A

AQA

Surname _____

Forename(s) _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: SYNERGY

F

Foundation Tier

Paper 2 Life and Environmental Sciences

8465/2F

Thursday 25 May 2023 Morning

Time allowed: 1 hour 45 minutes

At the top of the page, write your surname and forename(s), your centre number, your candidate number and add your signature.

[Turn over]

JUN238465 2F 01

MATERIALS
For this paper you must have:

- **a ruler**
- **a protractor**
- **a scientific calculator**
- **the periodic table (enclosed)**
- **the Physics Equations Sheet (enclosed).**

INSTRUCTIONS

- **Use black ink or black ball-point pen. Pencil should only be used for drawing.**
- **Answer ALL questions in the spaces provided. Do not write on blank pages.**
- **If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).**
- **Do all rough work in this book. Cross through any work you do not want to be marked.**
- **In all calculations, show clearly how you work out your answer.**

INFORMATION

- **The maximum mark for this paper is 100.**
- **The marks for questions are shown in brackets.**
- **You are expected to use a calculator where appropriate.**
- **You are reminded of the need for good English and clear presentation in your answers.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

0 1

Bees feed on sugar solution produced by the flowers of plants.

FIGURE 1 shows a bee feeding on a flower.

FIGURE 1

0 1 . 1

Why do bees feed on sugar solution? [1 mark]

Tick (✓) ONE box.

- ☐ **For gaseous exchange**
- ☐ **To obtain energy**
- ☐ **To provide proteins**

[Turn over]

Bees have a simple nervous system.

The bee nervous system has many similar features to the human nervous system.

0 1 . 2

The antenna is a sense organ.

The antenna contains specialised cells that detect stimuli.

What are cells that detect stimuli called? [1 mark]

Tick (✓) ONE box.

- ☐ **Coordinators**
- ☐ **Effectors**
- ☐ **Receptors**

0 1 . 3

When an antenna of a bee touches sugar solution the bee automatically sticks out its tongue.

What type of action is automatic? [1 mark]

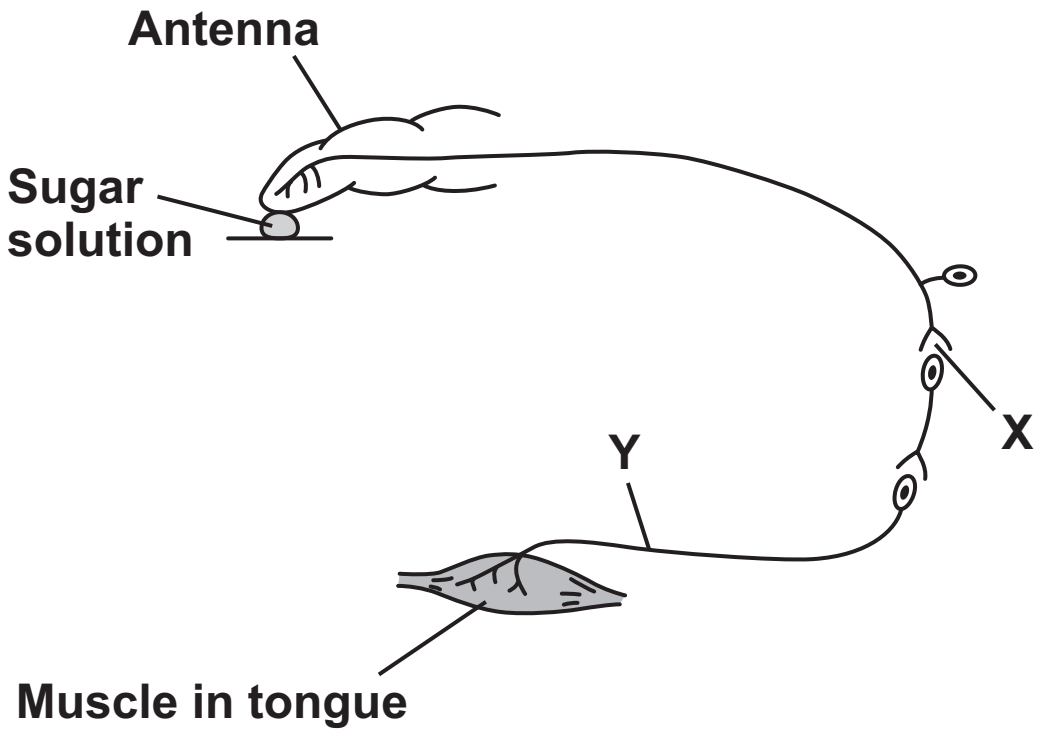
Tick (✓) ONE box.

- ☐ **A conscious action**
- ☐ **A delayed action**
- ☐ **A reflex action**

[Turn over]

FIGURE 2 shows the nervous pathway taken when a bee antenna touches sugar solution.

FIGURE 2



0 1 . 4

What is the gap labelled X? [1 mark]

Tick (✓) ONE box.

☐ **A gland**

☐ **A synapse**

☐ **An impulse**

0 1 . 5

What type of neurone is Y? [1 mark]

Tick (✓) ONE box.

- ☐ **Motor neurone**
- ☐ **Relay neurone**
- ☐ **Sensory neurone**

[Turn over]

Eyes are sense organs that can detect electromagnetic radiation.

A bee's eye can detect ultraviolet radiation.

0 1 . 6

Detecting ultraviolet radiation allows the bee to see the parts of the flower that produce sugar solution.

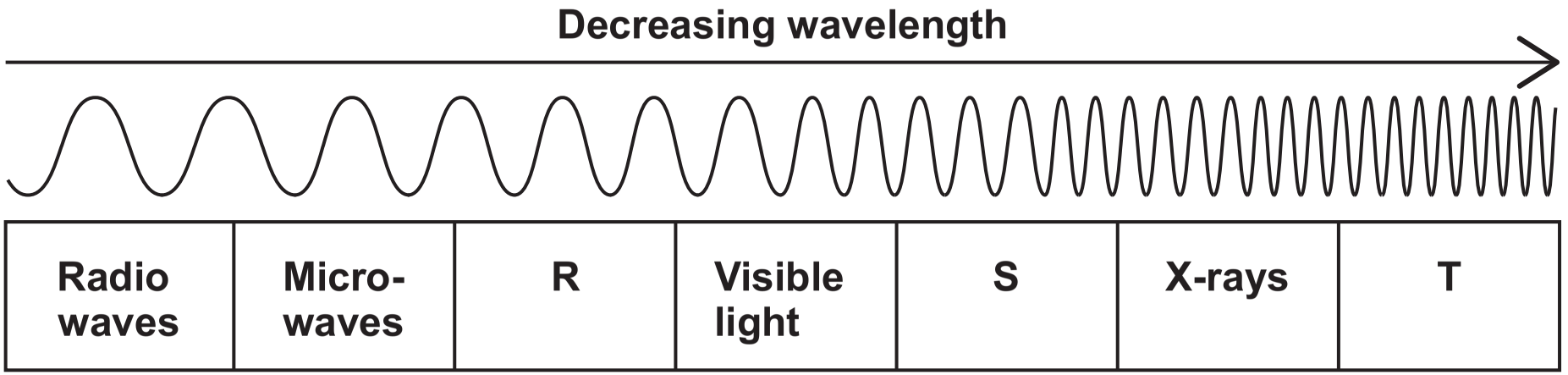
Why is it an advantage for bees to see the parts of the flower that produce sugar solution? [1 mark]

BLANK PAGE

[Turn over]

FIGURE 3 shows the electromagnetic spectrum.

FIGURE 3



0 1 . 7

Which letter shows the position of ultraviolet radiation in the electromagnetic spectrum? [1 mark]

Tick (✓) ONE box.

- ☐ **R**
- ☐ **S**
- ☐ **T**

[Turn over]

0 1 . 8

Which part of the electromagnetic spectrum in FIGURE 3, on page 12, has the lowest frequency?
[1 mark]

_____

_____

8

0 2

The orca is a large animal that lives in the ocean.

FIGURE 4 shows an orca.

FIGURE 4

0 2 . 1

Complete the sentence.

