A

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: SYNERGY

F

8465/2F

Foundation Tier

Paper 2 Life and Environmental Sciences

Time allowed: 1 hour 45 minutes

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

JUN228465 2F01

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

Hormones are released by glands.

0 1 . 1

Which organ system produces hormones?

Tick (✓) ONE box. [1 mark]

☐ **Circulatory system**

☐ **Digestive system**

☐ **Endocrine system**

0 1 . 2

How are hormones transported around the body?

Tick (✓) ONE box. [1 mark]

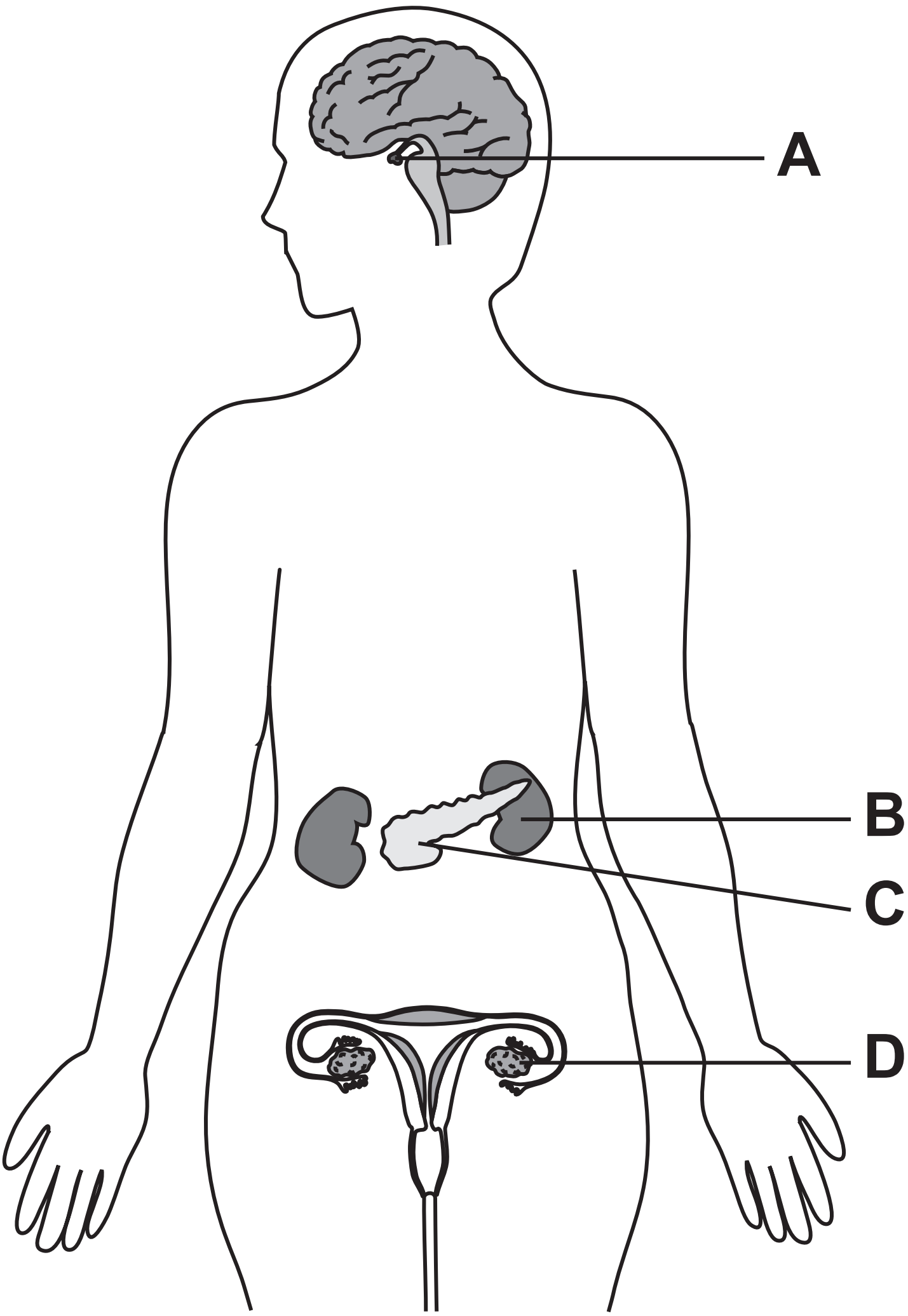
☐ **Through the bloodstream**

☐ **Through the muscles**

☐ **Through the nerves**

FIGURE 1 shows some of the organs in the human body.

