions:

- most parts of a bean seedling contain catalase
- the seed contains a lot of catalase
- stems and roots have quite a lot of catalase
- the leaves have a little bit of catalase
- the seed coat has hardly any catalase.

The students' teacher said that the students needed to improve their investigation in order to make valid conclusions.

(a) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Describe how you would carry out an investigation to compare the amounts of catalase in different parts of bean seedlings.

You should include details of how you would make sure your results give a valid comparison of the amounts of catalase.

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(6)

- (b) Scientists investigated the effect of pH on the activity of the enzyme catalase in a fungus.

The table below shows the scientists' results.

pH	Enzyme activity in arbitrary units					
	Test 1	Test 2	Test 3	Test 4	Test 5	Mean
3.0	0	0	0	0	0	0
4.0	6	5	8	4	7	6
5.0	38	65	41	42	39	
5.5	80	86	82	84	88	84
6.0	100	99	96	103	102	100
6.5	94	92	90	93	91	92
7.0	61	63	61	62	63	62
8.0	22	22	21	24	21	22

- (i) Calculate the mean enzyme activity at pH 5.0.

.....

.....

Mean = arbitrary units

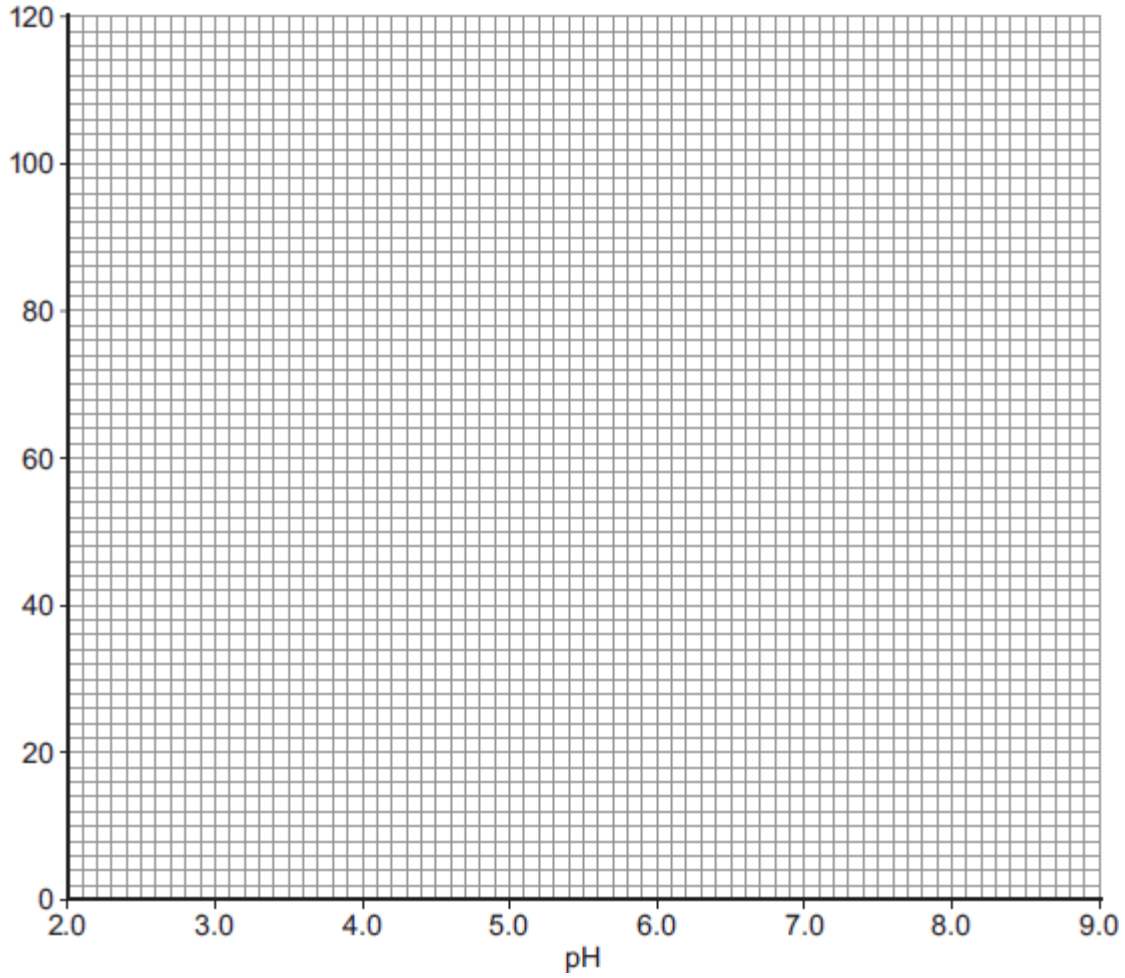
(2)

(ii) On the graph paper in **Figure 3**, draw a graph to show the scientists' results.

Remember to:

- add a label to the vertical axis
- plot the mean values of enzyme activity
- draw a line of best fit.

Figure 3



(4)

(iii) At what pH does the enzyme work best?

.....

(1)

(iv) Predict the activity of the enzyme at pH 9.0.

..... arbitrary units

(1)

(v) Suggest why the enzyme's activity at pH 3.0 is zero.

.....

.....

(1)

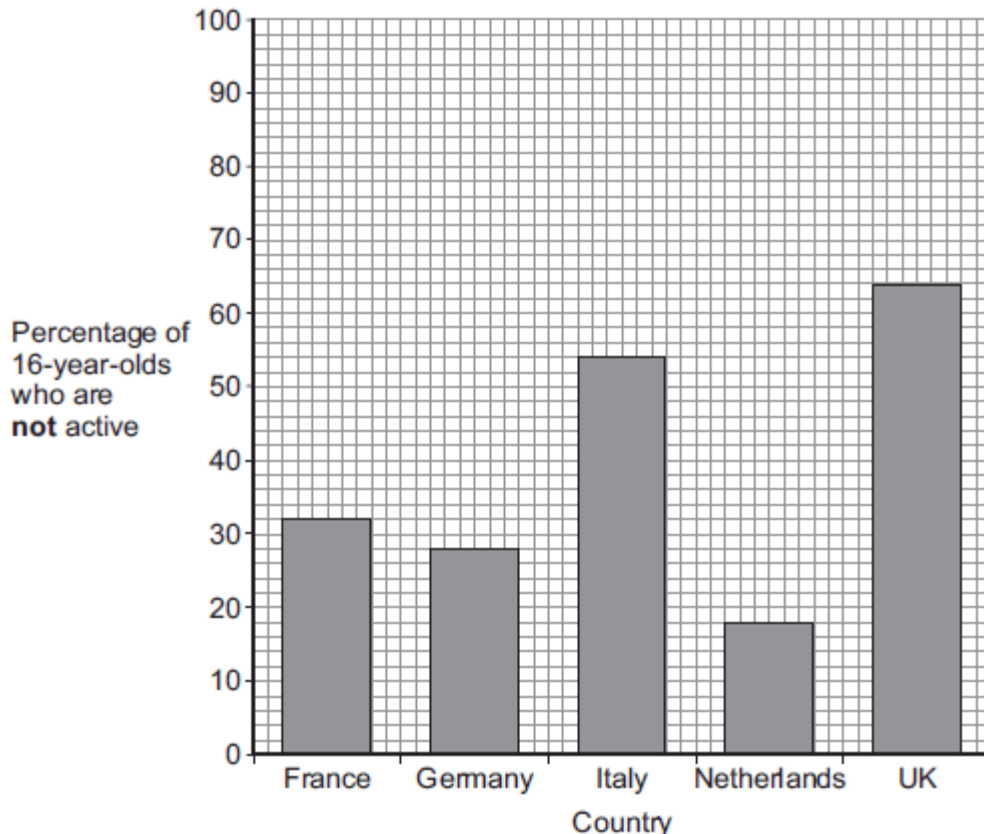
(Total 15 marks)

13

Scientists investigated the effect of different factors on health.

(a) People who are **not** active may have health problems.

The graph shows the percentage of 16-year-olds in some countries who are **not** active.



(i) What percentage of 16-year-olds in the UK are **not** active?
 % (1)

(ii) What percentage of 16-year-olds in the UK are **active**?
 % (1)

(iii) A newspaper headline states:

People in the UK are the laziest in the world.

Information in **Figure 1** does **not** support the newspaper headline.

Suggest **one** reason why the newspaper headline may be wrong.

.....

(1)

- (b) Doctors gave a percentage rating to the health of 16-year-olds. 100% is perfect health.

The table shows the amount of exercise 16-year-olds do and their health rating.

Amount of exercise done in minutes every week	Health rating as %
Less than 30	72
90	76
180	82
300	92

What conclusion can be made about the effect of exercise on health?

Use information from the table.

.....

(1)

- (c) Inherited factors can also affect health.

Give **one** health problem that may be affected by the genes someone inherits.

Draw a ring around the correct answer.

**being
malnourished**

**having a high
cholesterol level**

**having a
deficiency disease**

(1)

- (d) White blood cells are part of the immune system.

Use the correct answer from the box to complete each sentence.

antibiotics	antibodies	pathogens	vaccines
--------------------	-------------------	------------------	-----------------

- (i) When we are ill, white blood cells produce to kill microorganisms.

(1)

- (ii) Many strains of bacteria, including MRSA, have developed resistance to drugs called

.....

(1)

(Total 7 marks)

14

(a) Enzymes are used in body cells.

(i) What is an enzyme?

Draw a ring around the correct answer.

an antibody**a catalyst****a hormone****(1)**

(ii) All enzymes are made of the same type of substance.

What is this substance?

Draw a ring around the correct answer.

carbohydrate**fat****protein****(1)**

(iii) Where is the enzyme amylase produced in the human body?

Draw a ring around the correct answer.

liver**salivary glands****stomach****(1)**

(b) Enzymes are sometimes used in industry.

Draw **one** line from each enzyme to the correct industrial use of that enzyme.

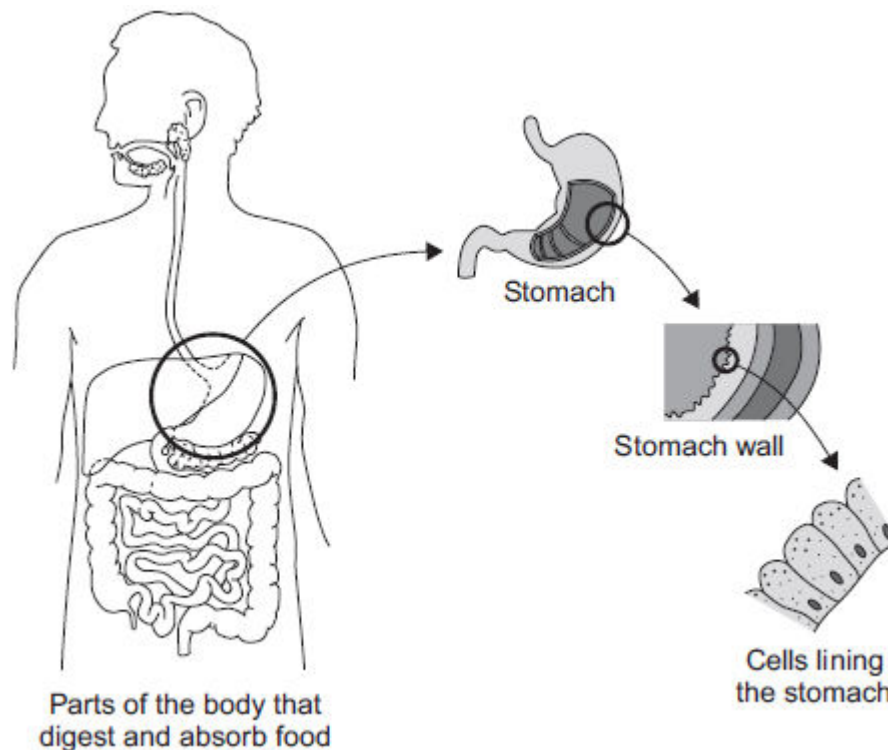
Enzyme	Industrial use
Carbohydrase	Changes starch into sugars
Isomerase	Removes grease stains from clothes
Protease	Pre-digests proteins in some baby foods
	Changes glucose syrup into fructose syrup

(3)**(Total 6 marks)**

15

The diagram below shows the parts of the body that digest and absorb food.

It also shows some details about the structure of the stomach.



- (a) Complete the table to show whether each structure is an organ, an organ system or a tissue.

For each structure, tick (✓) **one** box.

Structure	Organ	Organ system	Tissue
Stomach			
Cells lining the stomach			
Mouth, oesophagus, stomach, liver, pancreas, small and large intestine			

(2)

- (b) (i) The blood going to the stomach has a high concentration of oxygen. The cells lining the stomach have a low concentration of oxygen.

Complete the following sentence.

Oxygen moves from the blood to the cells lining the stomach by

the process of

(1)

- (ii) What other substance must move from the blood to the cells lining the stomach so that respiration can take place?

Draw a ring around the correct answer.

glucose **protein** **starch**

(1)

- (iii) In which part of a cell does aerobic respiration take place?

Draw a ring around the correct answer.

cell membrane **mitochondria** **nucleus**

(1)

(Total 5 marks)

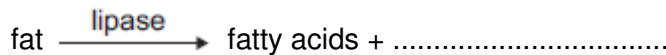
16

Lipase is an enzyme that digests fat.

- (a) (i) Complete the equation to show the digestion of fat.

Use the correct answer from the box.

glucose	glycerol	glycogen
----------------	-----------------	-----------------



(1)

- (ii) Name **one** organ that makes lipase.

.....

(1)

- (b) Some students investigated the effect of bile on the digestion of fat by lipase.

The students:

- 1 mixed milk and bile in a beaker
- 2 put the pH sensor of a pH meter into the beaker
- 3 added lipase solution
- 4 recorded the pH at 2-minute intervals
- 5 repeated steps 1 to 4, but used water instead of bile.

Suggest **two** variables that the students should have controlled in this investigation.

1.....

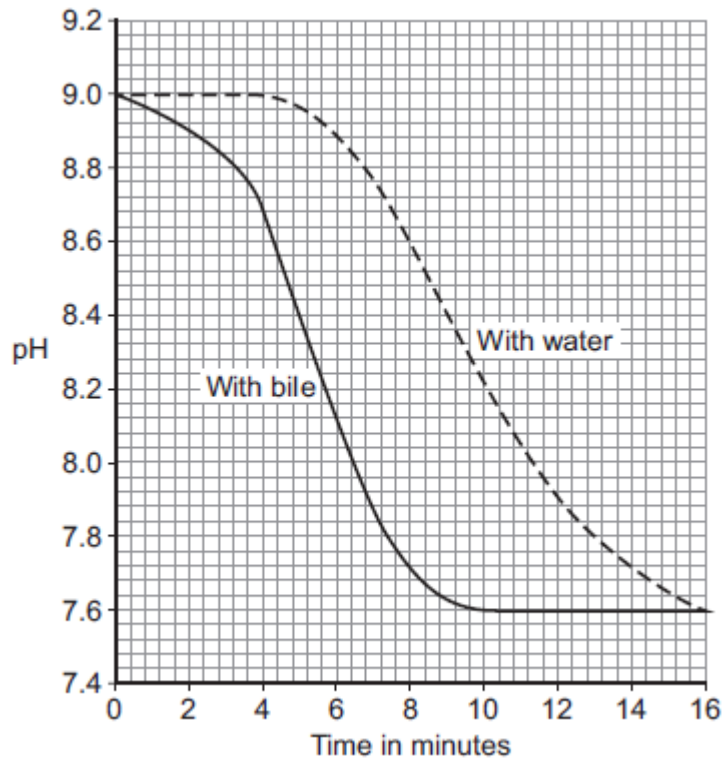
.....

2.....

.....

(2)

(c) The graph shows the students' results.



(i) Why did the pH decrease in both investigations?

.....

.....

(1)

(ii) Bile helps lipase to digest fat.