Choose the answer from the list. [1 mark]

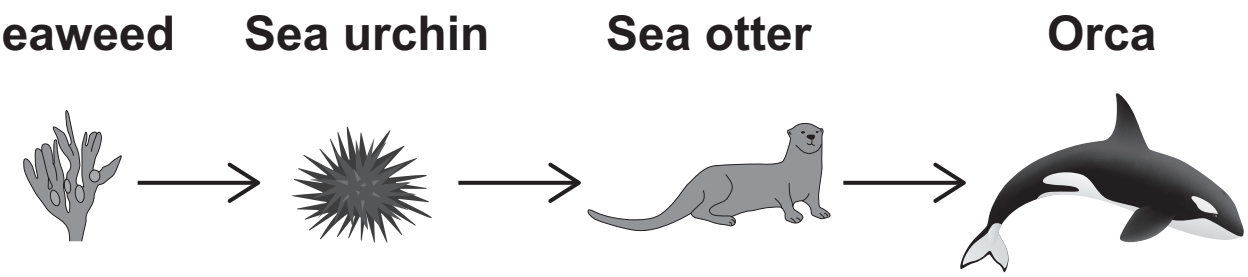
COMMUNITY HABITAT POPULATION

The ocean is the orca's _____ .

[Turn over]

FIGURE 5 shows a food chain.

FIGURE 5



0 2 . 2

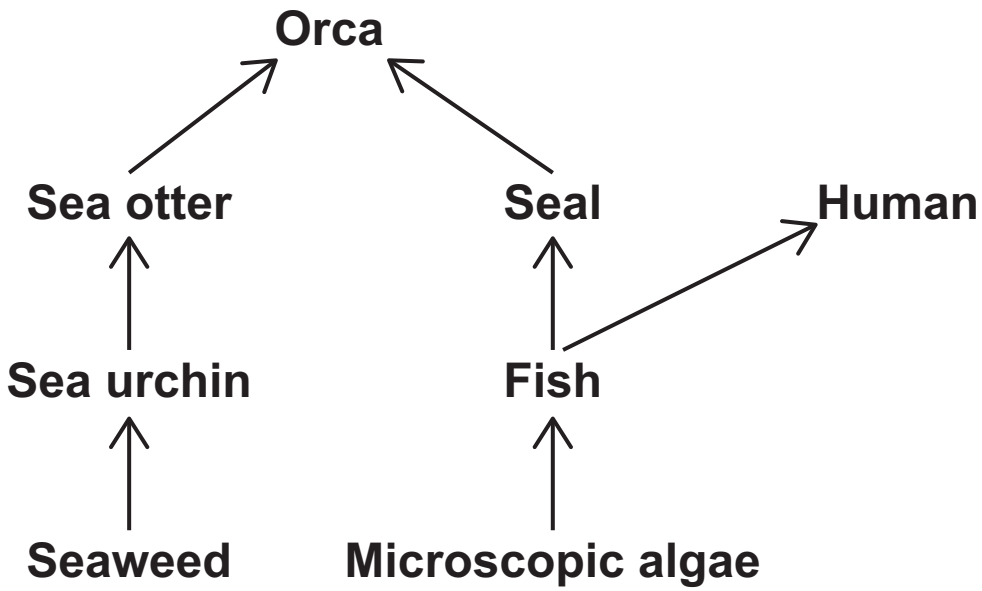
Draw ONE line from each organism to the description of that organism in the food chain.

Use information from FIGURE 5. [3 marks]

ORGANISM	DESCRIPTION
Orca	Primary consumer
Sea otter	Producer
Seaweed	Secondary consumer
	Tertiary consumer

FIGURE 6 shows a food web.

FIGURE 6



[Turn over]

0 2 . 3

Seaweed and microscopic algae photosynthesise.

Give TWO factors that affect the rate of photosynthesis. [2 marks]

1 _____

_____

_____

2 _____

_____

_____

The number of fish in the oceans has decreased since 1990.

0 2 . 4

Suggest ONE way that human activity has caused the decrease in the number of fish. [1 mark]

_____

_____

_____

0 2 . 5

Explain how a decrease in the number of fish could affect the numbers of other organisms in the food web.

Use FIGURE 6 on page 17. [6 marks]

13

0 3

Pollutants in the atmosphere can be harmful to the environment and to human health.

Four pollutants in the atmosphere are:

- **carbon monoxide**
- **oxides of nitrogen**
- **particulates**
- **sulfur dioxide.**

0 3 . 1

How is carbon monoxide produced? [1 mark]

Tick (✓) ONE box.

☐ **By carbon dioxide dissolving in water**

☐ **From the incomplete combustion of hydrocarbon fuels**

☐ **When carbonates form sedimentary rocks**

[Turn over]

0 3 . 2

What is formed when sulfur dioxide dissolves in moisture in the air? [1 mark]

Tick (✓) ONE box.

- ☐ **Acid rain**
- ☐ **Methane**
- ☐ **Ozone**

0 3 . 3

Complete the sentence. [1 mark]

Oxides of nitrogen are produced when fuels are burnt in air at a high _____ .

0 3 . 4

Give ONE way that oxides of nitrogen can be harmful to human health. [1 mark]

_____

_____

_____

Particulates are classified into different groups depending on the diameter of the particulate.

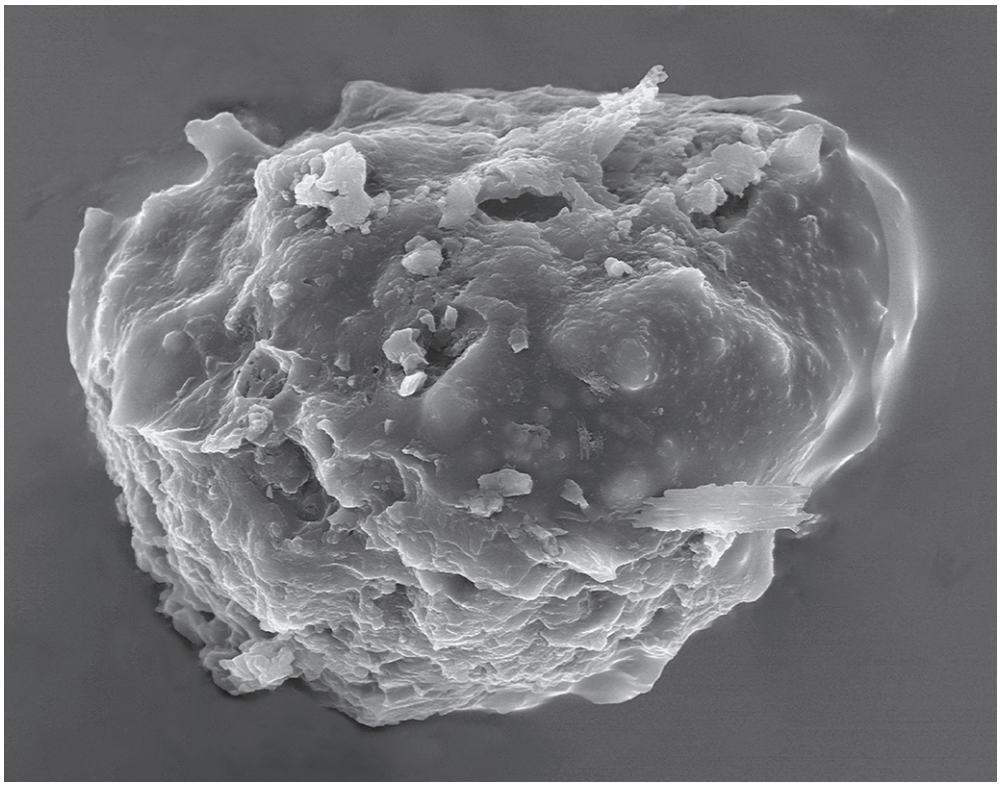
TABLE 1 shows information about the different groups.

TABLE 1

PARTICULATE GROUP	PARTICULATE DIAMETER IN MICROMETRES
PM_{10}	Less than 10 and more than 2.5
$PM_{2.5}$	Less than 2.5 and more than 0.1
$PM_{0.1}$	Less than 0.1

FIGURE 7 shows a soot particle viewed using an electron microscope.