FIGURE 1



0 1 . 3

Which organ is the pituitary gland?

Tick (✓) ONE box. [1 mark]

☐ **A**

☐ **B**

☐ **C**

☐ **D**

0 1 . 4

Which organ produces oestrogen?

Tick (✓) ONE box. [1 mark]

☐ **A**

☐ **B**

☐ **C**

☐ **D**

Homeostasis is the control of the body's internal conditions.

0 1 . 5

Which internal body condition is controlled by homeostasis?

Tick (✓) ONE box. [1 mark]

- ☐ **Body temperature**
- ☐ **Muscle contraction**
- ☐ **Nerve impulses**

[Turn over]

Homeostasis also controls blood glucose concentration.

FIGURE 2, on the opposite page, shows the change in blood glucose concentration in a person during 180 minutes.

0 1 . 6

When did the person start eating a meal?

Use FIGURE 2.

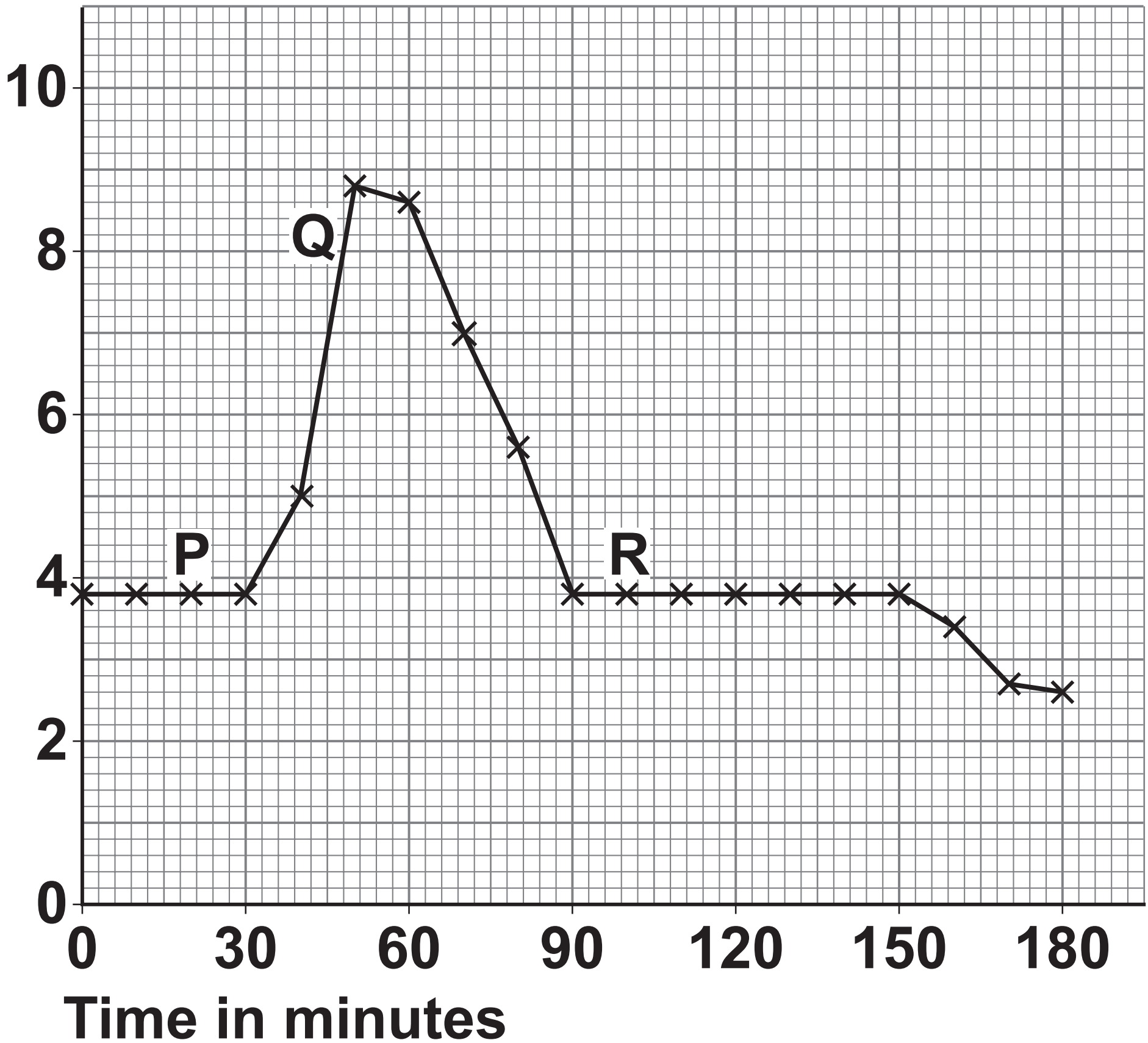
Tick (✓) ONE box. [1 mark]