What evidence is there in the graph to support this conclusion?

.....

.....

(1)

(iii) Suggest **one** reason why the contents of both beakers had the same pH at the end of the investigations.

.....

.....

(1)

(Total 7 marks)

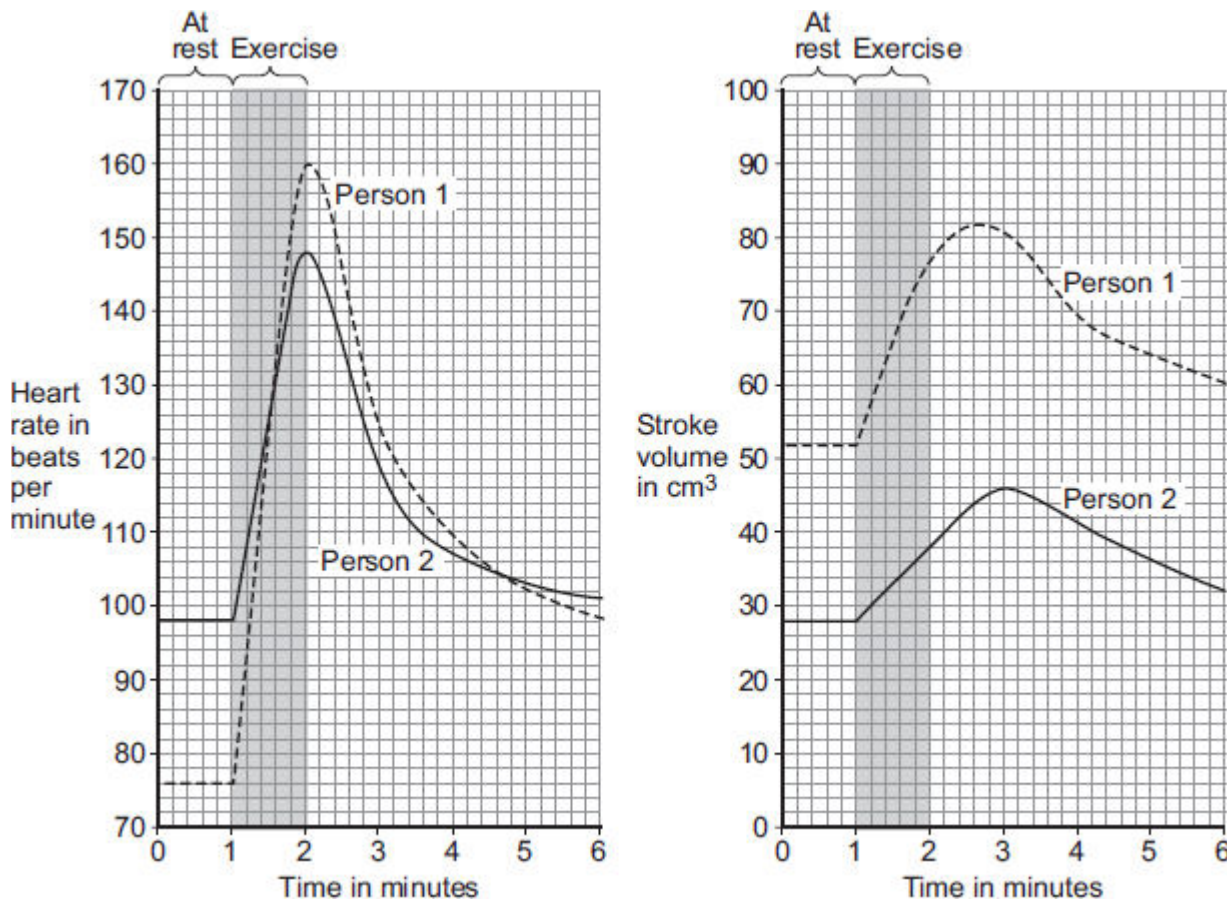
17

During exercise, the heart beats faster and with greater force.

The 'heart rate' is the number of times the heart beats each minute. The volume of blood that travels out of the heart each time the heart beats is called the 'stroke volume'.

In an investigation, **Person 1** and **Person 2** ran as fast as they could for 1 minute. Scientists measured the heart rates and stroke volumes of **Person 1** and **Person 2** at rest, during the exercise and after the exercise.

The graph below shows the scientists' results.



(a) The 'cardiac output' is the volume of blood sent from the heart to the muscles each minute.

$$\text{Cardiac output} = \text{Heart rate} \times \text{Stroke volume}$$

At the end of the exercise, **Person 1's** cardiac output = $160 \times 77 = 12\,320 \text{ cm}^3$ per minute.

Use information from **Figure above** to complete the following calculation of **Person 2's** cardiac output at the end of the exercise.

At the end of the exercise:

Person 2's heart rate = beats per minute

Person 2's stroke volume = cm^3

Person 2's cardiac output = cm^3 per minute

(3)

(b) **Person 2** had a much lower cardiac output than **Person 1**.

(i) Use information from **Figure above** to suggest the **main** reason for the lower cardiac output of **Person 2**.

.....
.....

(1)

(ii) **Person 1** was able to run much faster than **Person 2**.

Use information from **Figure above** and your own knowledge to explain why.

.....
.....
.....
.....
.....
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.....
.....
.....
.....
.....

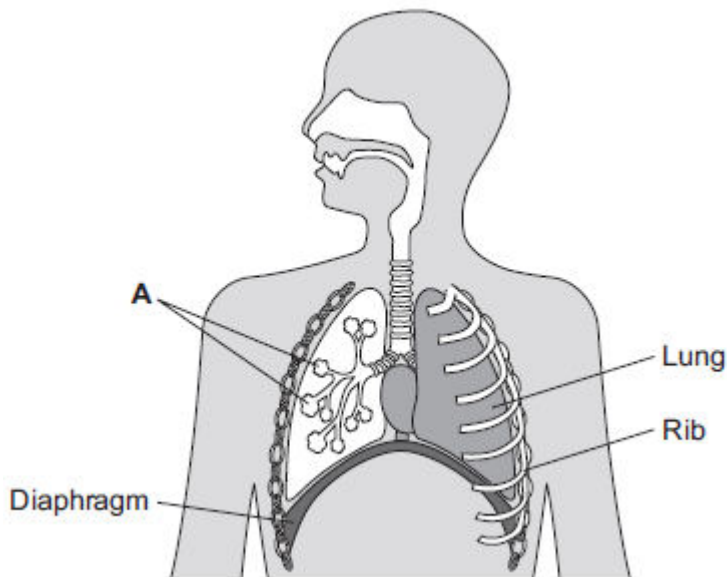
(5)

(Total 9 marks)

18

Our lungs help us to breathe.

The image below shows the human breathing system.



(a) (i) Name part **A**.

.....

(1)

(ii) Give **one** function of the ribs.

.....

(1)

(b) (i) Use the correct answer from the box to complete the sentence.

active transport	diffusion	osmosis
-------------------------	------------------	----------------

Oxygen moves from the air inside the lungs into the blood by the process of

(1)

(ii) Use the correct answer from the box to complete the sentence.

arteries	capillaries	veins
-----------------	--------------------	--------------

Oxygen moves from the lungs into the blood through the walls of the

(1)

(iii) Inside the lungs, oxygen is absorbed from the air into the blood.

Give **two** adaptations of the lungs that help the rapid absorption of oxygen into the blood.

- 1
-
- 2
-

(2)
(Total 6 marks)

19

(a) Humans need to remove waste products from their bodies.

Which organ removes waste carbon dioxide from the body?

Tick (✓) **one** box.

- Liver
- Lung
- Skin

(1)

(b) Kidneys make urine. Urine is stored in the bladder.

Which **one** of the following stages is involved in making urine in a healthy kidney?

Tick (✓) **one** box.

- Filtering the blood
- Reabsorbing **all** of the ions
- Reabsorbing **all** of the water

(1)

- (c) A healthy kidney keeps the correct amount of water in the blood.

If there is too much water in the blood, what might happen to the blood cells?

Tick (✓) **one** box.

They will take in water and burst.

There will be no change.

They will lose water and shrink.

(1)

- (d) A child has kidney failure.

A doctor recommends dialysis to treat the kidney failure.

Before dialysis starts, the doctor measures the concentration of glucose and of urea in the child's blood.

The concentration of glucose in the dialysis fluid is 6 mmol per dm³.

The results are shown below in the table.

	Concentration in the blood before dialysis starts in mmol per dm ³
Glucose	6
Urea	28

- (i) Suggest what the concentration of glucose in the blood will be **after** the dialysis treatment.

Draw a ring around the correct answer.

less than 6

6

more than 6

(1)

- (ii) Suggest what the concentration of urea in the blood will be **after** the dialysis treatment.

Draw a ring around the correct answer.

less than 28 28 more than 28

(1)

- (iii) Give a reason for your answer to part (d)(ii).

.....

(1)

- (e) (i) Some patients have kidney transplants. Transplanted kidneys may be rejected by the body.

Use the correct answer from the box to complete the sentence.

antibodies	hormones	tissues
-------------------	-----------------	----------------

Transplanted kidneys have proteins on the surface of the cells. These proteins may be

attacked by the patient's

(1)

- (ii) It is important to prevent rejection of a new kidney.

Which **one** of the following helps to prevent the kidney from being rejected?

Tick (✓) **one** box.

Giving the patient antibodies	<input type="checkbox"/>
Giving the patient painkillers	<input type="checkbox"/>
Tissue typing the donor kidney	<input type="checkbox"/>

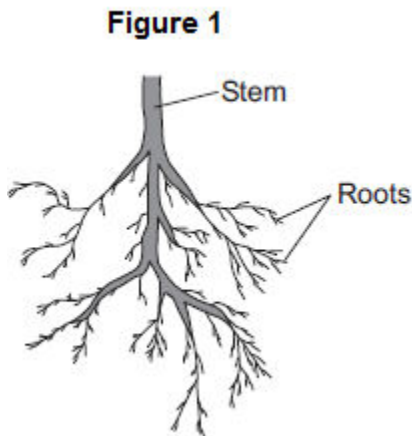
(1)

(Total 8 marks)

20

Plants need different substances to survive.

Figure 1 shows the roots of a plant.



(a) (i) Mineral ions are absorbed through the roots.

Name **one** other substance absorbed through the roots.

.....

(1)

(ii) The plant in **Figure 1** has a higher concentration of mineral ions in the cells of its roots than the concentration of mineral ions in the soil.

Which **two** statements correctly describe the absorption of mineral ions into the plant's roots?

Tick (✓) **two** boxes.

The mineral ions are absorbed by active transport.

The mineral ions are absorbed by diffusion.

The mineral ions are absorbed down the concentration gradient.

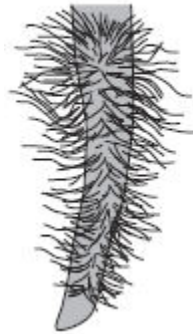
The absorption of mineral ions needs energy.

(2)

(iii) The plant in **Figure 1** has roots adapted for absorption.

Figure 2 shows a magnified part of a root from **Figure 1**.

Figure 2



Describe how the root in **Figure 2** is adapted for absorption.

.....
.....
.....
.....

(2)

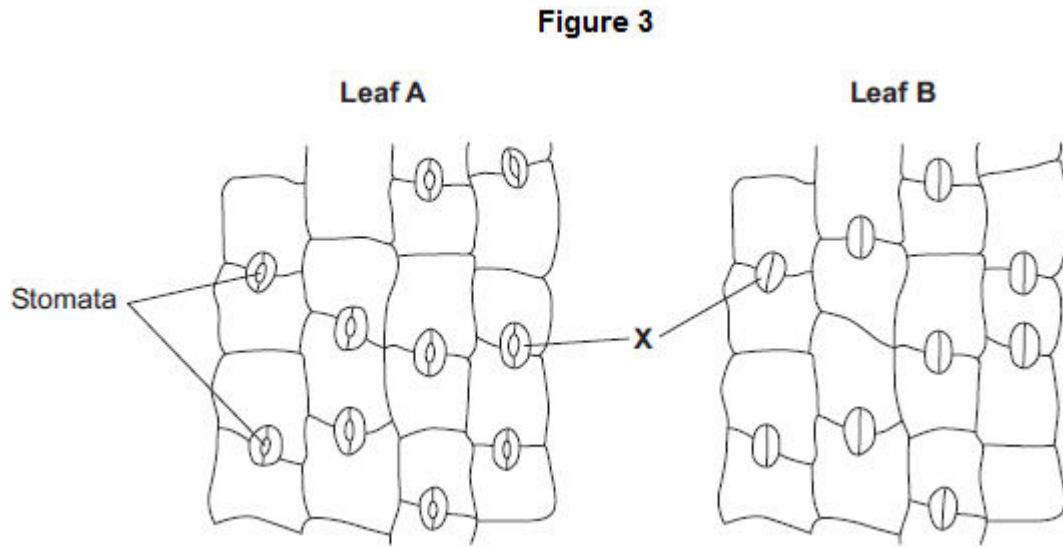
(b) The leaves of plants have stomata.

What is the function of the stomata?

.....
.....

(1)

(c) **Figure 3** shows the underside of two leaves, **A** and **B**, taken from a plant in a man's house.



(i) In **Figure 3**, the cells labelled **X** control the size of the stomata.

What is the name of the cells labelled **X**?

Tick (✓) **one** box.

- | | |
|--------------|--|
| Guard cells | |
| Phloem cells | |
| Xylem cells | |

(1)

(ii) Describe how the appearance of the stomata in leaf **B** is different from the appearance of the stomata in leaf **A**.

.....

(1)

(iii) The man forgets to water the plant.

What might happen to the plant in the next few days if the stomata stay the same as shown in leaf **A** in **Figure 3**?

.....
.....

(1)
(Total 9 marks)

21

The circulatory system transports substances such as glucose and oxygen around the body.

(a) Name **two** other substances that the circulatory system transports around the body.

1.....
2.....

(2)

(b) (i) Blood is a tissue. Blood contains red blood cells and white blood cells.

Name **two** other components of blood.

1.....
2.....

(2)

(ii) The heart is part of the circulatory system.

What type of tissue is the wall of the heart made of?

.....

(1)

(c) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Every year, many patients need to have heart valve replacements.

The table gives information about two types of heart valve.

Living human heart valve	Cow tissue heart valve
<ul style="list-style-type: none">• It has been used for transplants for more than 12 years.• It can take many years to find a suitable human donor.• It is transplanted during an operation after a donor has been found.• During the operation, the patient's chest is opened and the old valve is removed before the new valve is transplanted.	<ul style="list-style-type: none">• It has been used since 2011.• It is made from the artery tissue of a cow.• It is attached to a stent and inserted inside the existing faulty valve.• A doctor inserts the stent into a blood vessel in the leg and pushes it through the blood vessel to the heart.

A patient needs a heart valve replacement. A doctor recommends the use of a cow tissue heart valve.

Give the advantages and disadvantages of using a cow tissue heart valve compared with using a living human heart valve.

Use information from the table and your own knowledge in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6)
(Total 11 marks)

22

Many runners drink sports drinks to improve their performance in races.

A group of students investigated the effects of three brands of sports drink, **A**, **B** and **C**, on the performance of three runners on a running machine. One of the runners is shown in the image below.



© Keith Brofsky/Photodisc/Thinkstock

Table 1 gives information for each drink.

Table 1

Nutrient per dm ³	Brand of sports drink		
	A	B	C
Glucose in g	63	31	72
Fat in g	9	0	2
Ions in mg	312	332	495

- (a) (i) In the investigation, performance was measured as the time taken to reach the point of exhaustion.

Exhaustion is when the runners could not run anymore.

All three runners:

- ran on a running machine until the point of exhaustion
- each drank 500 cm³ of a different brand of sports drink
- rested for 4 hours to recover
- ran on the running machine again and recorded how much time they ran until the point of exhaustion.

The speed at which the runners ran was the same and all other variables were controlled.