FIGURE 7



0 3 . 5

The diameter of the soot particle in FIGURE 7, on page 24, is 1.5 micrometres.

Which particulate group does the soot particle belong to? [1 mark]

Use TABLE 1.

Tick (✓) ONE box.

☐ **PM_{10}**

☐ **$PM_{2.5}$**

☐ **$PM_{0.1}$**

0 3 . 6

Why is an electron microscope and NOT a light microscope used to view the soot particle? [1 mark]

_____

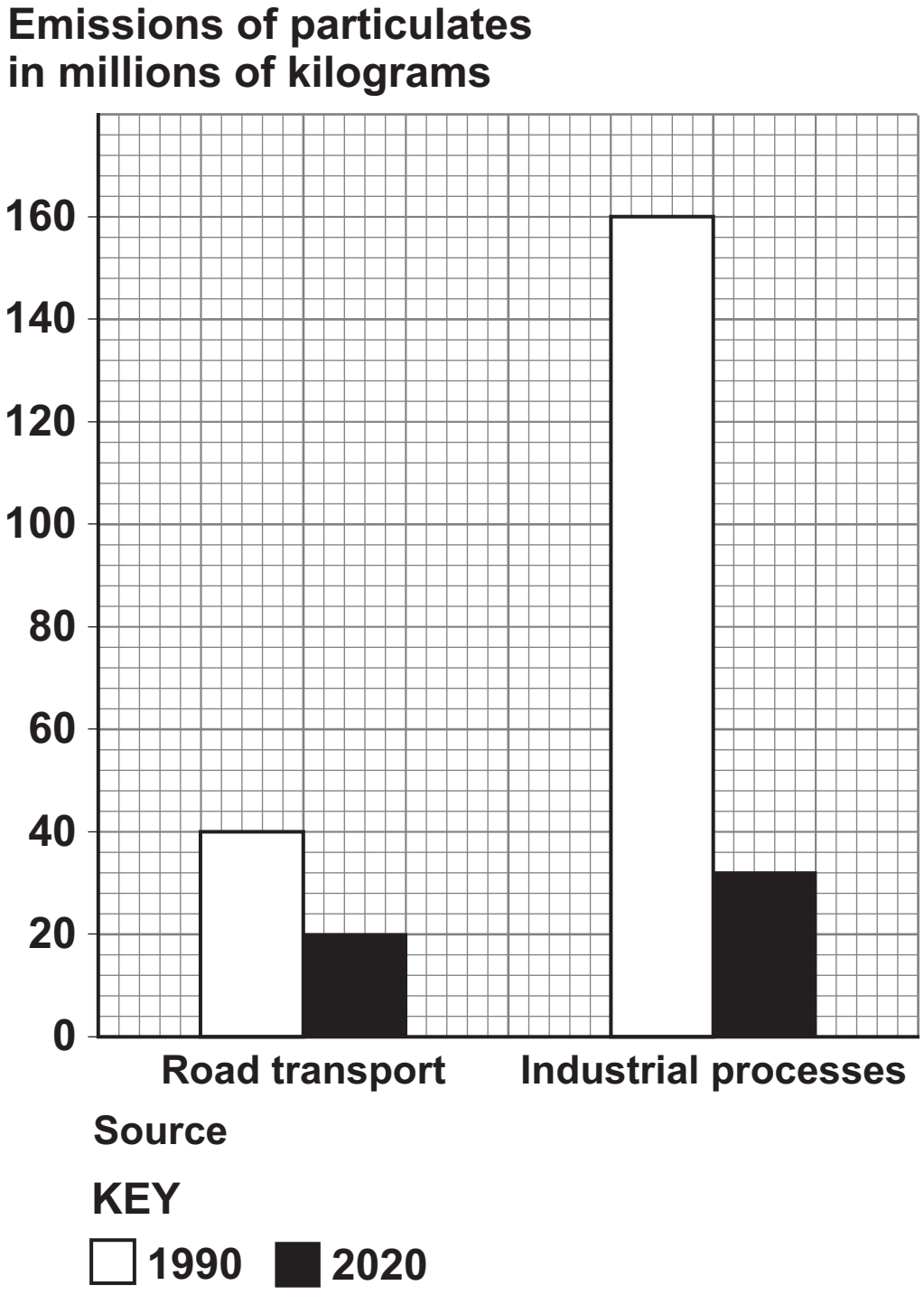
_____

_____

[Turn over]

FIGURE 8 shows the emissions of particulates from two different sources in 1990 and in 2020.

FIGURE 8



0 3 . 7

Determine the difference between the emission of particulates from industrial processes and the emission of particulates from road transport in 1990.

Use FIGURE 8, on page 26. [3 marks]

Emission of particulates from industrial processes =

_____ millions of kilograms

Emission of particulates from road transport =

_____ millions of kilograms

Difference in emissions of particulates in 1990 =

_____ millions of kilograms

[Turn over]

0 3 . 8

Give THREE conclusions from FIGURE 8 on page 26.
[3 marks]

1 _____

_____

_____

2 _____

_____

_____

3 _____

_____

_____

0 3 . 9

Particulates can be harmful to people's health when breathed in.

Large particulates are prevented from getting into the lungs by the body's defences.

Complete the sentences.

Choose answers from the list. [2 marks]

ACIDS	**CILIA**	**ENZYMES**
MUCUS	**SAP**	

The cells in the trachea and bronchi produce sticky

_____ .

The particulates are moved away from the lungs using

_____ . 14

[Turn over]