☐ P

☐ Q

☐ R

FIGURE 2



[Turn over]

When blood glucose concentration is high the hormone insulin is released into the blood.

0 1 . 7

Complete the sentence.

Choose the answer from the list. [1 mark]

kidney

pancreas

stomach

Insulin is produced by the

.

0 1 . 8

When will the concentration of insulin in the blood be the greatest?

Use FIGURE 2, on page 11.

Tick (✓) ONE box. [1 mark]

☐ **P**

☐ **Q**

☐ **R**

0 1 . 9

What might have caused the fall in blood glucose concentration at 150 minutes? [1 mark]

9

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[Turn over]

0 2

Different substances change state at different temperatures.

TABLE 1 shows the melting points and boiling points of three substances.

TABLE 1

Substance	Melting point in °C	Boiling point in °C
Sodium	98	883
Sodium chloride	801	1413
Water	0	100

0 2 . 1

What is the state of sodium at 90 °C?

Tick (✓) ONE box. [1 mark]

☐ **Gas**

☐ **Liquid**

☐ **Solid**

0 2 . 2

Complete the sentence.

Choose the answer from the list. [1 mark]

10

100

1000

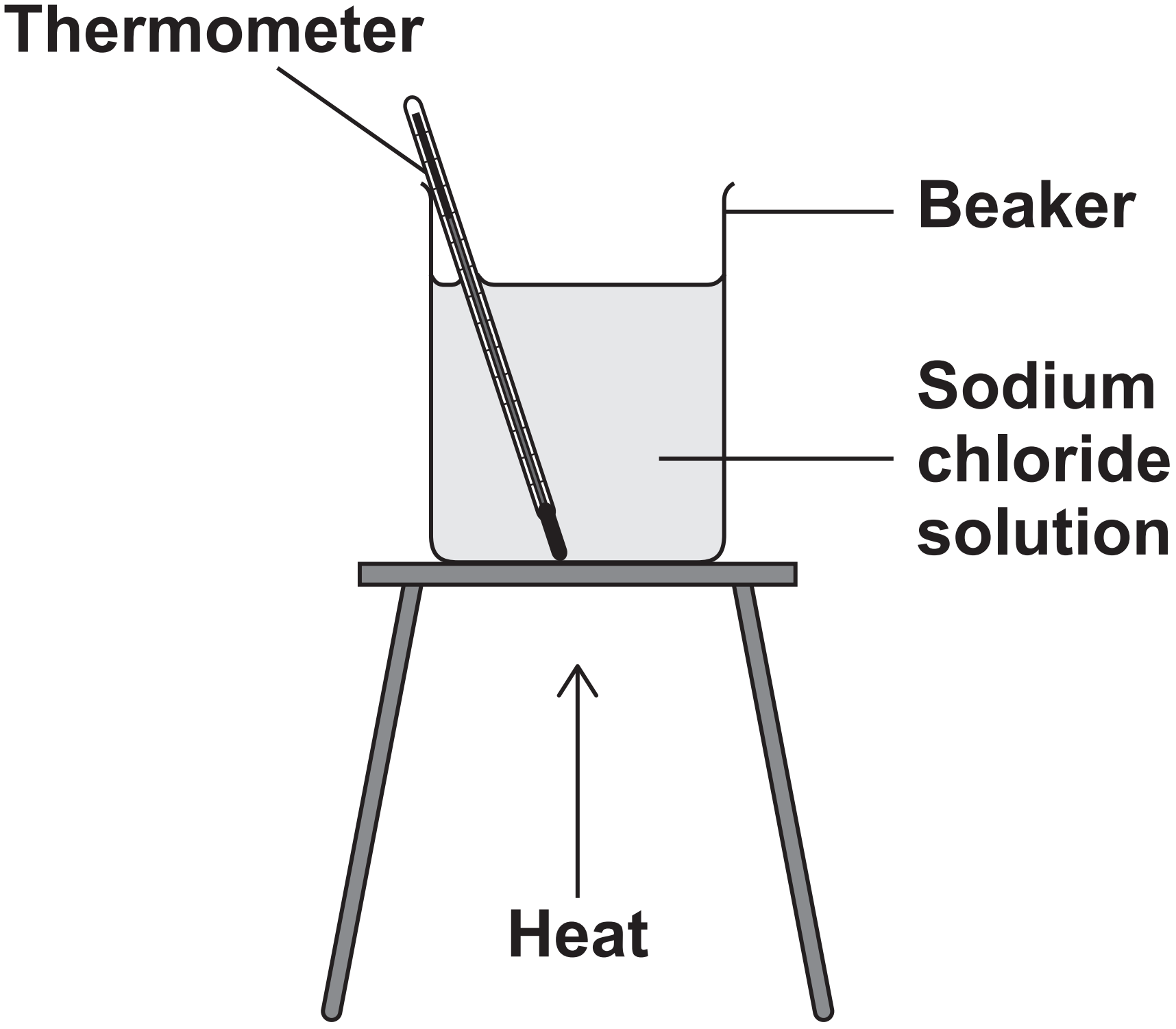
Sodium chloride is a liquid at

_____ °C.

A student investigated the boiling point of different concentrations of sodium chloride solutions.

FIGURE 3 shows the apparatus.

FIGURE 3



[Turn over]

This is the method used.