The students predicted that the runner drinking brand **B** would run for the shortest time on the second run before reaching the point of exhaustion.

Use information from **Table 1** to suggest an explanation for the students' prediction.

.....
.....
.....
.....

(2)

- (ii) If the balance between ions and water in a runner's body is not correct, the runner's body cells will be affected.

Describe **one** possible effect on the cells if the balance between ions and water is **not** correct.

.....
.....

(1)

(b) When running, a runner's body temperature increases.

Describe how the brain monitors body temperature.

.....

.....

.....

.....

.....

.....

(3)

(c) (i) **Table 2** is repeated here to help you answer this question.

Table 2

	Brand of sports drink		
Nutrient per dm ³	A	B	C
Glucose in g	63	31	72
Fat in g	9	0	2
Ions in mg	312	332	495

People with diabetes need to be careful about drinking too much sports drink.

Use information from **Table 2** to explain why drinking too much sports drink could make people with diabetes ill.

.....

.....

.....

.....

.....

.....

(3)

(ii) Other than paying attention to diet, how do people with diabetes control their diabetes?

.....

.....

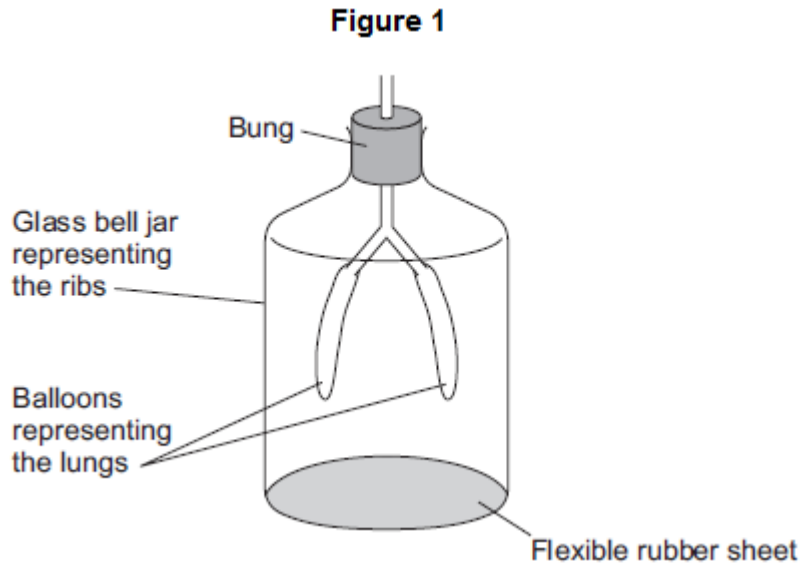
(1)

(Total 10 marks)

23

Figure 1 shows a model representing the human breathing system.

The different parts of the model represent different parts of the human breathing system.



(a) (i) Which part of the human breathing system does the flexible rubber sheet represent?

.....

(1)

(ii) Explain why the balloons inflate when the flexible rubber sheet is pulled down.

.....
.....
.....
.....
.....
.....

(3)

(b) (i) During breathing, oxygen moves into the blood.

Explain how oxygen moves into the blood.

.....

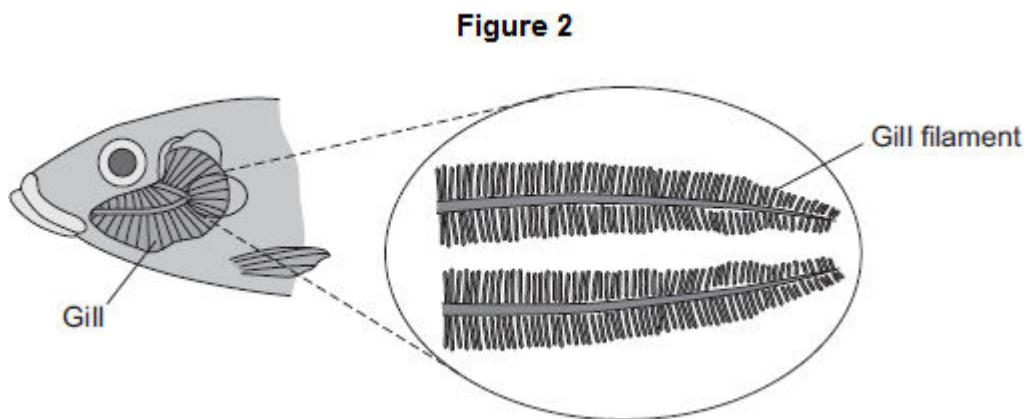
.....

.....

.....

(2)

(ii) **Figure 2** shows a fish head and gill.



Fish absorb oxygen from the water. Oxygen is absorbed through the gills of the fish.

Explain **one** way in which the gills are adapted for rapid absorption of oxygen.

.....

.....

.....

.....

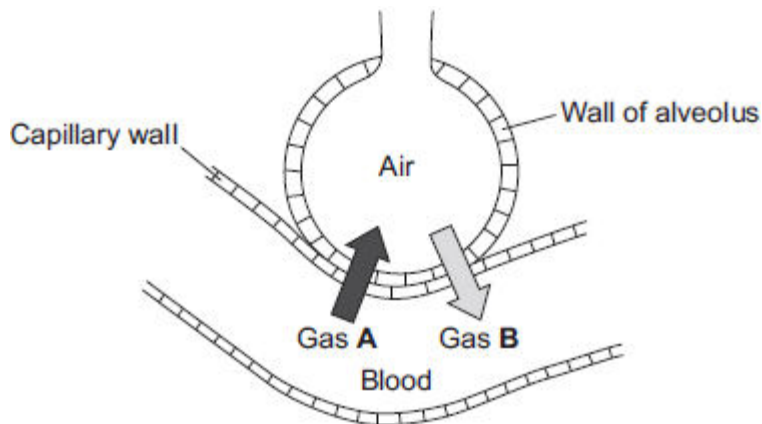
(2)
(Total 8 marks)

24

Gas exchange takes place in the lungs.

The diagram shows an alveolus next to a blood capillary in a lung.

The arrows show the movement of two gases, **A** and **B**.



(a) (i) Draw a ring around the correct answer to complete the sentence.

Gases **A** and **B** move by

- | |
|--|
| diffusion.
osmosis.
respiration. |
|--|

(1)

(ii) Gas **A** moves from the blood to the air in the lungs.

Gas **A** is then breathed out.

Name Gas **A**.

.....

(1)

(iii) Which cells in the blood carry Gas **B**?

Draw a ring around the correct answer.

- platelets** **red blood cells** **white blood cells**

(1)

(b) The average number of alveoli in each human lung is 280 million.

The average surface area of 1 million alveoli is 0.25 m².

Calculate the total surface area of a human lung.

.....

Answer m²

(2)

- (c) An athlete trains to run a marathon. The surface area of each of the athlete's lungs has increased to 80 m².

Give **one** way in which this increase will help the athlete.

.....
.....

(1)
(Total 6 marks)

25

The photograph shows a fossil of a prehistoric bird called *Archaeopteryx*.



By Ghedoghedo (own work) [CC-BY-SA-3.0 (<http://creativecommons.org/licenses/by-sa/3.0>) or GFDL (<http://www.gnu.org/copyleft/fdl.html>)], via Wikimedia Commons; By Steenbergs from Ripon, United Kingdom (Small Fishing Boat In North Sea) [CC-BY-2.0 (<http://creativecommons.org/licenses/by/2.0>)], via Wikimedia Commons.

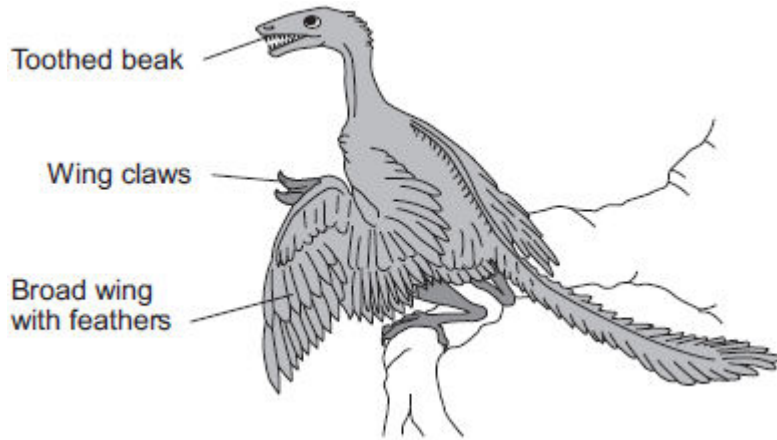
- (a) Describe **three** ways fossils can be made.

.....
.....
.....
.....
.....
.....

(3)

(b) The drawing shows what an *Archaeopteryx* might have looked like when it was alive.

Scientists think that *Archaeopteryx* was a predator.



(i) Look at the drawing.

Write down **three** adaptations that might have helped *Archaeopteryx* to catch prey.

How would **each** adaptation have helped *Archaeopteryx* to catch prey?

Adaptation 1

How it helps

.....

Adaptation 2

How it helps

.....

Adaptation 3

How it helps

.....

(3)

(ii) *Archaeopteryx* is now extinct.

Give **two** reasons why animals may become extinct.

1

.....

2

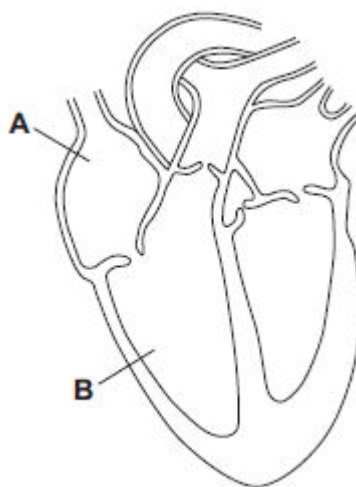
.....

(2)
(Total 8 marks)

26

Diagram 1 shows a section through the heart.

Diagram 1



(a) Use words from the box to name the structures labelled **A** and **B** on **Diagram 1**.

arota	atrium	pulmonary artery	ventricle
-------	--------	------------------	-----------

A

B

(2)

(b) The tissue in the wall of the heart contracts.

(i) What type of tissue is this?

Tick (✓) **one** box.

muscular

glandular

epithelial

(1)

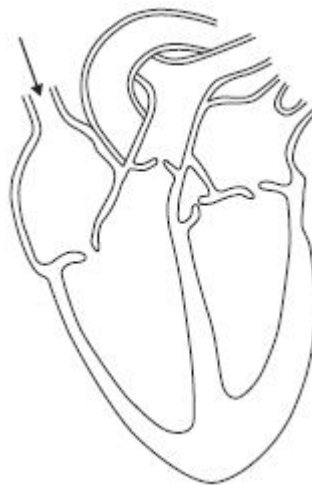
(ii) What does the heart do when this tissue contracts?

.....
.....

(1)

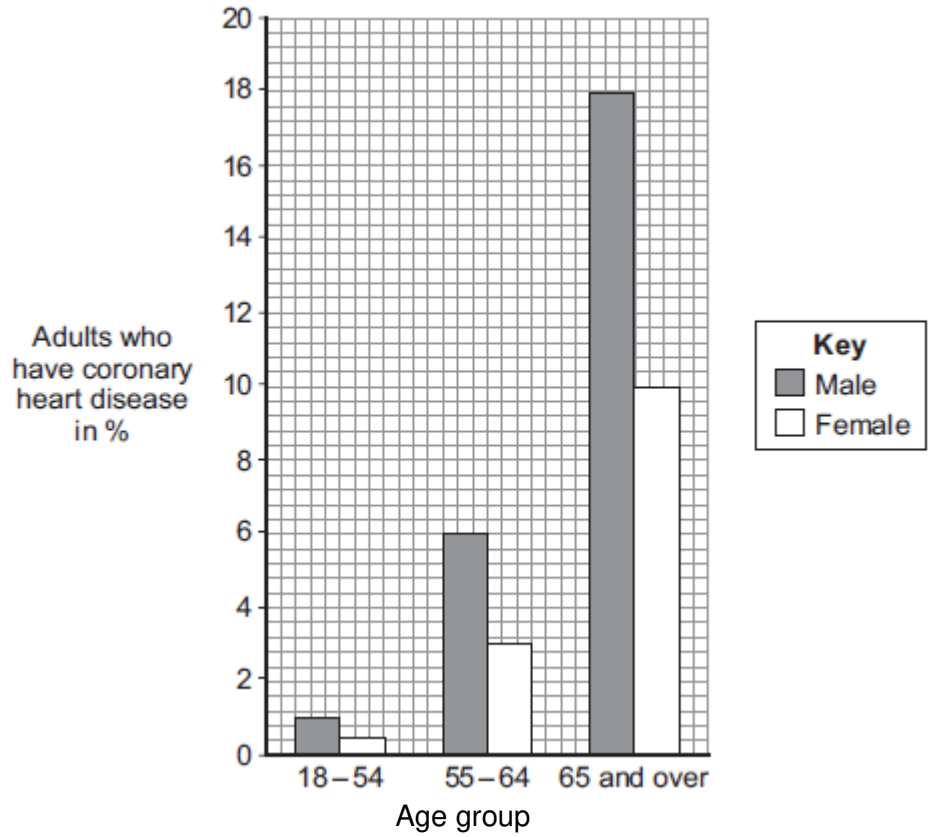
(c) Draw arrows on **Diagram 2** to complete the route taken by deoxygenated blood through the heart.

Diagram 2



(2)

(d) The graph shows the percentage (%) of adults in the UK who have coronary heart disease.



(i) Look at the graph.

Which group of people is **most** at risk of having coronary heart disease in the UK?

.....

(2)

(ii) Explain what happens to the heart in coronary heart disease.

.....
.....
.....
.....
.....
.....

(3)

(Total 11 marks)

27

- (a) High-fructose corn syrup (HFCS) is used instead of sucrose as a sweetener in many types of food.

Table 1 shows the relative sweetness of different types of sugar.

Table 1

Sugar	Relative sweetness
Fructose	173
Glucose	74
Lactose	16
Sucrose	100

- (i) One of the sugars was used as a 'standard' measure of sweetness.

The sweetness of all the other sugars was compared with this.

Which sugar was used as the standard of sweetness?

.....

(1)

- (ii) Fructose is used instead of sucrose in many types of food.

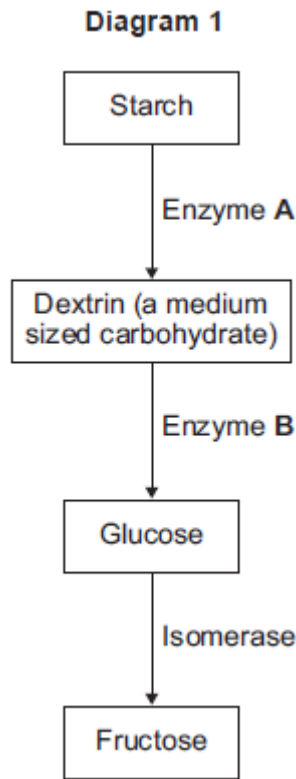
Suggest why.

Use information from **Table 1** in your answer.

.....
.....
.....
.....
.....
.....

(3)

(b) **Diagram 1** shows the main stages in the industrial production of fructose for use in HFCS.



(i) **A** and **B** are two enzymes that digest carbohydrates.

What general name do scientists give to enzymes like **A** and **B**?

Tick (✓) **one** box.

carbohydrases

lipases

proteases

(1)

(ii) The enzymes in **Diagram 1** come from bacteria that live in hot springs.

The enzymes work best at a temperature of 60 °C.

What would happen to most enzymes at a temperature of 60 °C?

.....

.....

(1)

- (iii) It is an advantage to carry out these reactions in the industrial production of HFCS at 60 °C.