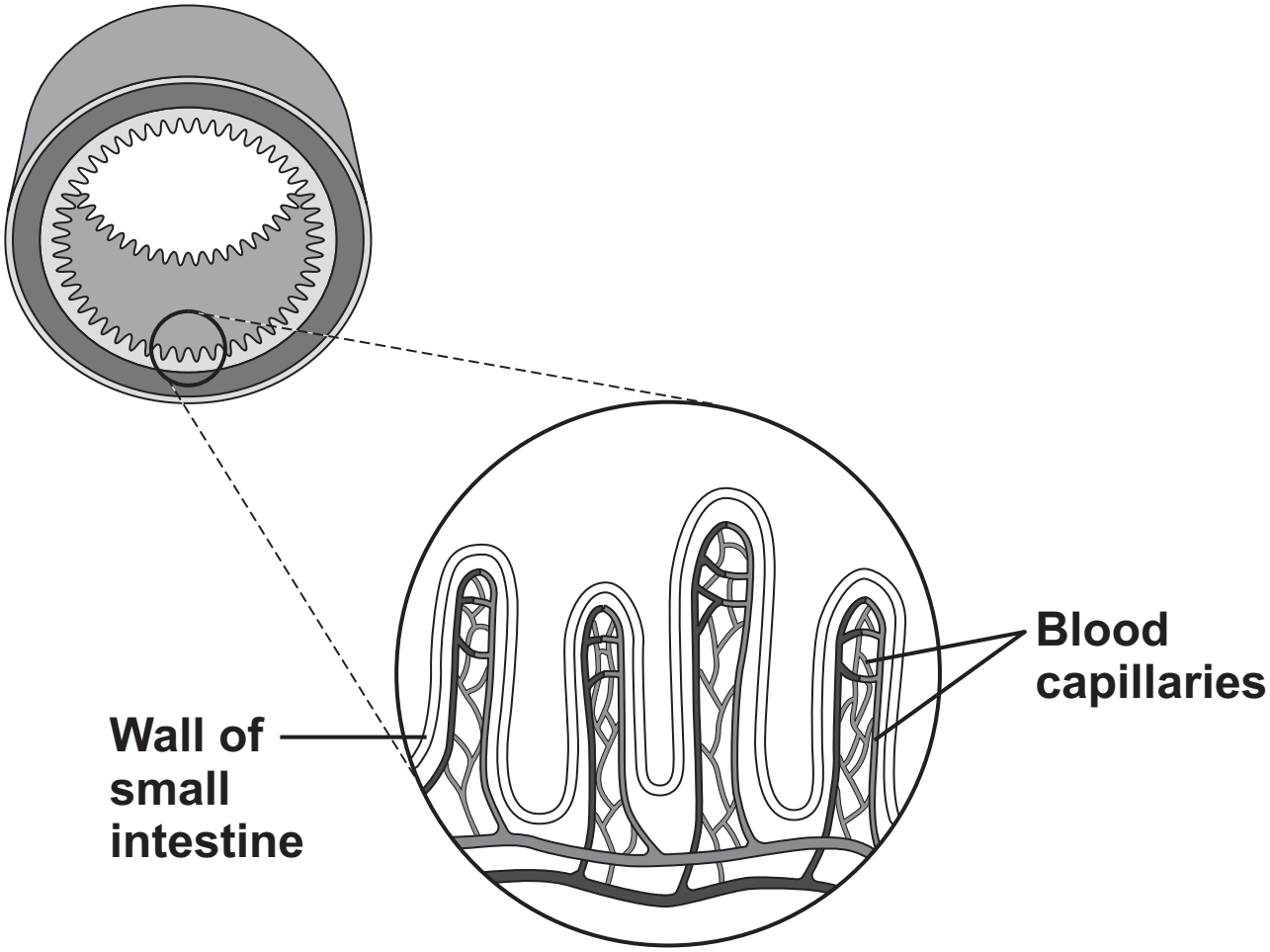
0 4

Starch molecules are broken down into glucose molecules in the small intestine (gut).

The glucose molecules are absorbed across the wall of the small intestine into the blood.

FIGURE 9 shows part of the wall of the small intestine.

FIGURE 9



0 4 . 1

Give TWO ways that the small intestine is adapted for the absorption of glucose into the blood.

Use FIGURE 9, on page 30. [2 marks]

1 _____

_____

_____

2 _____

_____

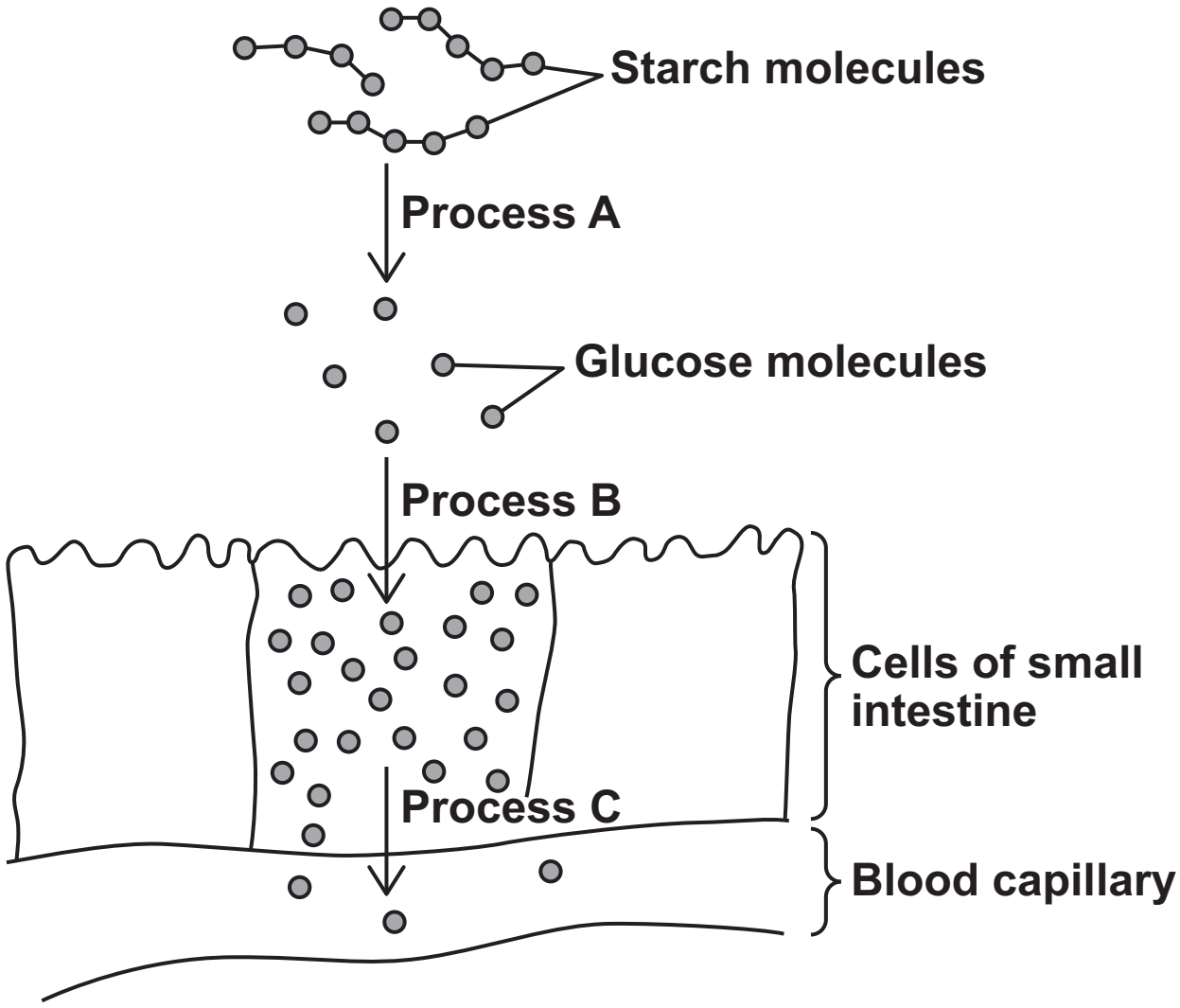
_____

[Turn over]

FIGURE 10 shows:

- **the breakdown of starch molecules**
- **the movement of glucose molecules across the wall of the small intestine.**

FIGURE 10



0 4 . 2

Look at processes A, B and C in FIGURE 10, on page 32.

Complete the sentences.

Choose answers from the list. [3 marks]

ACTIVE TRANSPORT EVAPORATION

DIFFUSION DIGESTION TRANSPIRATION

In process A, starch molecules are broken down into glucose by the process of

_____ .

In process B, glucose molecules move into the cells of the small intestine by

_____ .

In process C, glucose molecules move from the cells of the small intestine into the blood by

_____ .

0 4 . 3

Give ONE reason why starch molecules CANNOT be absorbed into the blood.

Use FIGURE 10 on page 32. [1 mark]

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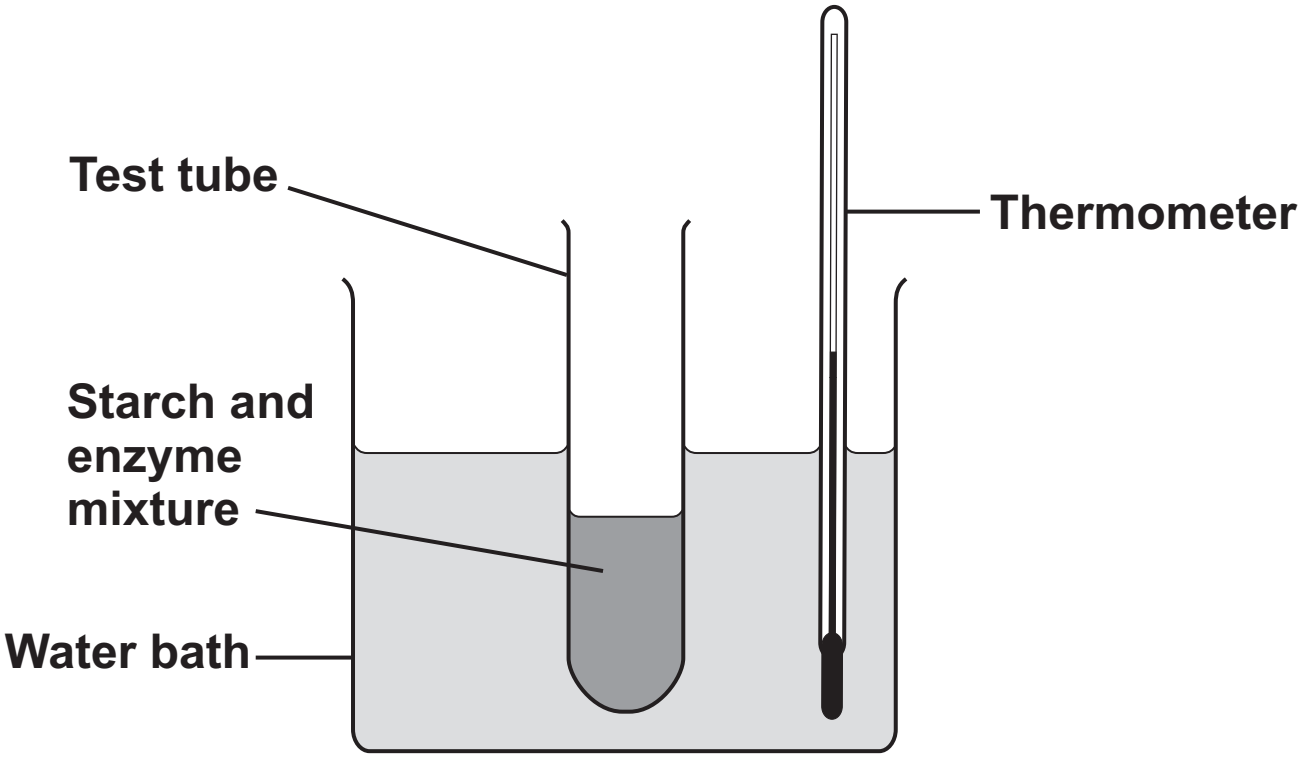
[Turn over]