1. **Add 100 cm^3 of water to a beaker.**

2. **Add 10 g of sodium chloride to the water.**

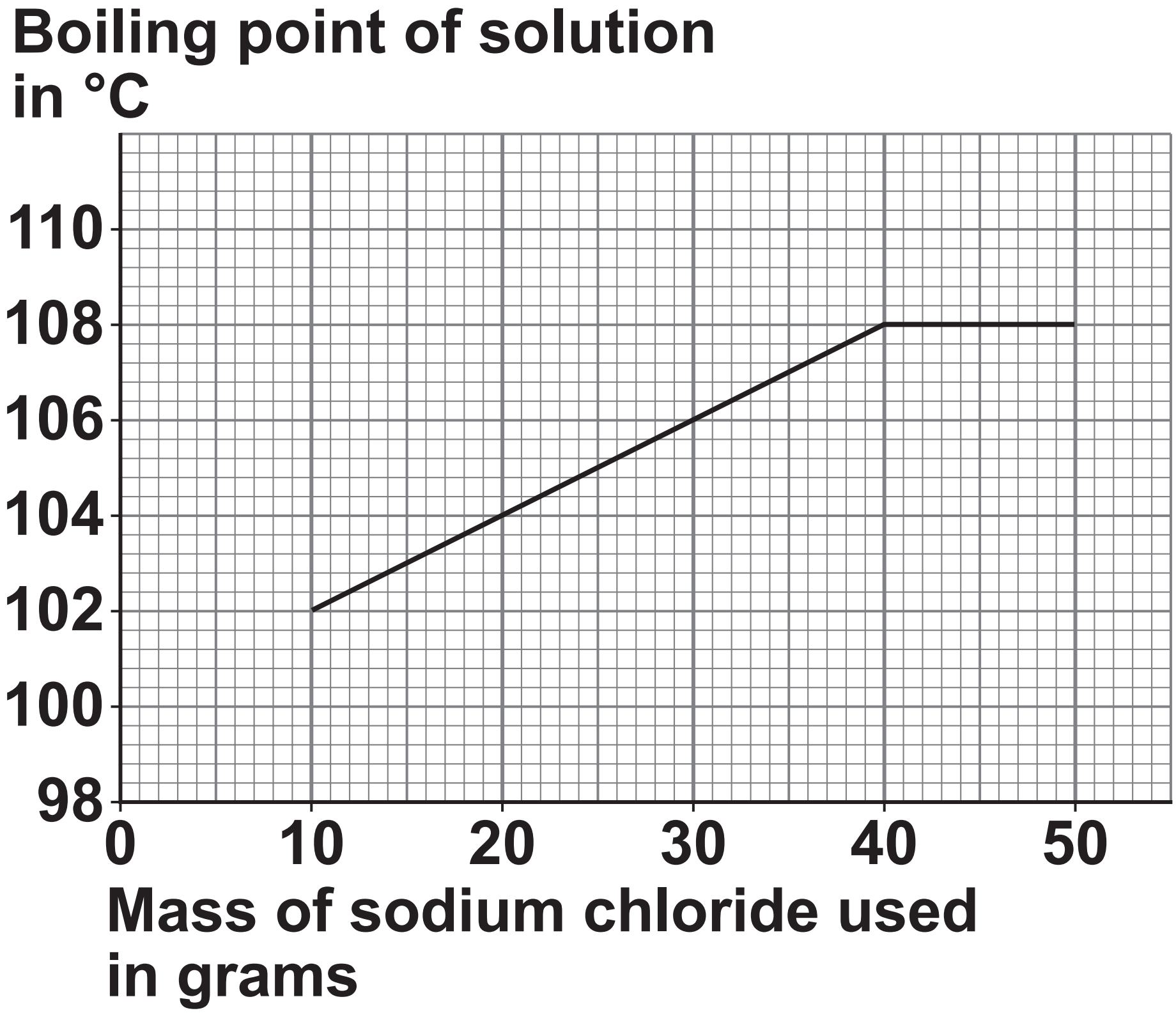
3. **Heat the beaker until the solution boils.**

4. **Record the boiling point of the solution.**

5. **Repeat steps 1 to 4 with different masses of sodium chloride.**

FIGURE 4 shows the results.

FIGURE 4



[Turn over]

0 2 . 3

Determine the difference between the boiling point of the solution using:

- **15 g of sodium chloride**

and

- **30 g of sodium chloride**

Use FIGURE 4, on page 21. [3 marks]