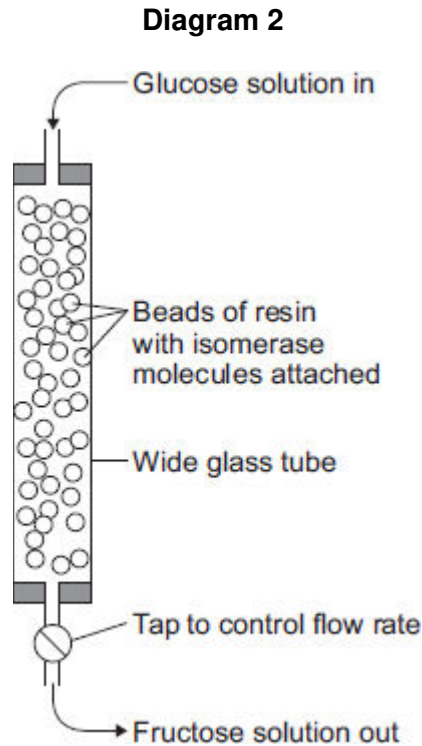
Suggest why.

.....
.....
.....
.....

(2)

Isomerase is used in an immobilised form in the production of HFCS. Isomerase molecules are immobilised by attaching them to beads made of resin in a glass tube.

Diagram 2 shows how immobilised isomerase is used.



- (c) An alternative to using immobilised isomerase is to mix isomerase solution with glucose solution in a large container.

Suggest **two** advantages of using immobilised isomerase, rather than isomerase solution, in the production of HFCS for use in human foods.

1

.....

2

.....

(2)

(d) **Table 2** shows some differences between the industrial production of HFCS from glucose using:

- isomerase solution
- immobilised isomerase.

Table 2

	Isomerase solution	Immobilised isomerase
Reaction container volume in m ³	1100	15
Time taken for reaction in hours	20	0.5
Temperature in °C	65	60
Number of product refining stages	4	1
Total production cost in £ per tonne	500	5

Explain how factors given in **Table 2** help to lower production costs when using the immobilised enzyme.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(3)

- (e) **Table 3** gives information about the half-life of isomerase in the two processes.

The **half-life** of the enzyme is the time it takes for the enzyme's activity to fall to half its starting value.

The **active life** of the enzyme is the time for which it can be used before it is thrown away.

Table 3

	Isomerase solution	Immobilised isomerase
Half-life of enzyme in hours	30	1500
Active life of enzyme in half-lives	0.7	3

- (i) Using the information from **Table 3**, we can calculate that the active life, in hours, of isomerase solution is 21 hours.

Calculate the active life, in hours, of **immobilised isomerase**.

.....

Active life of immobilised isomerase = hours

(2)

- (ii) A high active life of isomerase is important in lowering the production costs of HFCS.

Explain why.

.....

(2)

(Total 17 marks)

28

- (a) A person cut his finger. A small amount of blood flowed from the cut but soon stopped due to blood clotting.

The following sentences describe what happens when a person has a small cut and a blood clot is formed.

Draw a ring around the correct answer to complete each sentence.

(i) The tiny blood vessels near the surface of the skin that are damaged

are

arteries.
capillaries.
veins.

(1)

(ii) Blood clotting is stimulated by

platelets.
red blood cells.
white blood cells.

(1)

(iii) During blood clotting

fibrinogen changes to fibrin.
haemoglobin changes to oxyhaemoglobin.
lipid changes to fatty acids.

(1)

(b) A blood transfusion is when a person is given blood from a donor.

A person has lost a lot of blood and needs a blood transfusion.

It is important to use blood of the correct blood group. If blood of the wrong blood group is used, the transfusion will not be safe.

The person giving the blood is called the **donor**.

The person receiving the blood is called the **recipient**.

Complete the table to show which transfusions are safe and which are unsafe.

Some of the table has been completed for you as an example.

Use the following symbols:

✓ = a safe transfusion

✗ = an unsafe transfusion

Donor blood group and antigens

		Donor			
		Group A only A antigens	Group B only B antigens	Group AB A + B antigens	Group O no antigens
Recipient blood group and antibodies	Group A anti-B antibodies	✓	✗	✗	✓
	Group B anti-A antibodies	✗			
	Group AB no antibodies	✓			
	Group O anti-A + anti-B antibodies	✗			

(3)

(c) (i) **Anti-B** antibodies will bind only to the **B** antigen. They will not bind to the **A** antigen.

Explain why.

.....

.....

.....

.....

(2)

(ii) Red blood cells have a diameter of about 8 micrometres.

Some capillaries have an internal diameter of about 10 micrometres.

Red blood cells, with antibodies bound to them, stick together.

B antigens are found on the surface of red blood cells in people who have blood group **B**.

Use this information to explain why transfusion of group **B** blood into a person of blood group **A** is unsafe.

.....

.....

.....

.....

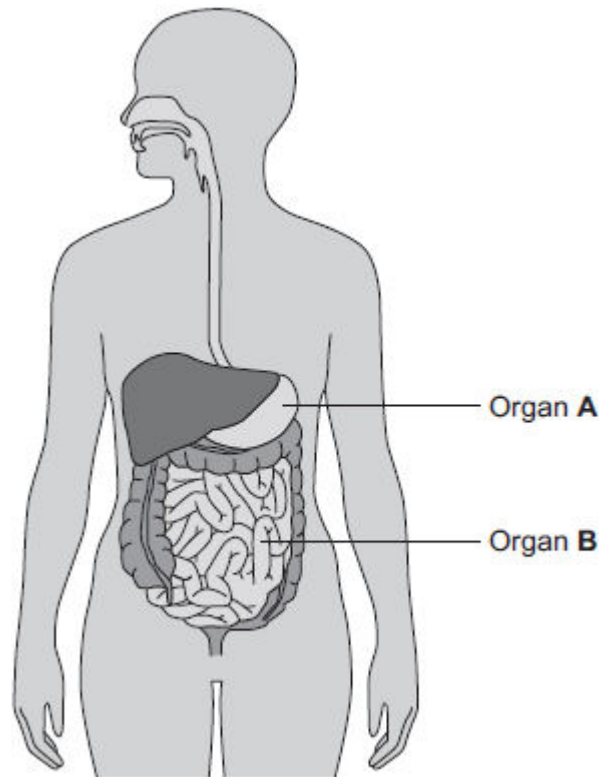
.....

.....

(3)
(Total 11 marks)

29

The diagram below shows the human digestive system.



- (a) (i) What is Organ
- A**
- ?

Draw a ring around the correct answer.

gall bladder liver stomach

(1)

- (ii) What is Organ
- B**
- ?

Draw a ring around the correct answer.

large intestine pancreas small intestine

(1)

- (b) Digestive enzymes are made by different organs in the digestive system.

Complete the table below putting a tick (✓) or cross (×) in the boxes.

The first row has been done for you.

		Organ producing enzyme			
		salivary glands	stomach	pancreas	small intestine
Enzyme	amylase	✓	×	✓	✓
	lipase				
	protease				

(2)

- (c) The stomach also makes hydrochloric acid.

How does the acid help digestion?

.....

.....

(1)

(d) Draw **one** line from each digestive enzyme to the correct breakdown product.

Digestive enzyme

Breakdown products

Amylase breaks down starch into.....

Lipase breaks down fats into...

Protease breaks down proteins into...

amino acids.

bases.

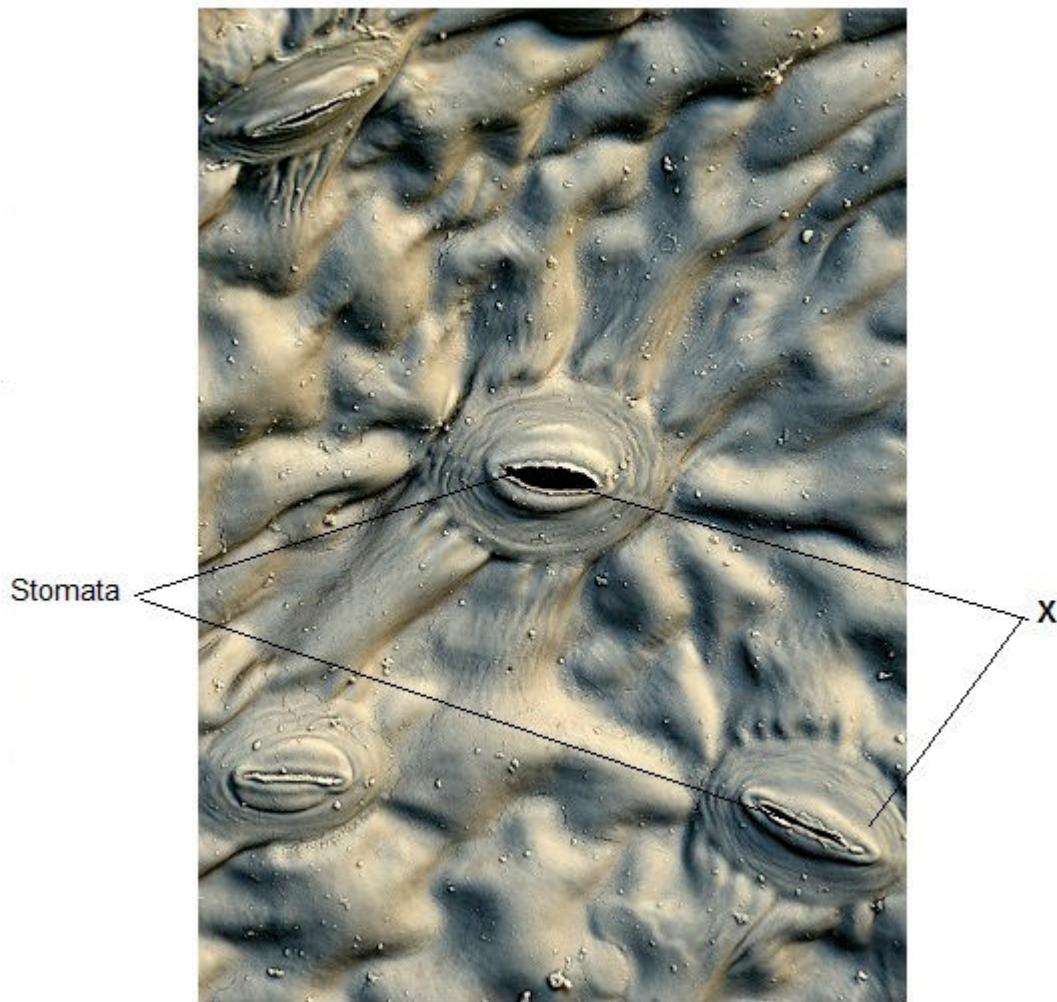
fatty acids and glycerol.

sugars.

(3)
(Total 8 marks)

30

The image below shows some cells on the lower surface of a leaf.



© Stefan Diller/Science Photo Library

- (a) What are the cells labelled **X** called?

Draw a ring around the correct answer.

guard cells

palisade cells

mesophyll cells

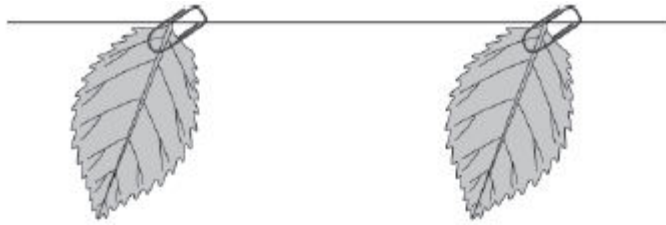
(1)

- (b) Water loss by evaporation from leaves is called **transpiration**.

A student set up an experiment to investigate water loss from leaves.

The student:

- took two leaves, **A** and **B**, from a plant
- put Vaseline (grease) on both sides of **Leaf B**; did nothing to **Leaf A**
- wrote down the mass of each leaf
- attached the leaves onto a string as shown in the diagram below.



Leaf A
(no treatment)

Leaf B
(both surfaces covered
in Vaseline)

- left the leaves for 48 hours
- wrote down the mass of each leaf again
- calculated the percentage (%) change in mass for each leaf.

(i) Give **one** variable that the student controlled in this investigation.

.....
.....

(1)

(ii) The mass of **Leaf A** was 1.60 g at the start of the investigation. After 48 hours it was 1.28 g.

Calculate the % decrease in mass over 48 hours.

.....
.....

% decrease =

(2)

(c) Vaseline blocks the stomata.

The % change in mass of **Leaf B** was less than **Leaf A** after 48 hours.
Explain why.

.....
.....
.....

(1)

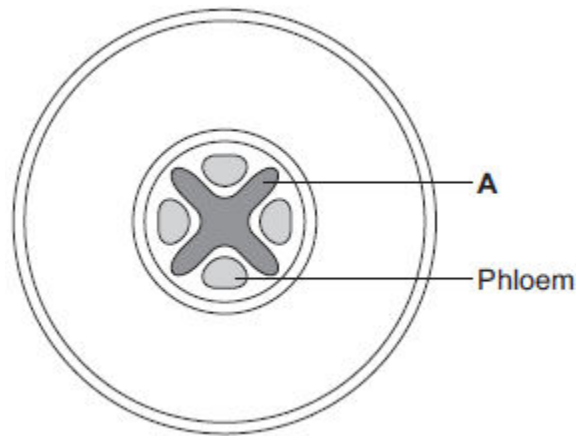
(d) Give **three** environmental conditions that would increase transpiration.

- 1
- 2
- 3

(3)
(Total 8 marks)

31

The diagram below shows a cross-section of a plant root. The transport tissues are labelled.



(a) (i) What is tissue **A**?

Draw a ring around the correct answer.

- cuticle epidermis xylem**

(1)

(ii) Name **two** substances transported by tissue **A**.

- 1
- 2

(2)

(b) Phloem is involved in a process called translocation.

(i) What is translocation?

-
-
-

(1)

(ii) Explain why translocation is important to plants.

.....
.....
.....
.....

(2)

(c) Plants must use active transport to move some substances from the soil into root hair cells.

(i) Active transport needs energy.

Which part of the cell releases most of this energy?

Tick (✓) **one** box.

mitochondria

nucleus

ribosome

(1)

(ii) Explain why active transport is necessary in root hair cells.

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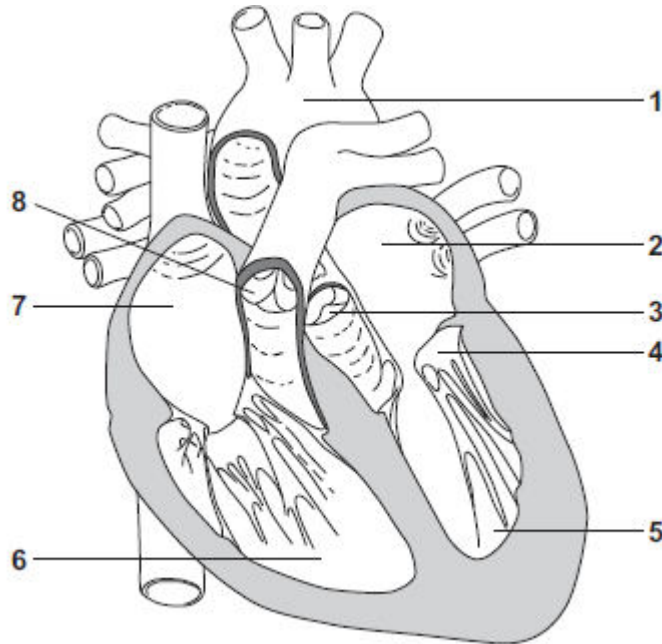
(2)

(Total 9 marks)

32

The diagram in **Figure 1** shows a section through the human heart, seen from the front.

Figure 1



(a) Draw a ring around the correct answer to complete each sentence.

(i) The wall of the heart is made mostly of

epithelial
glandular
muscular

 tissue.

(1)

(ii) The resting heart rate is controlled by the pacemaker.

The pacemaker is located at position

1.
6.
7.

(1)

(iii) If a person's heart rate is irregular, the person may be fitted with an artificial pacemaker.

The artificial pacemaker is

an electrical device.
a pump.
a valve.

(1)

- (b) (i) Write a number, **2, 5, 6** or **7**, in **each** of the three boxes to answer this question.