A student investigated the breakdown of starch with an enzyme and without an enzyme.

FIGURE 11 shows the apparatus.

FIGURE 11



This is the method used.

1. **Add 5 cm^3 of starch and enzyme mixture to a test tube.**

2. **Place the test tube into a water bath at 37 °C.**

3. **Remove one drop of the mixture every 60 seconds and test for starch using iodine solution.**

4. **Repeat step 3 until the starch is broken down or until 20 minutes is reached.**

5. **Repeat steps 1 to 4 another three times.**

6. **Repeat steps 1 to 5 using 5 cm^3 of starch solution with no enzyme.**

[Turn over]

0 4 . 4

What colour will the iodine solution change to when starch is present? [1 mark]

Tick (✓) ONE box.

- ☐ **Black**
- ☐ **Orange**
- ☐ **Red**
- ☐ **White**

0 4 . 5

What is the dependent variable in this investigation? [1 mark]

Tick (✓) ONE box.

- ☐ **Temperature of the water bath**
- ☐ **Time taken for starch to break down**
- ☐ **Volume of the sample tested**

TABLE 2 shows the results for the starch and enzyme mixture.

TABLE 2

TEST	TIME TAKEN FOR STARCH TO BREAK DOWN IN SECONDS
1	300
2	420
3	60
4	360

[Turn over]

0 4 . 6

One of the results in TABLE 2, on page 39, is anomalous. [1 mark]

Which result is anomalous?

Tick (✓) ONE box.

☐ **300 s** ☐ **420 s**

☐ **60 s** ☐ **360 s**

0 4 . 7

What should the student do with the anomalous result? [1 mark]

_____

_____

_____

0 4 . 8

The student removed one drop of the mixture every 60 seconds and tested the drop for starch. [1 mark]

How could the student improve the method?

Tick (✓) ONE box.

- ☐ **Test for starch every 30 seconds**
- ☐ **Test for starch every 3 minutes**
- ☐ **Test for starch every 10 minutes**

[Turn over]

0 4 . 9

Another student repeated the investigation.

TABLE 3 shows the results.

TABLE 3

STARCH SOLUTION	MEAN TIME TAKEN FOR STARCH TO BREAK DOWN
With enzyme	300 seconds
With NO enzyme	Starch not broken down after 20 minutes

Give ONE conclusion that can be made from the results.
[1 mark]

_____

_____

_____

12

BLANK PAGE

[Turn over]

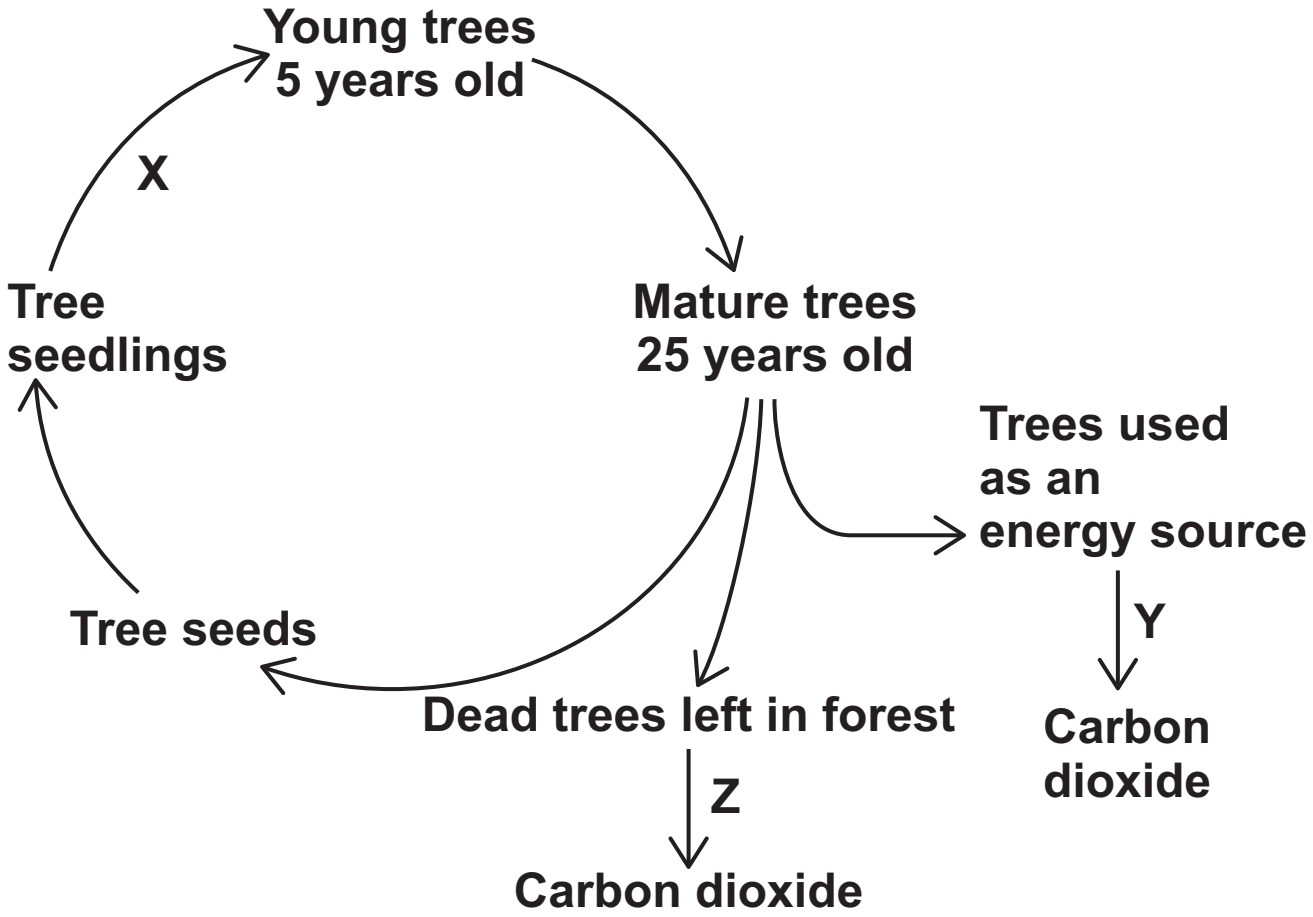
0 5

In a managed forest:

- **tree seedlings are regularly planted**
- **some trees are regularly removed.**

FIGURE 12 shows information about the managed forest.

FIGURE 12



0 5 . 1

Name the processes X, Y and Z in FIGURE 12, on page 44.

Choose answers from the list. [3 marks]

COMBUSTION **DECOMPOSITION**

EVAPORATION **FERTILISATION**

GROWTH

X _____

_____

Y _____

_____

Z _____

_____

[Turn over]

0 5 . 2

The dead trees are broken down during process Z.

What type of organism breaks down the dead trees?
[1 mark]

0 5 . 3

When dead trees are broken down:

- **carbon dioxide is released into the atmosphere**
- **mineral ions are released into the soil.**

Tree seedlings take in the carbon dioxide and the mineral ions.

Complete the sentences.

Choose answers from the list. [2 marks]

MERISTEMS	**PHLOEM**	**ROOT HAIRS**
STOMATA	**XYLEM**	

Carbon dioxide enters the tree seedlings through

_____ .

Mineral ions enter the tree seedlings through

_____ .

[Turn over]

A farmer removes some of the young trees from the managed forest every year.

0 5 . 4

Explain why removing some of the young trees allows the remaining trees to grow faster. [2 marks]

0 5 . 5

Suggest ONE advantage to the farmer if the remaining trees grow faster. [1 mark]

0 5 . 6

Explain how growing trees reduces climate change.

You should refer to carbon dioxide in your answer.
[3 marks]

[Turn over]

0 5 . 7

A scientist investigated the number of tree species in two forests in 1970 and 2000.

TABLE 4 shows the results.

TABLE 4

FOREST	NUMBER OF TREE SPECIES	
	1970	2000
A	26	24
B	28	22

Give TWO conclusions about the number of tree species in the forests in 1970 and 2000. [2 marks]

1 _____

_____

_____

2 _____

_____

_____

14

BLANK PAGE

[Turn over]

0 6

The genetic material in a cell is made of DNA.

0 6 . 1

A DNA molecule is made from two strands twisted around each other.

What scientific term describes the structure of DNA?
[1 mark]

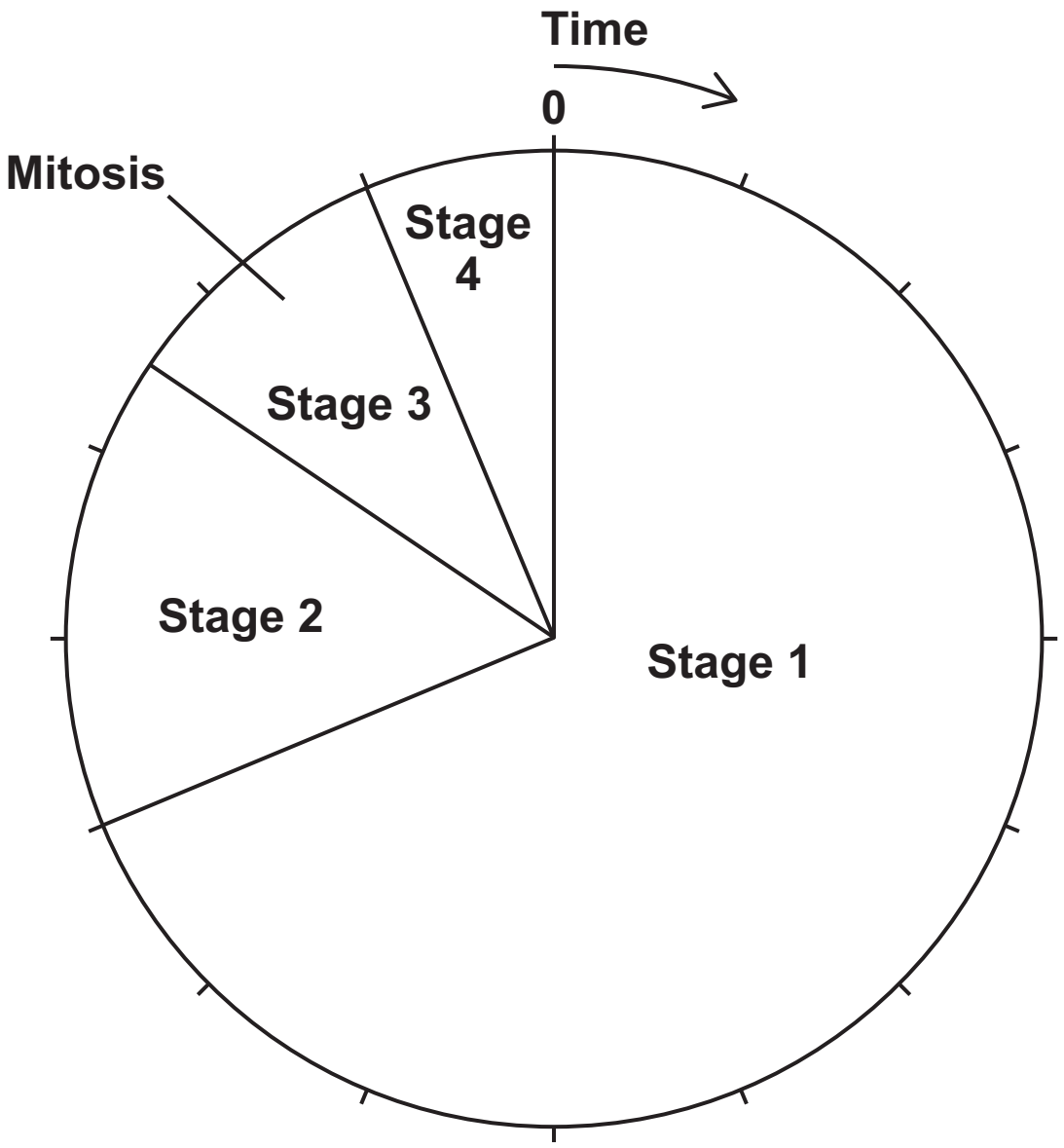
_____

_____

Cells divide in a series of stages called the cell cycle.

FIGURE 13 shows a cell cycle for a human cell.

FIGURE 13



[Turn over]

0 6 . 2

What happens during the mitosis stage of the cell cycle? [1 mark]

Tick (✓) ONE box.

- ☐ **Chromosomes move to opposite ends of the cell.**
- ☐ **Copies of the organelles are made.**
- ☐ **The cell increases in size.**

0 6 . 3

Before a cell divides by mitosis, the mass of DNA in the cell is 6 picograms.

What mass of DNA will be in each of the new cells at the end of cell division? [1 mark]

Tick (✓) ONE box.

- ☐ **3 picograms**
- ☐ **6 picograms**
- ☐ **12 picograms**

0 6 . 4

One cell takes 16 hours to divide and form two new cells.

Estimate the total number of cells produced from one cell at the end of 48 hours.

Use the following steps. [3 marks]

Calculate the number of divisions in 48 hours

_____

_____

_____

Calculate the number of cells after 48 hours

_____

_____

_____

Number of cells = _____

[Turn over]

0 6 . 5

Give ONE factor that can cause a mutation in DNA.

Do NOT refer to ionising radiation in your answer.
[1 mark]