Which chamber of the heart:

pumps oxygenated blood to the head and body

receives deoxygenated blood from the head and body

receives oxygenated blood from the lungs?

(3)

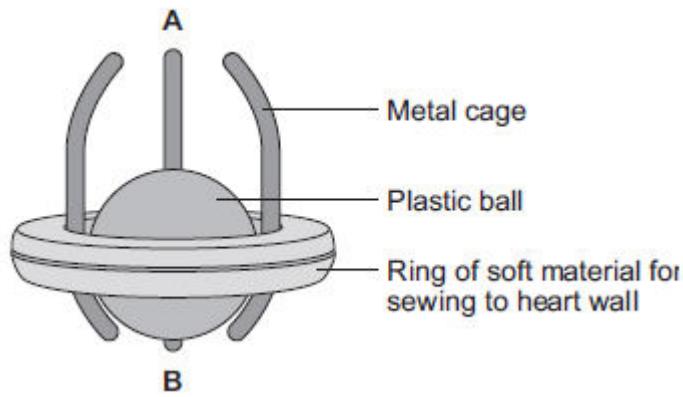
- (ii) Give the number, **3, 4** or **8**, of the valve that closes when the blood pressure in the aorta is greater than the blood pressure in the left ventricle.

Write the correct answer in the box.

(1)

- (c) The diagram in **Figure 2** shows one type of artificial heart valve. The plastic ball is in the closed position.

Figure 2



This type of artificial valve could be used to replace a faulty valve in the heart.

- (i) What is the function of valves in the heart?

.....
.....

(1)

(ii) The artificial valve could be used to replace valve **4** shown in **Figure 1**.

The artificial valve opens to let blood through when the ball is moved towards **A**.

Which end of the valve, **A** or **B**, should point towards chamber **5**?

Explain your answer.

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(3)

(d) (i) The artificial heart valve may cause blood clots to form on its surface.

Describe what happens during blood clotting.

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(2)

(ii) Read the information in the passage.

Replacing a damaged heart valve can dramatically improve the blood circulation and the supply of oxygen to the body's tissues. The operation to replace a heart valve is a long one during which the patient's blood goes through a bypass machine. Sometimes the artificial valve can fail to work. If the surface of the valve becomes rough, small blood clots can form on its surface then break away and be carried around the body by the blood.

Evaluate the advantages and disadvantages of artificial heart valves.

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(4)
(Total 17 marks)

33 (a) Dodder is an unusual flowering plant. It is a parasite.

The dodder plant:

- has no chlorophyll
- has no roots
- has no leaves
- grows attached to the stem of a host plant.

The image below shows dodder attached to its host plant.



© yogesh_more/iStock/Thinkstock

- (i) Dodder has no chlorophyll. Most plants have leaves containing chlorophyll.

What is the function of chlorophyll in most plants?

.....
.....
.....
.....

(2)

- (ii) Parts of the dodder stem grow into the host stem and attach to the host's phloem tissue.

Suggest why it is helpful to the dodder plant to be attached to the host's phloem tissue.

.....
.....

(1)

- (iii) Suggest why the dodder will have a harmful effect on the host plant.

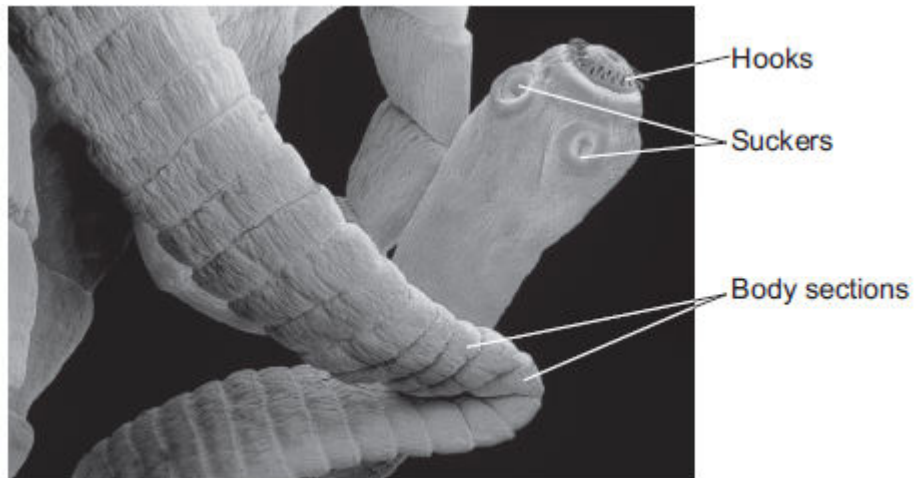
.....
.....

(1)

- (b) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

The tapeworm is another parasite.

The image below shows part of a tapeworm.



The tapeworm lives inside the small intestine of a mammal.

Describe and explain how the tapeworm is adapted for living inside the small intestine of its host.

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Extra space

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(6)
(Total 10 marks)

34

A healthy diet contains the right balance of different foods and the right amount of energy.

(a) An unbalanced diet can lead to health problems.

One problem caused by an unbalanced diet is being overweight.

Name **one** health problem, other than being overweight, that is linked to an unbalanced diet.

.....

(1)

(b) Sugar is a type of carbohydrate.

(i) Eating too much sugar can make a person overweight.

Suggest why.

.....

(1)

(ii) Which other substance in food is linked to people being overweight?

Draw a ring around the correct answer.

fat mineral ions vitamins

(1)

(c) Sugar substitutes taste sweet.

Taking sugar substitutes helps to reduce the chance of becoming overweight.

The table below gives information about four sugar substitutes, **A**, **B**, **C** and **D**.

Sugar substitute	Number of times sweeter than sugar	Effects on health
A	× 200	Harmful to some people
B	× 250	Not known
C	× 600	Not known
D	× 500	None

(i) Which sugar substitute, **A**, **B**, **C** or **D**, is the sweetest?

(1)

(ii) A person is advised to use sugar substitute **D** and **not** sugar substitutes **A**, **B** or **C**.

Suggest a reason why.

.....

(1)

(iii) A food has a sugar substitute in it.

Why must it say on the packet which sugar substitute it is?

.....
.....

(1)
(Total 6 marks)

35

Drugs affect the human body.

(a) Draw **one** line from each drug to the correct information about the drug.

Drug	Information
Cannabis	Used to boost heart rate
Steroid	Used to treat leprosy
Stimulant	May cause mental illness in some people
Thalidomide	Used to increase muscle growth
	Used to treat measles

(4)

(b) New drugs must be tested and trialled before being used.

(i) New drugs are tested in a laboratory before they are trialled on people.

What are new drugs tested on in a laboratory?

.....

(1)

(ii) Why is it important that drugs are trialled before doctors give them to patients?

Tick (✓) **two** boxes.

To check that the drug works

To check the cost of the drug

To find out if the drug is legal

To find the best dose to use

(2)

(iii) In a double blind drug trial, only some people know which patients have been given the drug.

Who knows which patients have been given the drug?

Tick (✓) **one** box.

The patient and the doctor

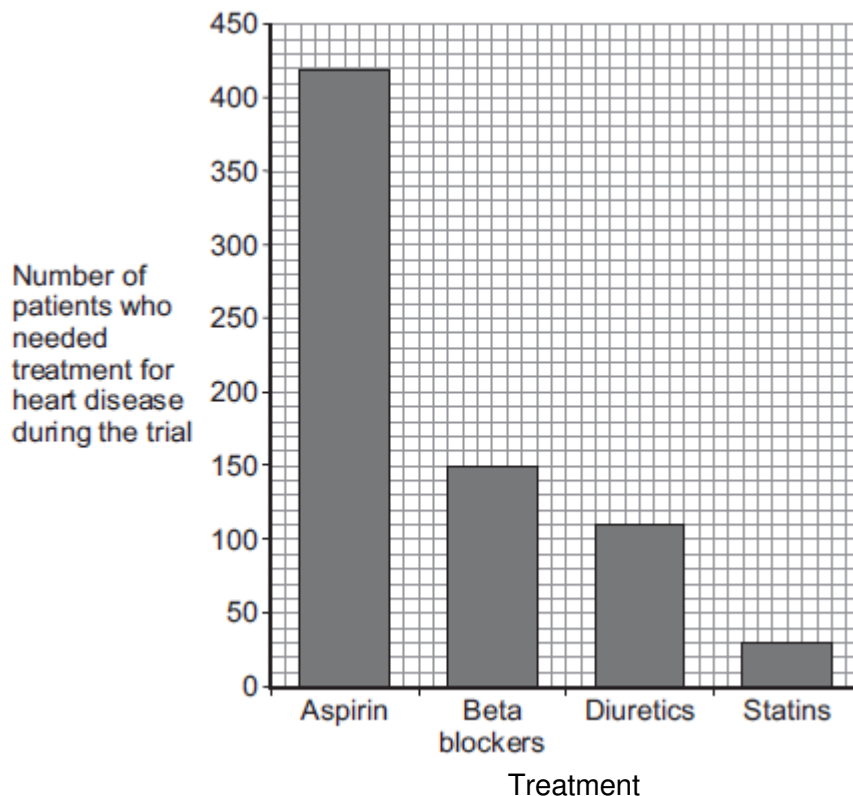
Only the doctor

Only scientists at the drug company

(1)

- (c) Doctors trialled four different treatments for reducing the risk of heart disease. Each treatment was trialled on the same number of patients for 5 years. The patients did **not** have heart disease at the start of the trial.

The graph below shows the results.



- (i) How many patients who took aspirin needed treatment for heart disease during the trial?

Number of patients =

(1)

- (ii) Based **only** on the evidence in the graph, which would be the best treatment to reduce the risk of developing heart disease?

.....

(1)

- (iii) Suggest **one** other factor that a doctor might consider before deciding which treatment to use for a patient.

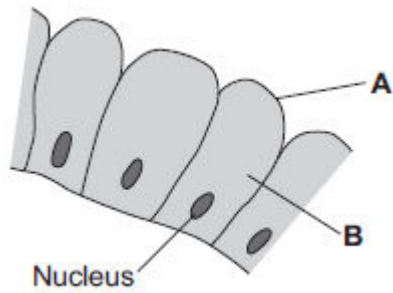
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(1)

(Total 11 marks)

36

The image below shows some cells in the lining of the stomach.



(a) (i) Use words from the box to name structures **A** and **B**.

cell membrane	chloroplast	cytoplasm	vacuole
---------------	-------------	-----------	---------

A

B

(2)

(ii) What is the function of the nucleus?

Tick (✓) **one** box.

To control the activities of the cell

To control movement of substances into and out of the cell

To release energy in respiration

(1)

(b) Draw **one** line from each part of the human body to its correct scientific name.

Part of human body	Scientific name
Layer of cells lining the stomach	An organ
Stomach	An organism
Mouth, stomach, intestines, liver and pancreas	An organ system
	A tissue

(3)
(Total 6 marks)

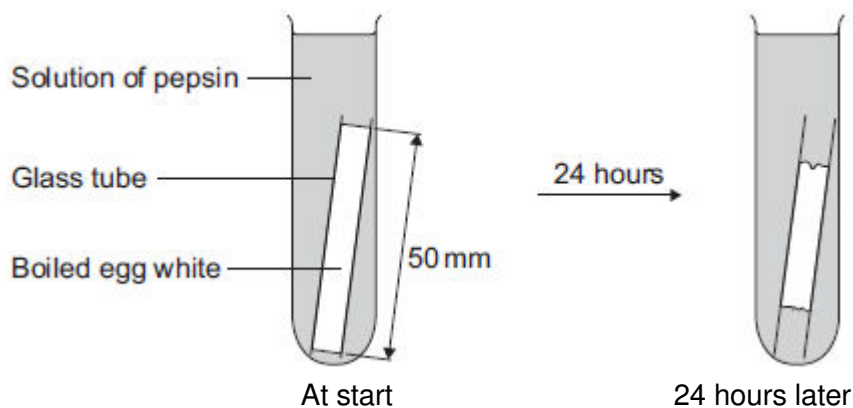
37

Some students investigated the effect of pH on the digestion of boiled egg white by an enzyme called pepsin. Egg white contains protein.

The students:

- put a glass tube containing boiled egg white into a test tube
- added a solution containing pepsin at pH 7
- set up six more tubes with solutions of pepsin at different pH values
- left the test tubes for 24 hours at room temperature.

The image below shows one of the test tubes, at the start and at the end of the 24 hours.



(a) (i) Name the product of protein digestion.

.....

(1)

(ii) What type of enzyme digests protein?

Tick (✓) **one** box.

amylase

lipase

protease

(1)

(b) The egg white in each tube was 50 mm long at the start of the investigation. The table below shows the students' results.

pH	Length in mm of boiled egg white after 24 hours
1	38
2	20
3	34
4	45
5	50
6	50
7	50

(i) At which pH did the pepsin work best?

pH

(1)

(ii) The answer you gave in part (b)(i) may not be the exact pH at which pepsin works best.

What could the students do to find a more accurate value for this pH?

.....
.....
.....
.....

(2)

(iii) There was no change in the length of the egg white from pH 5 to pH 7.

Explain why.

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.....
.....
.....

(2)

(c) Pepsin is made by the stomach.

Name the acid made by the stomach which allows pepsin to work well.

.....

(1)

(Total 8 marks)

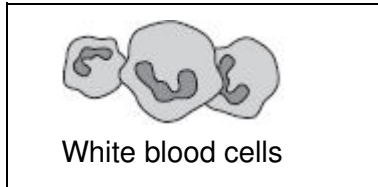
38

(a) (i) Blood is part of the circulatory system.

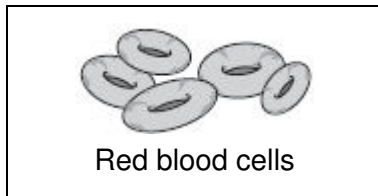
Draw **one** line from each part of the blood to its correct function.

Part of the blood

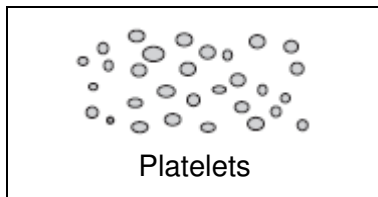
Function



carry glucose around the body



carry oxygen around the body



help the blood to clot

destroy microorganisms

(3)

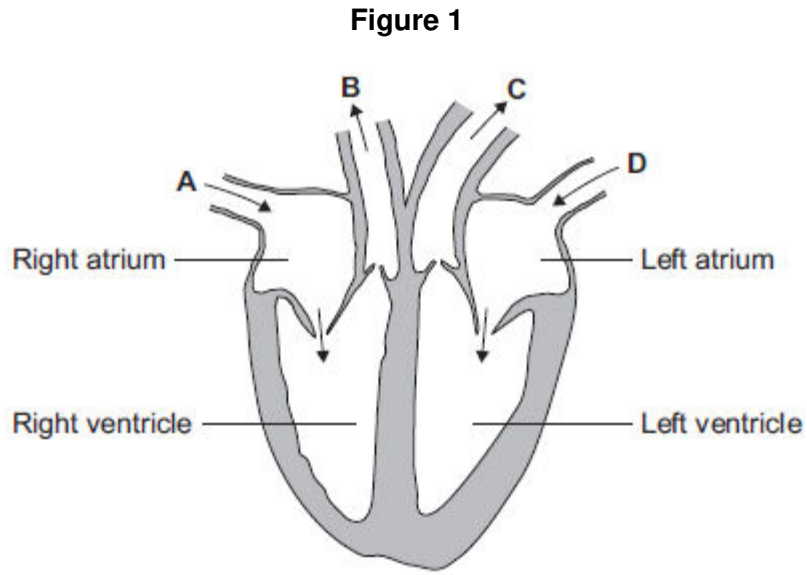
(ii) Name **one** waste product that is transported by the blood plasma.

.....

(1)

(b) The heart is also part of the circulatory system.

Figure 1 shows a section through the human heart.