_____

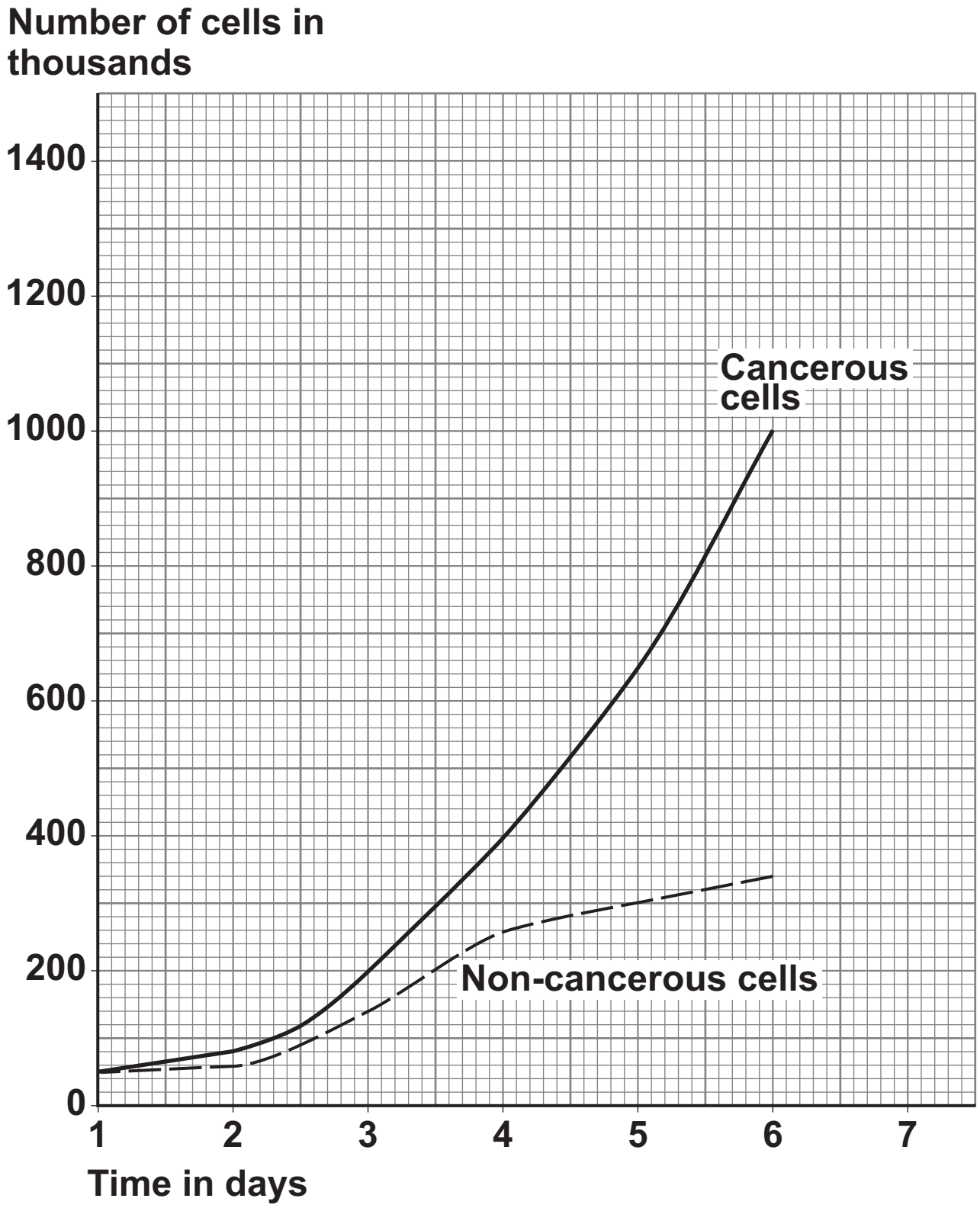
_____

_____

A mutation in DNA may cause cells to become cancerous.

FIGURE 14, on page 57, shows the change in the number of cancerous cells and non-cancerous cells during 6 days.

FIGURE 14


Number of cells in thousands
1400
1200
1000
800
600
400
200
0
1
2
3
4
5
6
7
Time in days
Cancerous cells
Non-cancerous cells

0 6 . 6

Describe THREE patterns shown in FIGURE 14.

Use data from FIGURE 14 on page 57. [3 marks]

1 _____

_____

_____

_____

_____

2 _____

_____

_____

_____

_____

_____

3 _____

_____

_____

_____

_____

_____

0 6 . 7

Predict the number of non-cancerous cells on day 7 if the pattern from day 4 continued.

You should extend the line for non-cancerous cells on the graph in FIGURE 14 on page 57. [2 marks]

Number of cells = _____ thousand

12

[Turn over]

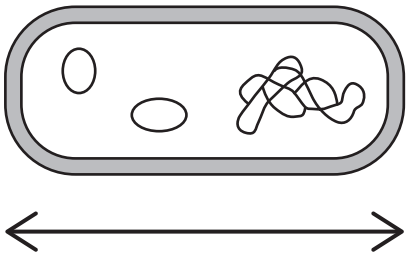
0 7

All living organisms are made of cells.

FIGURE 15 shows two types of cell.

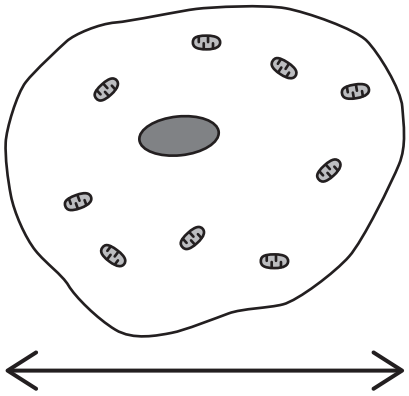
FIGURE 15

CELL A
Bacterial cell



4.4 micrometres

CELL B
Liver cell



28.6 micrometres

Not to scale

0 7 . 1

Calculate how many times longer the liver cell is than the bacterial cell. [2 marks]

_____

_____

_____

Number of times longer = _____

0 7 . 2

Compare the structure of cell A with the structure of cell B.

You should include similarities and differences in your answer.

Do NOT refer to cell size. [4 marks]

0 7 . 3

In multicellular organisms, cells are organised into tissues.

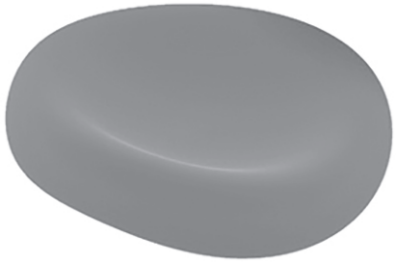
What is meant by a 'tissue'? [1 mark]

A scientist investigated the effect of different concentrations of sugar solution on red blood cells.

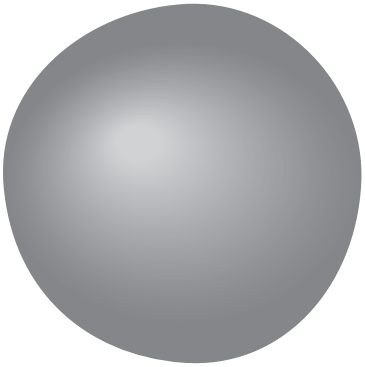
FIGURE 16 shows the effect of placing a red blood cell into a sugar solution.

FIGURE 16

Red blood cell BEFORE being placed in sugar solution



Red blood cell AFTER being placed in sugar solution



[Turn over]

0 7 . 4

What conclusion can be made from the result in FIGURE 16 on page 63? [1 mark]

Tick (✓) ONE box.

- ☐ **The sugar solution was less concentrated than inside the cell.**
- ☐ **The sugar solution was the same concentration as inside the cell.**
- ☐ **The sugar solution was more concentrated than inside the cell.**

A student investigated the effect of different concentrations of sugar solution on the change in mass of plant tissue.

The student used pieces of potato.

0 7 . 5

Describe a method the student could use to produce valid results. [6 marks]

The student used a valid method.

The student calculated the percentage change in mass of the pieces of potato.

TABLE 5 shows the results.

TABLE 5

CONCENTRATION OF SUGAR SOLUTION IN mol/dm^3	PERCENTAGE (%) CHANGE IN MASS
0.0	28
0.1	15
0.2	3
0.3	–5
0.4	–10
0.5	–12

[Turn over]