(i) Which arrow, **A**, **B**, **C** or **D**, shows blood leaving the heart in the pulmonary artery to

go to the lungs?

(1)

(ii) Which arrow, **A**, **B**, **C** or **D**, shows blood from the lungs entering the heart in the

pulmonary vein?

(1)

(iii) Valves in the circulatory system make sure blood only travels in one direction.

Name the type of blood vessel that has valves.

.....

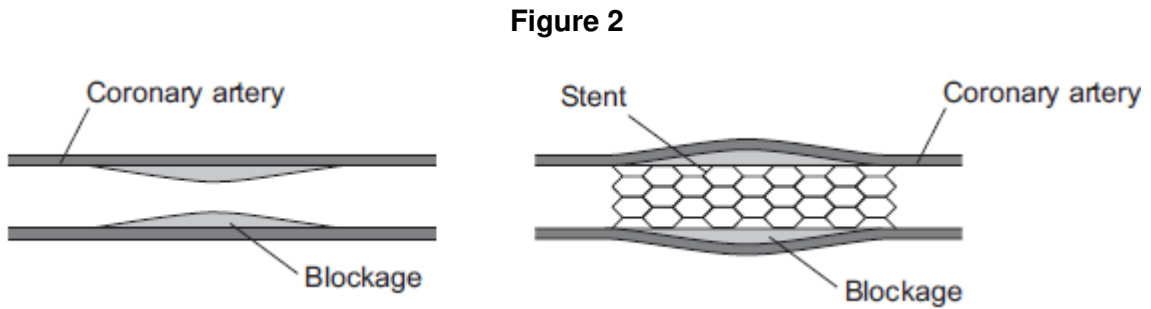
(1)

- (c) A person's coronary artery has become narrower.

The person has a heart attack.

A doctor puts a stent into the person's coronary artery.

Figure 2 shows a stent inside a coronary artery.



- (i) How does the stent help to prevent another heart attack?

Give **one** way.

.....

.....

(1)

- (ii) **Figure 3** shows a surgeon putting a stent into a patient.

Figure 3



© Science Photo Library

The surgeon puts the stent into an artery in the leg. He moves the stent through the artery to the coronary artery.

Suggest **two** possible risks of this operation.

- 1
-
- 2
-

(2)
(Total 10 marks)

39

Substances are transported through plants.

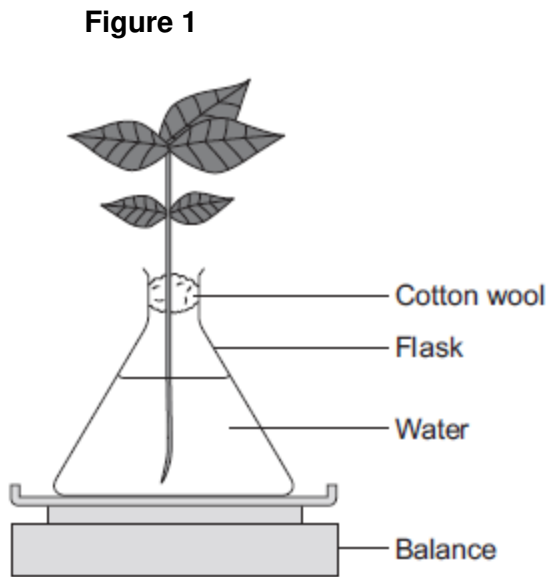
(a) Use the correct answer from the box to complete each sentence.

capillary	guard cells	phloem
stomata	transpiration	xylem

- (i) Water is transported from the roots to the stem of a plant in the (1)
- (ii) Dissolved sugars are transported through the plant in the (1)
- (iii) Movement of water through the plant is called the stream. (1)
- (iv) Water vapour moves out of the plant through pores called (1)

(b) Students investigated the effect of different conditions on water loss from leaves.

The apparatus is shown in **Figure 1**.



The students set up four flasks, **A**, **B**, **C** and **D**.

The students:

- used the same size plant shoot in each flask
- recorded the mass of the flask and plant shoot at the start of each experiment
- left each flask and plant shoot in different conditions
- recorded the mass of each flask and plant shoot after 2 hours.

Table 1 shows the conditions that flasks **A**, **B**, **C** and **D** were left in for 2 hours.

Table 1

Flask	Temperature in °C	Fan or no fan
A	20	No Fan
B	20	Fan
C	35	No Fan
D	35	Fan

(i) Suggest why the students used cotton wool in each flask.

.....

.....

(1)

(ii) The use of the same size of plant shoot made the investigation a fair test.

Explain why.

.....

.....

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.....

.....

(2)

(iii) **Table 2** shows the students' results.

Table 2

Flask	Conditions		Mass at the start in grams	Mass after 2 hours in grams	Mass of water lost in 2 hours in grams
	Temperature in °C	Fan or no fan			
A	20	No Fan	150.0	148.1	1.9
B	20	Fan	152.0	148.5	3.5
C	35	No Fan	149.0	145.9	3.1
D	35	Fan	150.0	145.5	

What mass of water was lost by the plant shoot in flask **D**?

.....

.....

..... grams

(1)

(iv) Suggest what conclusion can be made about the effect of temperature on water loss from the plant shoot.

.....

.....

.....

(1)

- (v) Suggest what conclusion can be made about the effect of the fan on water loss from the plant shoot.

.....

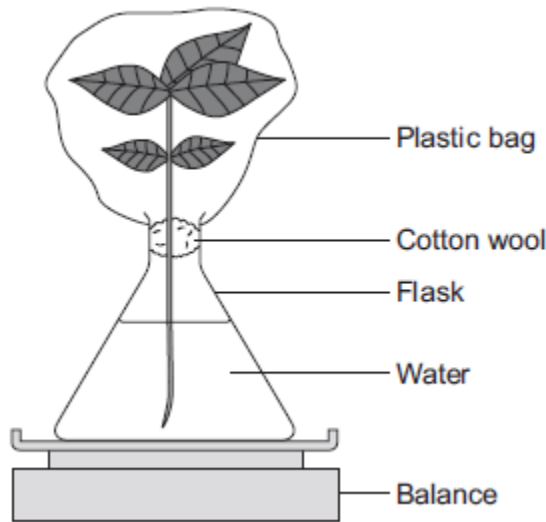
.....

.....

(1)

- (c) The students carried out another experiment at 20 °C, with no fan.
The students used the apparatus in **Figure 2**.

Figure 2



In this experiment, the students:

- recorded the mass of the flask and plant shoot before tying the plastic bag around the plant shoot
- removed the bag after 2 hours and recorded the mass again.

- (i) What mass of water would be lost from the plant shoot in 2 hours?

Draw a ring around the correct answer.

0.3 g **1.9 g** **3.9 g**

(1)

(ii) Give a reason for your answer to part (c)(i).

.....
.....
.....

(1)
(Total 12 marks)

40

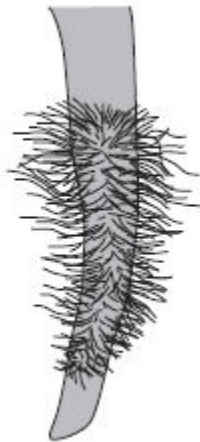
Plant roots absorb water from the soil by osmosis.

(a) What is osmosis?

.....
.....
.....
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.....

(3)

(b) The image below shows part of a plant root.



The plant root is adapted for absorbing water from the soil.

Use information from the diagram to explain how this plant root is adapted for absorbing water.

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(3)
(Total 6 marks)

41

Blood is part of the circulatory system.

(a) (i) Give **one** function of white blood cells.

.....

.....

(1)

(ii) Which of the following is a feature of platelets?

Tick (✓) **one** box.

They have a nucleus.

They contain haemoglobin.

They are small fragments of cells.

(1)

(b) Urea is transported by the blood plasma from where it is made to where the urea is excreted.

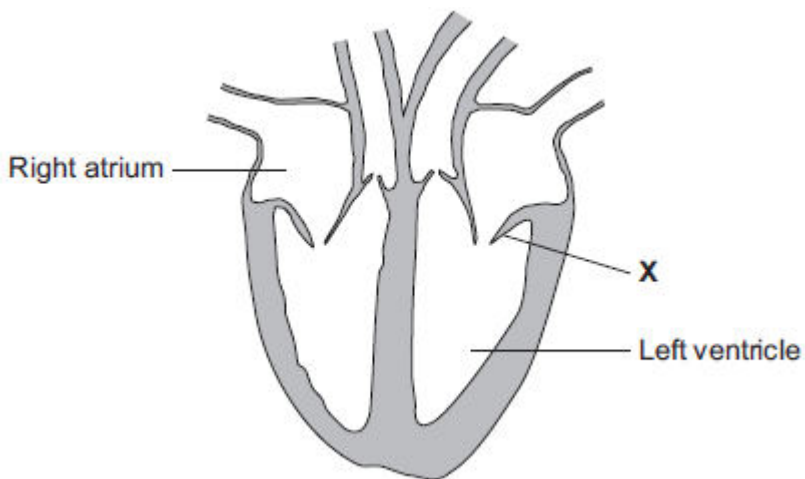
Complete the following sentence.

Blood plasma carries urea from where it is made in the

to the where the urea is removed from the blood.

(2)

(c) The illustration shows a section through the human heart.



Structure **X** is a valve. If valve **X** stops working, it may need to be replaced.

A scientist is designing a new heart valve. The scientist knows that the valve must be the correct size to fit in the heart.

Suggest **two** other factors the scientist needs to consider so that the newly designed valve works effectively in the heart.

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(2)
(Total 6 marks)

42 The leaves of most plants have stomata.

(a) (i) Name the cells which control the size of the stomata.

.....

(1)

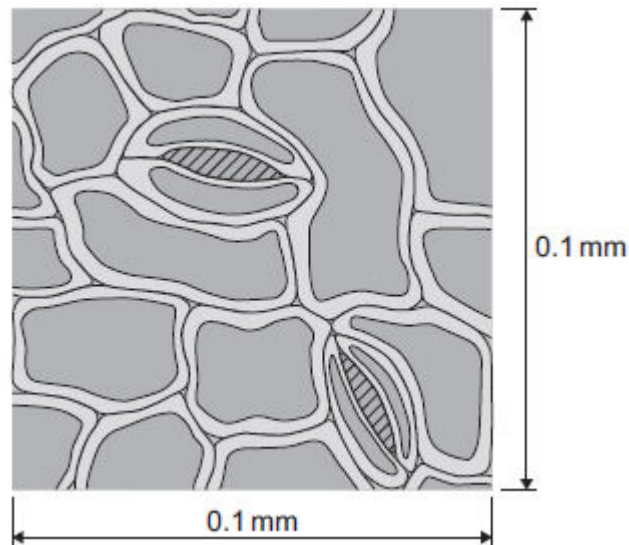
(ii) Give **one** function of stomata.

.....

.....

(1)

(b) The image below shows part of the surface of a leaf.



The length and width of this piece of leaf surface are both 0.1 mm.

(i) Calculate the number of stomata per mm^2 of this leaf surface.

.....
.....
..... per mm^2

(2)

(ii) A different plant species has 400 stomata per mm^2 of leaf surface.

Having a large number of stomata per mm^2 of leaf surface can be a disadvantage to a plant.

Give **one** disadvantage.

.....
.....

(1)

- (c) A student investigated the loss of water from plant leaves.

The student did the following:

- Step 1: took ten leaves from a plant
- Step 2: weighed all ten leaves
- Step 3: hung the leaves up in a classroom for 4 days
- Step 4: weighed all ten leaves again
- Step 5: calculated the mass of water lost by the leaves
- Step 6: repeated steps **1** to **5** with grease spread on the upper surfaces of the leaves
- Step 7: repeated steps **1** to **5** with grease spread on both the upper and lower surfaces of the leaves.

All the leaves were taken from the same type of plant.

The table below shows the student's results.

Treatment of leaves	Mass of water the leaves lost in g
No grease was used on the leaves	0.98
Grease on upper surfaces of the leaves	0.86
Grease on upper and lower surfaces of the leaves	0.01

- (i) What mass of water was lost in 4 days through the upper surfaces of the leaves?

.....

.....

Mass = g

(1)

- (ii) Very little water was lost when the lower surfaces of the leaves were covered in grease.

Explain why.

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(3)
(Total 9 marks)

43

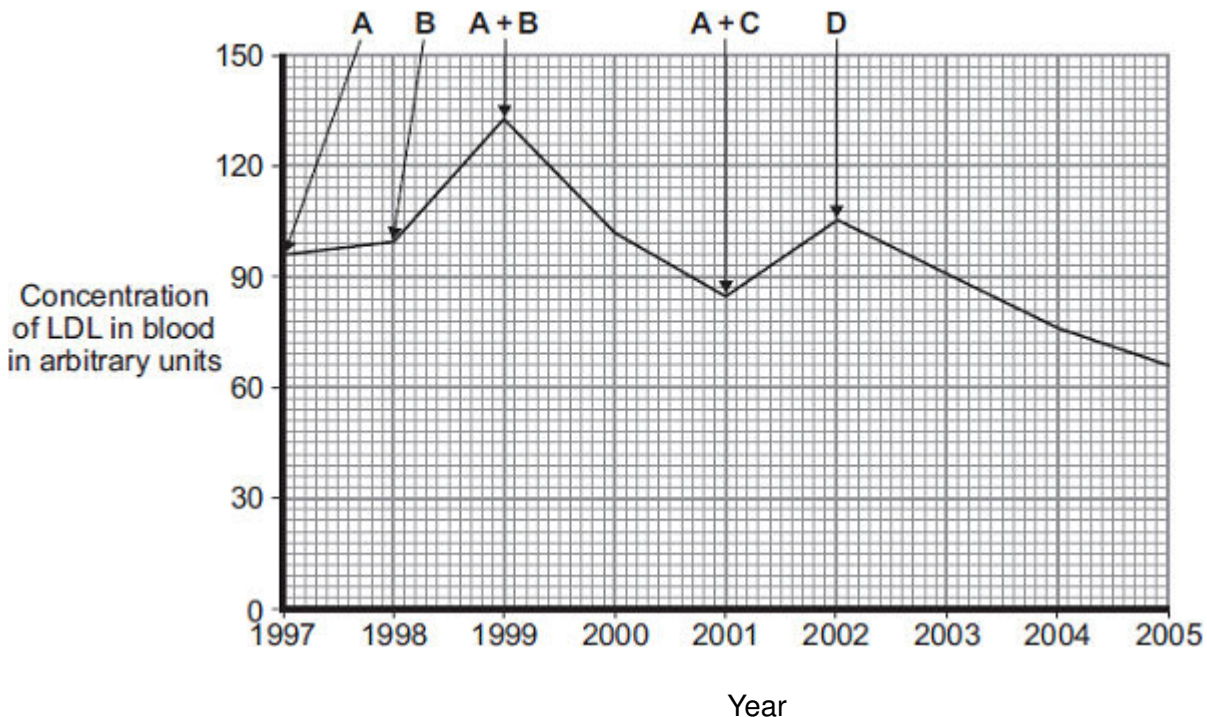
LDL is one form of cholesterol found in the blood.

People with a high concentration of LDL in their blood may be treated with drugs called statins.

A high concentration of LDL cholesterol in the blood may result in an increased risk of heart and circulatory diseases.

The graph shows the effects of the treatment of one person with four different statins, **A**, **B**, **C** and **D**, over a period of 8 years. The arrows show when each new treatment was started.

Each treatment was continued until the next treatment was started.



Compare the effectiveness of the five treatments in reducing the risk of heart and circulatory diseases for this person.

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(Total 4 marks)

44

Scientists investigated how exercise affects blood flow to different organs in the body.

The scientists made measurements of blood flow to different organs of:

- a person resting in a room at 20°C
- the same person, in the same room, doing vigorous exercise at constant speed on an exercise cycle.

The table shows the scientists' results.

Organ	Blood flow in cm ³ per minute whilst ...	
	resting	doing vigorous exercise
Brain	750	750
Heart	250	1000
Muscles	1200	22 000
Skin	500	600
Other	3100	650

(a) In this investigation, it was better to do the exercise indoors on an exercise cycle than to go cycling outdoors on the road.

Suggest **two** reasons why.

Do **not** include safety reasons.

1

.....

.....

.....

2

.....

.....

(2)

(b) Blood flow to **one** organ did **not** change between resting and vigorous exercise.

Which organ?

(1)

(c) (i) How much more blood flowed to the muscles during vigorous exercise than when resting?

.....
.....

Answer = cm³ per minute

(2)

(ii) Name **two** substances needed in larger amounts by the muscles during vigorous exercise than when resting.

1

2

(2)

(iii) Tick (✓) **one** box to complete the sentence.

The substances you named in part (c)(ii) helped the muscles to

make more lactic acid.

respire aerobically.

make more glycogen.

(1)

- (iv) The higher rate of blood flow to the muscles during exercise removed larger amounts of waste products made by the muscles.

Which **two** substances need to be removed from the muscles in larger amounts during vigorous exercise?

Tick (✓) **two** boxes.

Amino acids

Carbon dioxide

Glycogen

Lactic acid

(2)

- (d) The total blood flow was much higher during exercise than when resting.

One way to increase the total blood flow is for the heart to pump out a larger volume of blood each beat.

Give **one** other way to increase the blood flow.

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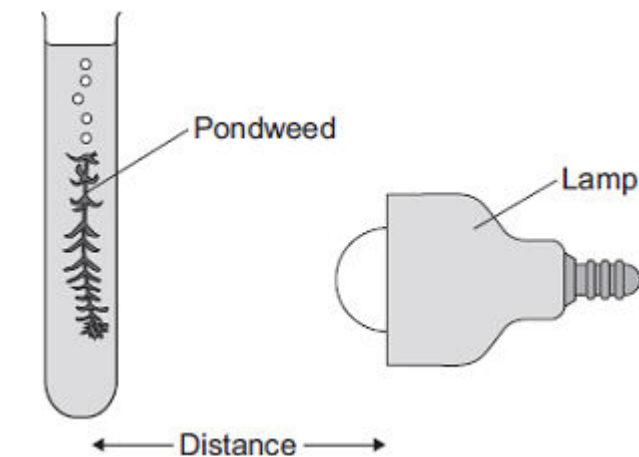
(1)
(Total 11 marks)

45

Some students investigated the effect of light intensity on the rate of photosynthesis.

They used the apparatus shown in **Diagram 1**.

Diagram 1



The students:

- placed the lamp 10 cm from the pondweed
- counted the number of bubbles of gas released from the pondweed in 1 minute
- repeated this for different distances between the lamp and the pondweed.

(a) The lamp gives out heat as well as light.

What could the students do to make sure that heat from the lamp did **not** affect the rate of photosynthesis?

.....
.....

(1)

- (b) The table shows the students' results.

Distance in cm	Number of bubbles per minute
10	84
15	84
20	76
40	52
50	26

- (i) At distances between 15 cm and 50 cm, light was a limiting factor for photosynthesis.

What evidence is there for this in the table?

.....
.....

(1)

- (ii) Give **one** factor that could have limited the rate of photosynthesis when the distance was between 10 cm and 15 cm.

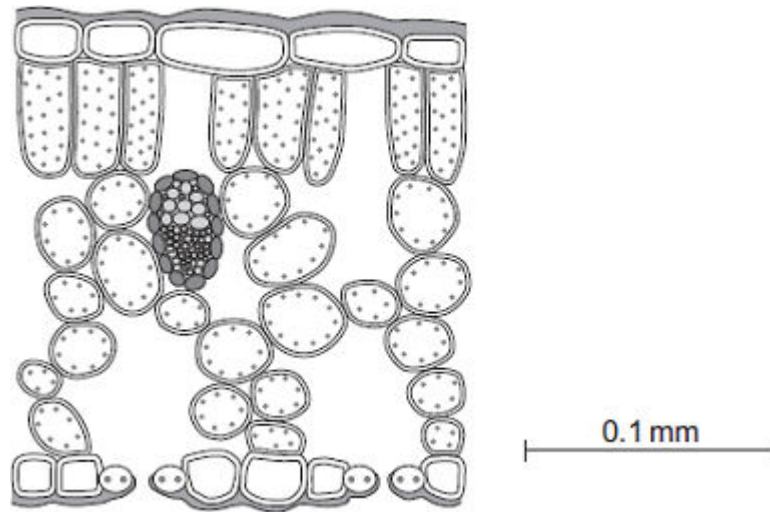
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(1)

- (c) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Diagram 2 shows a section through a plant leaf.

Diagram 2



Describe the structure of the leaf and the functions of the tissues in the leaf.

You should use the names of the tissues in your answer.

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(6)
(Total 9 marks)

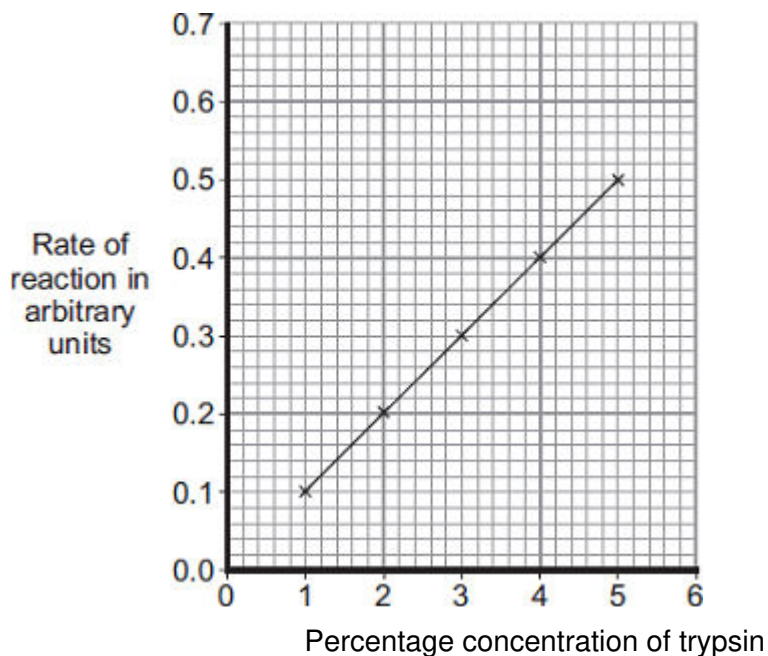
46

Trypsin is a protease enzyme. Trypsin will digest a protein called gelatine which covers the surface of photographic film.

Some students investigated the time taken to digest the gelatine with trypsin. The students used five different concentrations of trypsin.

The rate of reaction was calculated from the time taken for the gelatine to be digested.

The graph shows the students' results.



(a) (i) Describe the relationship between the concentration of trypsin and the rate of reaction.

.....

.....

.....

.....

(2)

(ii) Use the graph to predict the rate of reaction with 6% trypsin.

..... arbitrary units

(1)

- (b) In industry, trypsin is used to pre-treat some baby foods.
In their experiment, the students used 1–5% trypsin at 20°C.
The baby food manufacturers make most profit if they use 0.5% trypsin at 35°C.

Suggest why the manufacturers make most profit with these conditions.

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(4)

- (c) (i) Describe the effect trypsin would have on the baby food.

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(2)

- (ii) Apart from protease enzymes, give **one** other use of a **named** enzyme in industry.

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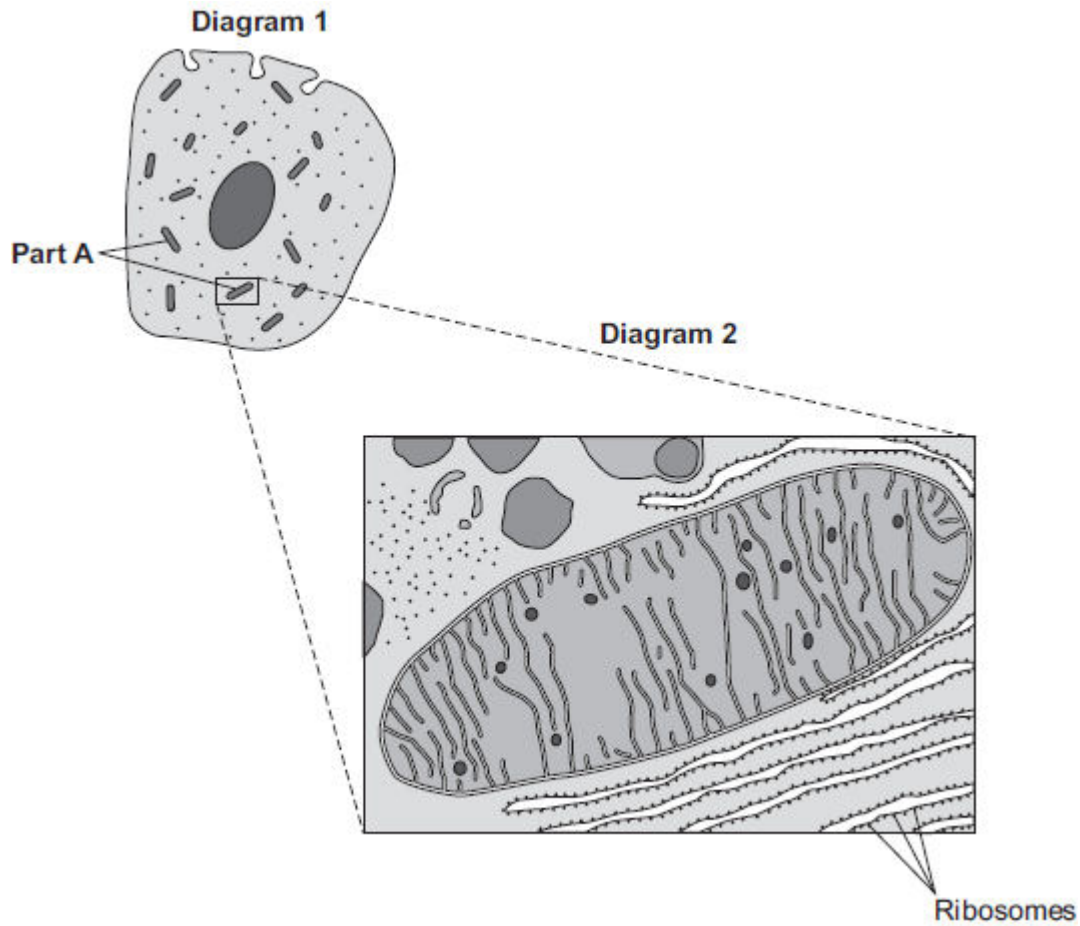
(2)

(Total 11 marks)

47

Diagram 1 shows a cell from the pancreas.

Diagram 2 shows part of the cell seen under an electron microscope.



Part **A** is where most of the reactions of aerobic respiration happen.

(a) (i) Name part **A**.

.....

(1)

(ii) Complete the equation for aerobic respiration.



(2)

(iii) Part **A** uses oxygen.

Explain how oxygen passes from the blood to part **A**.

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(3)

(b) The pancreas cell makes enzymes.

Enzymes are proteins.

Describe how the ribosomes and part **A** help the cell to make enzymes.

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(3)

(Total 9 marks)

48

Scientists have produced many different types of GM (genetically modified) food crops.

(a) Use words from the box to complete the sentence about genetic engineering.

clones	chromosomes	embryos	genes
---------------	--------------------	----------------	--------------

GM crops are produced by cutting out of the
 of one plant and inserting them into the cells of a crop plant.

(2)

(b) Read the information about GM food crops.

- Herbicide-resistant GM crops produce higher yields.
- Scientists are uncertain about how eating GM food affects our health.
- Insect-resistant GM crops reduce the total use of pesticides.
- GM crops might breed naturally with wild plants.
- Seeds for a GM crop can only be bought from one manufacturer.
- The numbers of bees will fall in areas where GM crops are grown.

Use this information to answer these questions.

(i) Give **two** reasons why some farmers are in favour of growing GM crops.

1

.....

2

.....

(2)

(ii) Give **two** reasons why many people are against the growing of GM crops.

1

.....

2

.....

(2)

(Total 6 marks)

49

Diabetes is a disease in which the concentration of glucose in a person's blood may rise to fatally high levels.

Insulin controls the concentration of glucose in the blood.

(a) Where is insulin produced?

Draw a ring around **one** answer.

gall bladder

liver

pancreas

(1)

(b) People with diabetes may control their blood glucose by injecting insulin.

(i) If insulin is taken by mouth, it is digested in the stomach.

What type of substance is insulin?

Draw a ring around **one** answer.

carbohydrate

fat

protein

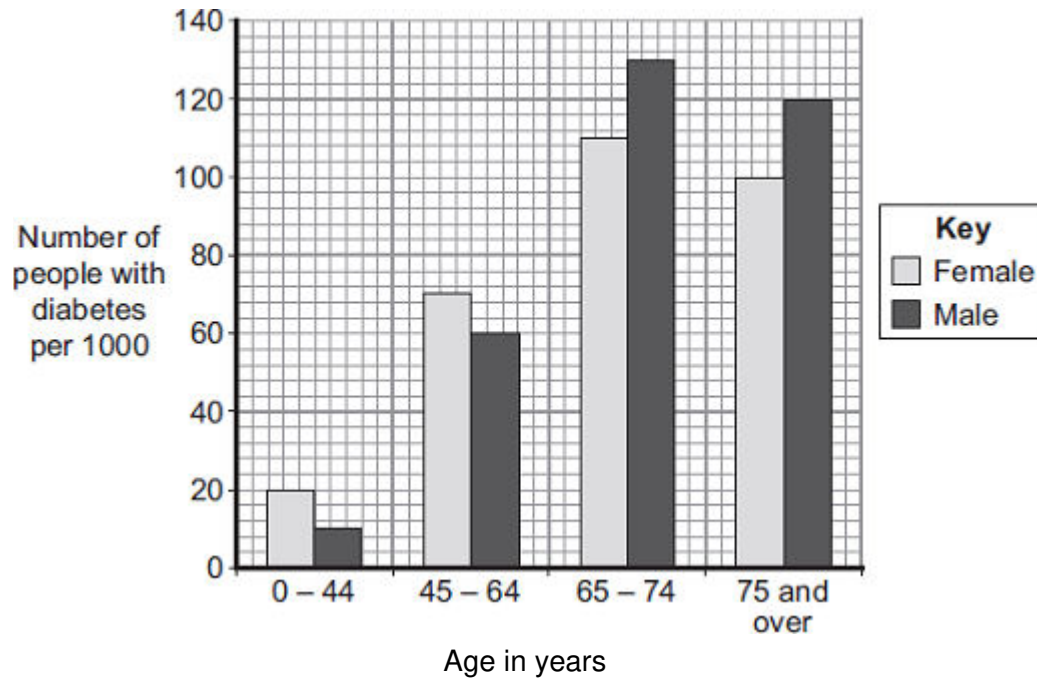
(1)

(ii) Apart from using insulin, give **one** other way people with diabetes may reduce their blood glucose.

.....

(1)

(c) The bar chart shows the number of people with diabetes in different age groups in the UK.



(i) Describe how the number of males with diabetes changes between the ages of 0 – 44 years and 75 years and over.

.....

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(3)

(ii) Compare the number of males and females with diabetes:

between the ages of 0 and 64 years

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.....
.....

over the age of 65 years.

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.....
.....

(2)
(Total 8 marks)

50

Denim jeans can be coloured with blue dye. The dye joins onto the fibres of the material. Some people like their denim jeans to look faded. The faded look is called 'stonewashed'. There are two different ways to make denim material look faded.

Traditional stonewashing

- Denim material is put in a slowly spinning container with large stones.
- Very hot water is added.
- Washing takes up to five hours.
- Washing breaks some of the fibres and lets the dye come out from the fibres.
- Washing will work with any dye.