0 7 . 6

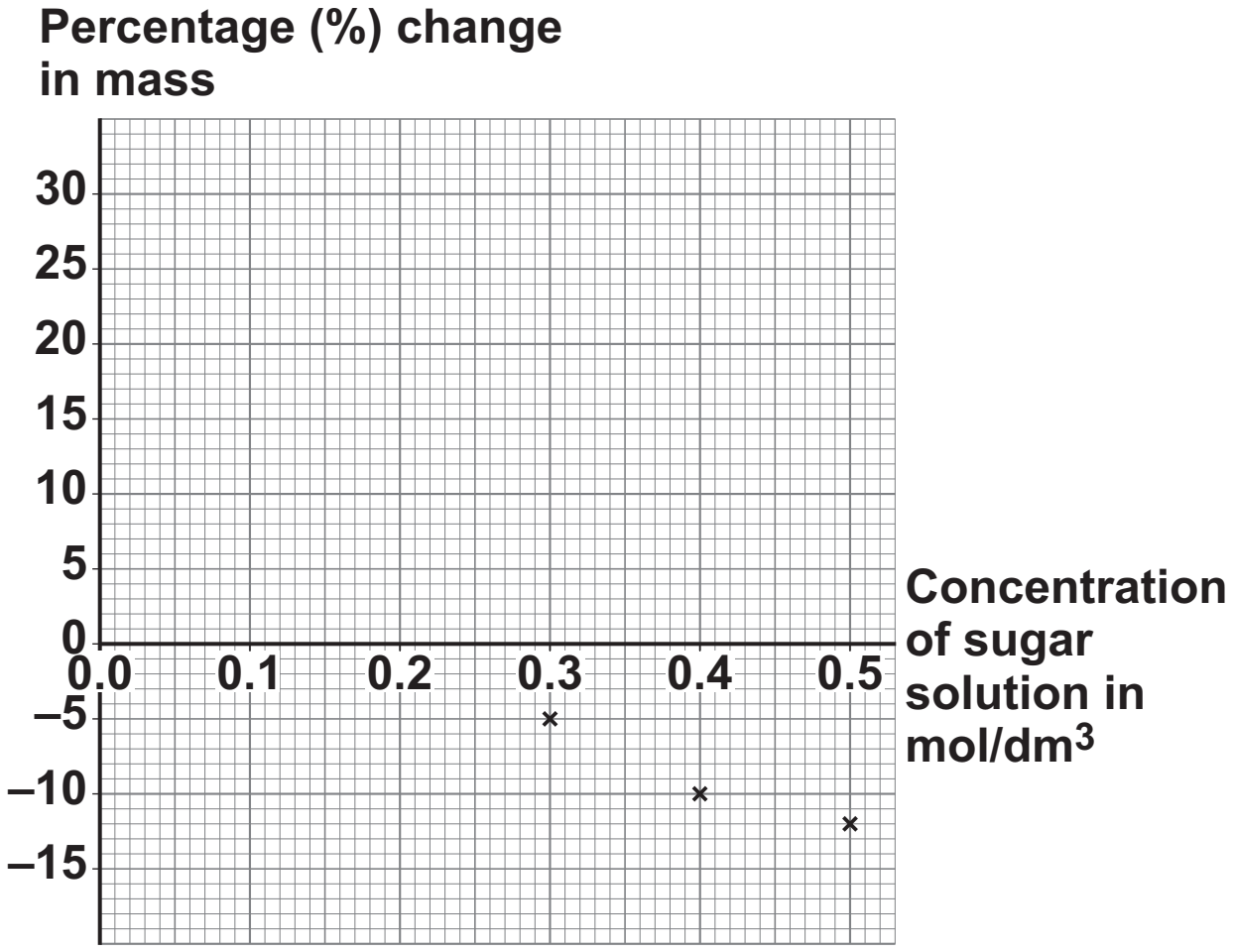
Complete FIGURE 17.

You should:

- **plot the data from TABLE 5, on page 67**
- **draw a line of best fit.**

Some of the results have been plotted for you.
[2 marks]

FIGURE 17



0 7 . 7

Determine the concentration of sugar solution that would cause no change in the mass of a piece of the potato.

Use FIGURE 17, on page 68. [1 mark]

Concentration of sugar solution =

_____ mol/dm^3 **17**

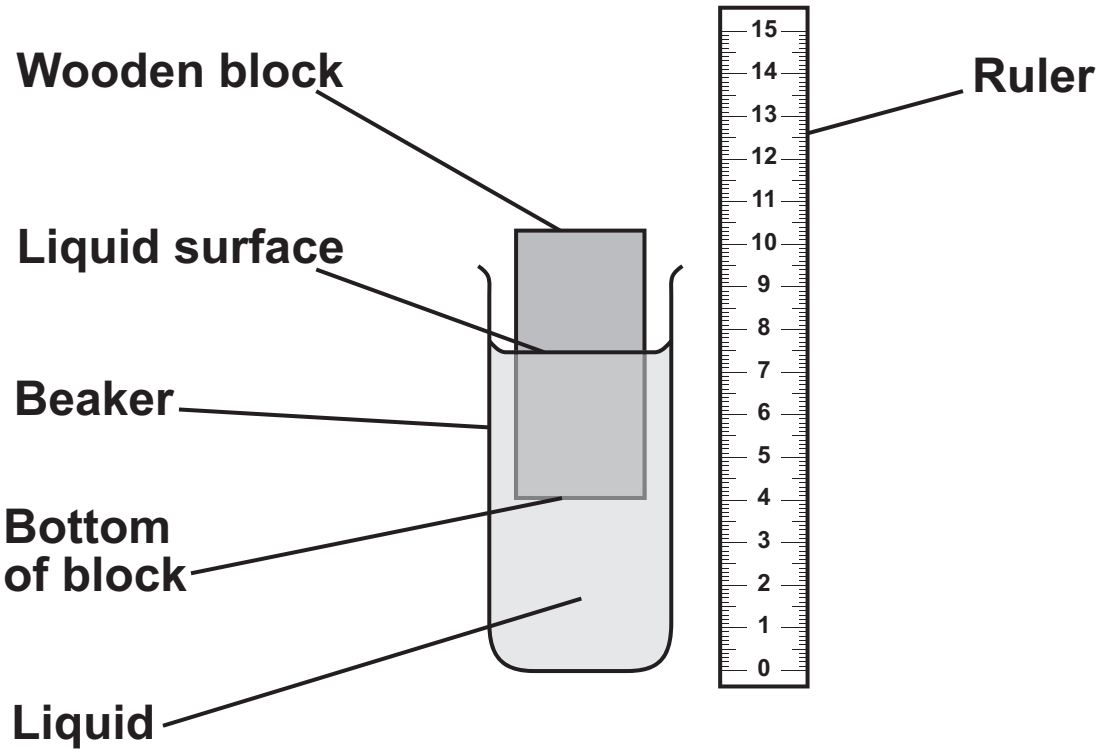
[Turn over]

0 8

A student investigated how the density of a liquid affects the position of a wooden block floating in the liquid.

FIGURE 18 shows the apparatus.

FIGURE 18



This is the method used.

1. **Put the wooden block in the beaker of liquid.**
2. **Allow the wooden block to come to rest so that it is floating in the liquid.**
3. **Measure the distance between the liquid surface and the bottom of the block.**
4. **Repeat steps 1 to 3 with liquids of different densities.**

0 8 . 1

Give the independent variable in the investigation.
[1 mark]

_____

_____

_____

0 8 . 2

Give ONE control variable for the investigation.
[1 mark]

_____

_____

_____

0 8 . 3

Give ONE possible source of error when the student measured the distance between the liquid surface and the bottom of the block. [1 mark]

_____

_____

_____

[Turn over]

0 8 . 4

TABLE 6 shows the results.

TABLE 6

LIQUID	DENSITY OF LIQUID IN g/cm^3	DISTANCE BETWEEN LIQUID SURFACE AND BOTTOM OF THE BLOCK IN cm
A	1.4	5.5
B	1.2	6.4
C	1.0	7.7
D	0.9	8.5

Give ONE conclusion from the results. [1 mark]

Use the Physics Equations Sheet to answer questions 08.5 and 08.6.

0 8 . 5

Which equation links density (ρ), mass (m) and volume (V)? [1 mark]

Tick (✓) ONE box.

☐ $\rho = m \times V$

☐ $\rho = \frac{m}{V}$

☐ $\rho = m \times V^3$

☐ $\rho = \frac{V}{m}$

[Turn over]

0 8 . 6

The density of the wooden block was 0.85 g/cm^3.

The mass of the wooden block was 30.6 g.

Calculate the volume of the wooden block in cm^3.
[3 marks]

Volume of wooden block = _____ cm^3

0 8 . 7

Liquid C is water.

When liquid water is heated to its boiling point the water changes state.

What happens to the density of the liquid water as it changes state? [2 marks]

Tick (✓) ONE box.

☐ **The density decreases**

☐ **The density stays the same**

☐ **The density increases**

Give a reason for your answer.

_____

_____

_____

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END OF QUESTIONS

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For Examiner's Use	
Question	Mark
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