Bio-stonewashing

- Denim material is washed with enzymes in warm water.
- Washing takes half an hour.
- The enzymes let the dye come out from the fibres.
- Different enzymes are needed for different dyes.
- The enzymes are expensive.
- After treatment the enzymes have to be removed from the denim.

(a) Use **only** the information above to answer these questions.

(i) Suggest **two** advantages of using the bio-stonewashing method instead of the traditional stonewashing method.

1.....

 2.....

(2)

(ii) Suggest **two** disadvantages of using the bio-stonewashing method instead of the traditional stonewashing method.

1.....

 2.....

(2)

(b) Some blue dyes are made of protein.

What type of enzyme would be used to remove these blue dyes from denim?

Draw a ring around **one** answer.

carbohydrase

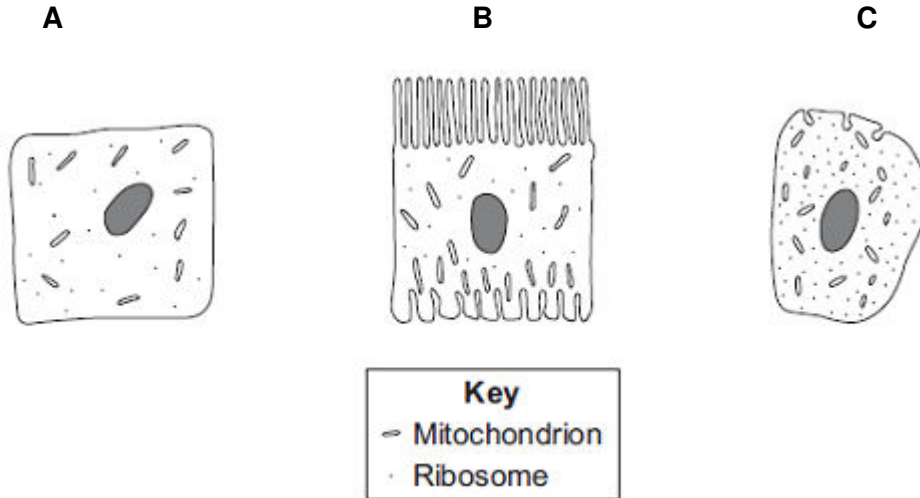
lipase

protease

(1)
(Total 5 marks)

51

Diagrams **A**, **B** and **C** show cells from different parts of the human body, all drawn to the same scale.



(a) Which cell, **A**, **B** or **C**, appears to be best adapted to increase diffusion into or

out of the cell?

Give **one** reason for your choice.

.....
.....

(1)

(b) (i) Cell **C** is found in the salivary glands.

Name the enzyme produced by the salivary glands.

.....

(1)

(ii) Use information from the diagram to explain how cell **C** is adapted for producing this enzyme.

.....

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.....

.....

(2)
(Total 4 marks)

52

Fresh milk is a mixture of compounds including lipid, protein and about 5% lactose sugar.

Lactose must be digested by the enzyme lactase, before the products can be absorbed.

Lactase can be added to fresh milk to pre-digest the lactose. This makes 'lactose-free' milk, which is suitable for people who do not produce enough lactase of their own.

A student investigated the effect of changing pH and temperature on the digestion of lactose in milk.

The results are shown in **Tables 1** and **2**.

Table 1
Effect of pH

pH	Time taken to digest lactose in minutes
4.0	20
5.0	18
6.0	13
7.0	7
8.0	5
9.0	6

Table 2
Effect of temperature

Temperature in °C	Time taken to digest lactose in minutes
25	20
30	14
35	11
40	6
45	29
50	No digestion

(a) The label on a carton of lactose-free milk states:

'Lactase is normally produced in the stomach of mammals.'

The results in **Table 1** suggest that this statement is **not** true.

Explain how.

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.....

.....

(2)

(b) Explain, as fully as you can, the results shown in **Table 2** .

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(3)

(c) Bile is produced in the liver and is released into the small intestine.

Bile helps the digestion of lipid in the milk.

Describe how.

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(2)

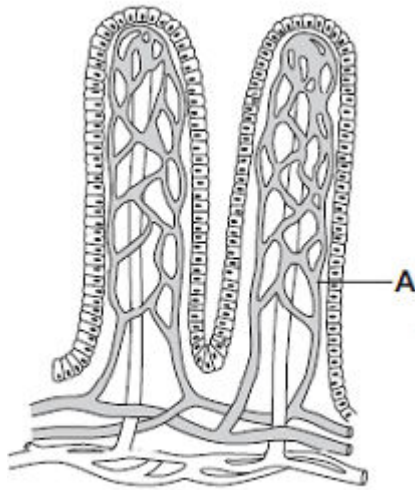
(Total 7 marks)

53

Villi are found in some parts of the digestive system.

Diagram 1 shows two villi.

Diagram 1



(a) Draw a ring around the correct answer to complete each sentence.

(i) Structure **A** is a

muscle.

nerve.

capillary.

(1)

(ii) The villi absorb the products of digestion by

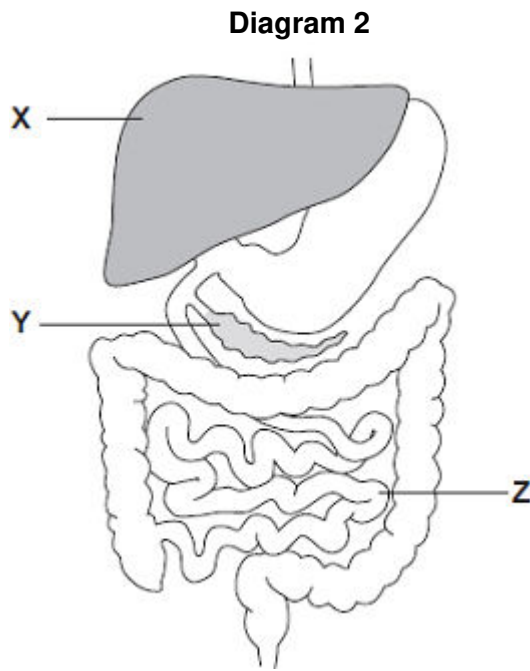
dialysis.

diffusion.

osmosis.

(1)

(b) **Diagram 2** shows the digestive system.



(i) In which part of the digestive system, **X**, **Y** or **Z**, are most villi found?

(1)

(ii) There are about 2000 villi in each cm² of this part of the digestive system.

Why is it helpful to have lots of villi?

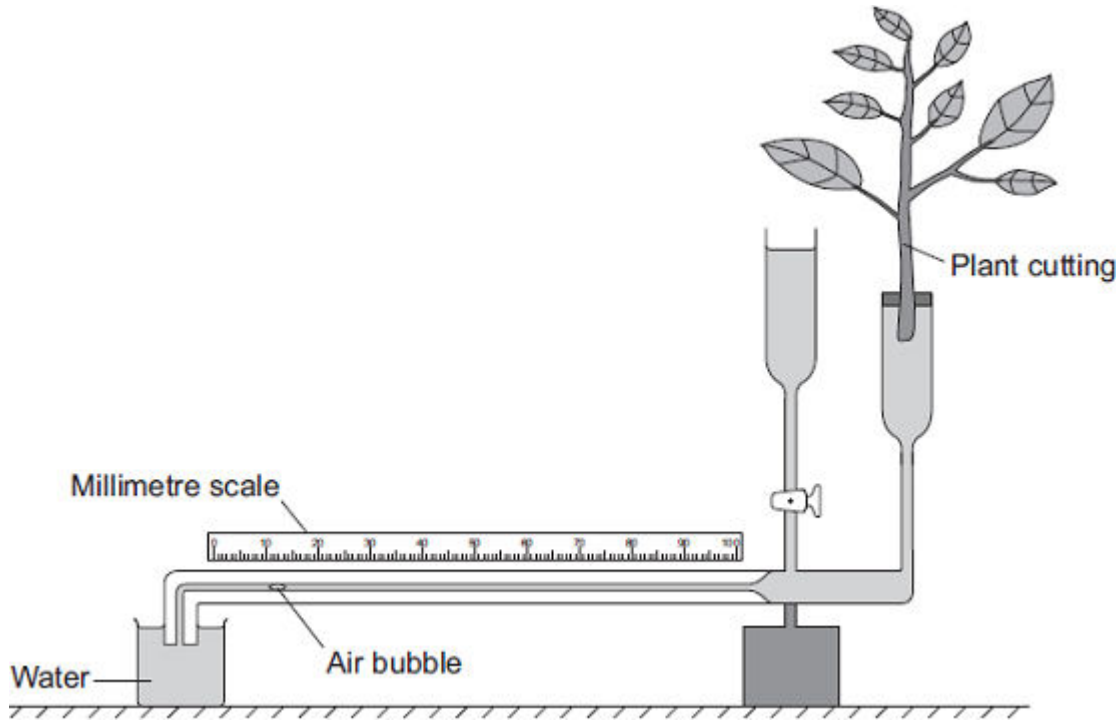
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.....

(1)
(Total 4 marks)

54

Some students used the apparatus shown in the diagram to measure the rate of water uptake by a plant cutting.



The students set up the apparatus in three different conditions:

- no wind at 15°C
- no wind at 25°C
- wind at 25°C

For each experiment, the students recorded the movement of the air bubble along the scale.

(a) (i) Name the **two** variables the students chose to change in these experiments.

- 1
- 2

(2)

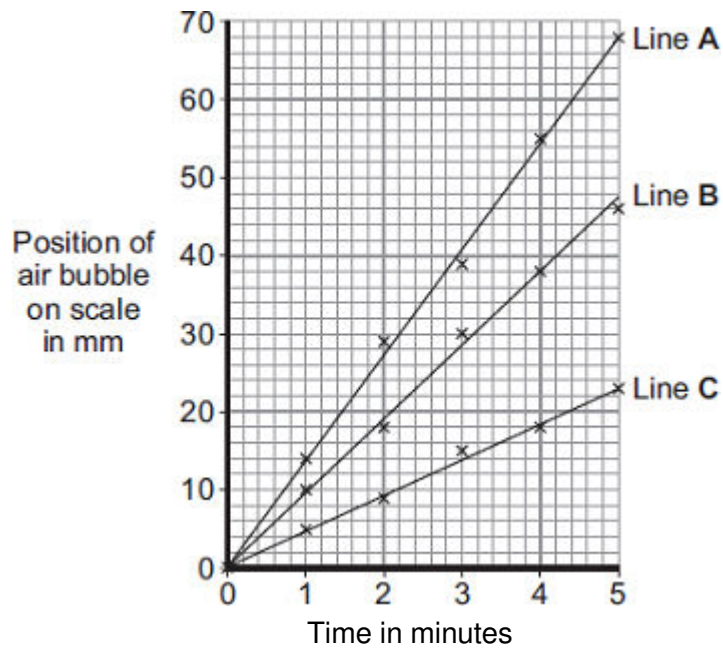
(ii) It was important to use the same plant cutting each time to make these experiments fair.

Explain why.

-
-

(1)

(b) The graph shows the students' results.



Which line on the graph, **A**, **B** or **C**, shows the results for each of the three different experiments?

Write each of the letters, **A**, **B** and **C**, in the correct boxes in the table.

Conditions	Letter
No wind at 15°C	
No wind at 25°C	
Wind at 25°C	

(2)

(c) Water is lost from the leaves of the plant cutting.

Name this process.

Draw a ring around **one** answer.

distillation

respiration

transpiration

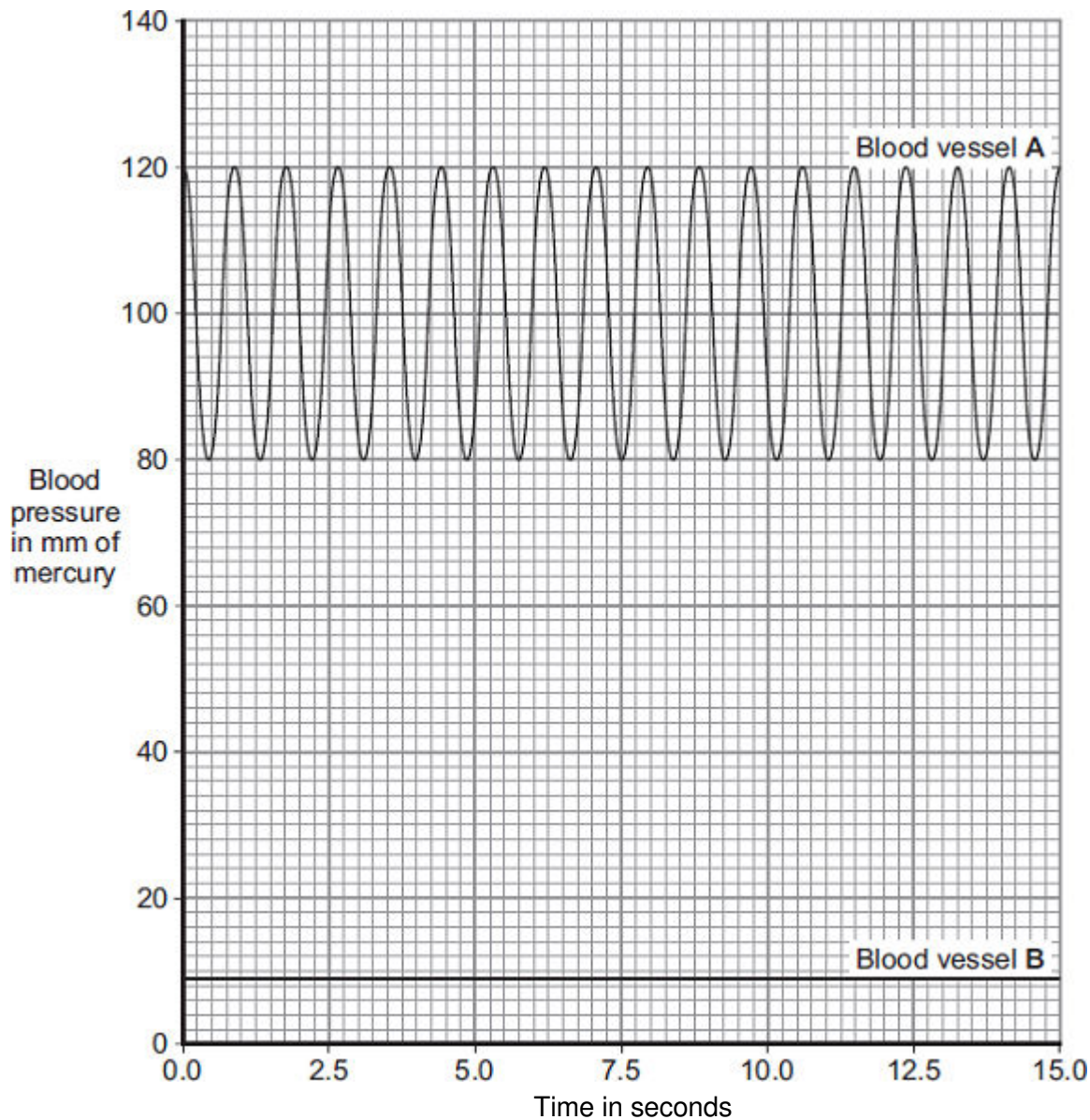
(1)

(Total 6 marks)

55

The heart pumps the blood around the body. This causes blood to leave the heart at high pressure.

The graph shows blood pressure measurements for a person at rest. The blood pressure was measured in an artery and in a vein.



(a) Which blood vessel, **A** or **B**, is the artery?

Blood vessel

Give **two** reasons for your answer.

Reason 1

.....

Reason 2

.....

(2)

(b) Use information from the graph to answer these questions.

(i) How many times did the heart beat in 15 seconds?

(1)

(ii) Use your answer from part (b)(i) to calculate the person's heart rate per minute.

.....

.....

Heart rate = beats per minute

(1)

(c) During exercise, the heart rate increases.

The increased heart rate supplies useful substances to the muscles at a faster rate.

Name **two** useful substances that must be supplied to the muscles at a faster rate during exercise.

1

2

(2)

(Total 6 marks)