Boiling point using 15 g of sodium chloride _____ °C

Boiling point using 30 g of sodium chloride _____ °C

Difference in boiling point =

_____ °C

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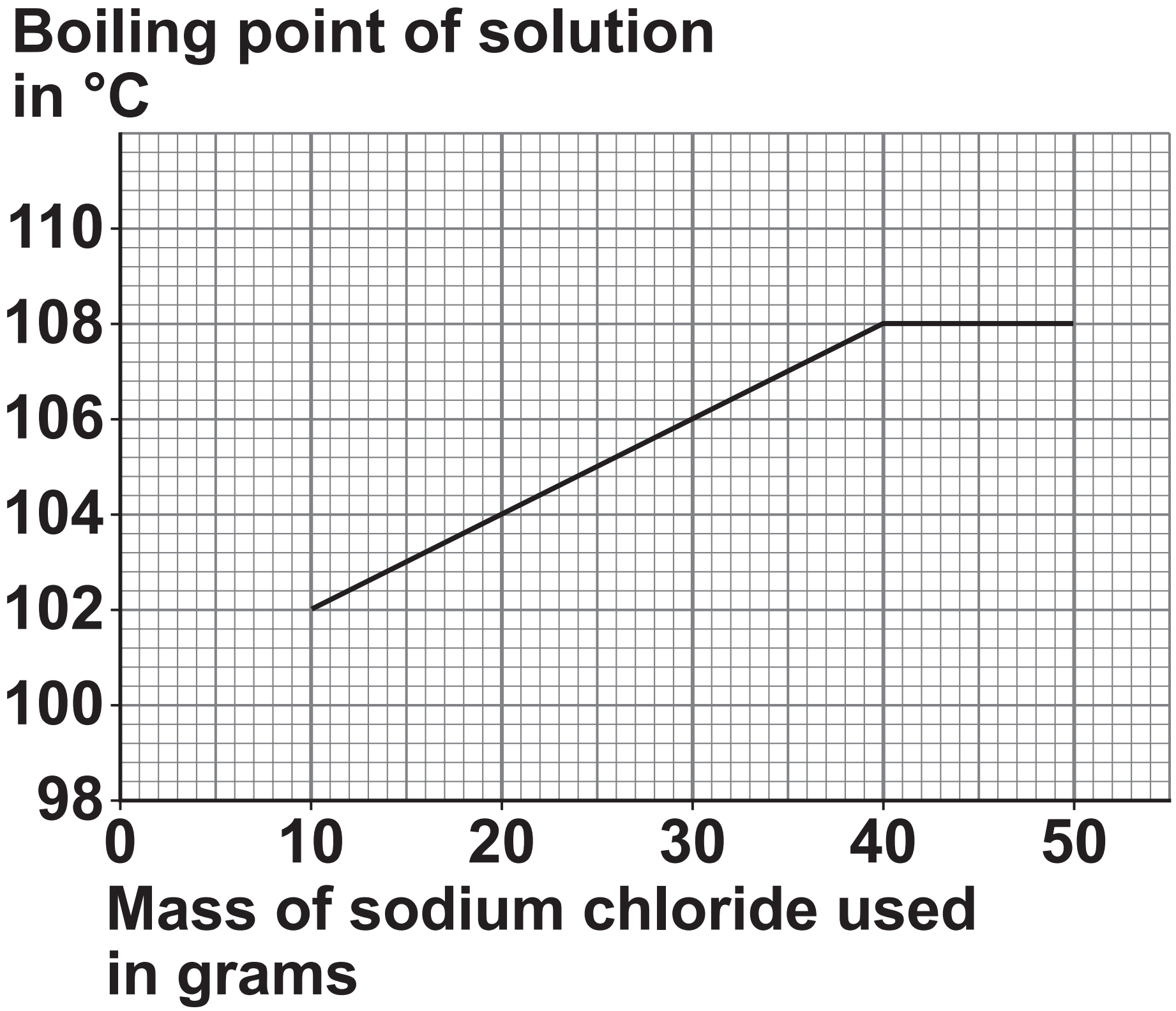
[Turn over]

FIGURE 4 is repeated from page 21.



0 2 . 4

Describe the pattern of the results in FIGURE 4, on the opposite page.

Include data from FIGURE 4 in your answer. [3 marks]

0 2 . 5

The student heated water at its boiling point until all the liquid water changed to water vapour.

mass of water = 0.20 kg

specific latent heat of vaporisation of water = 2 260 000 J/kg

Calculate the energy required to change the liquid water into water vapour.

Use the equation:

energy for the change of state = mass × specific latent heat of vaporisation

Choose the unit from the list. [3 marks]

°C

kg

J

J/kg

Energy = _____ Unit _____

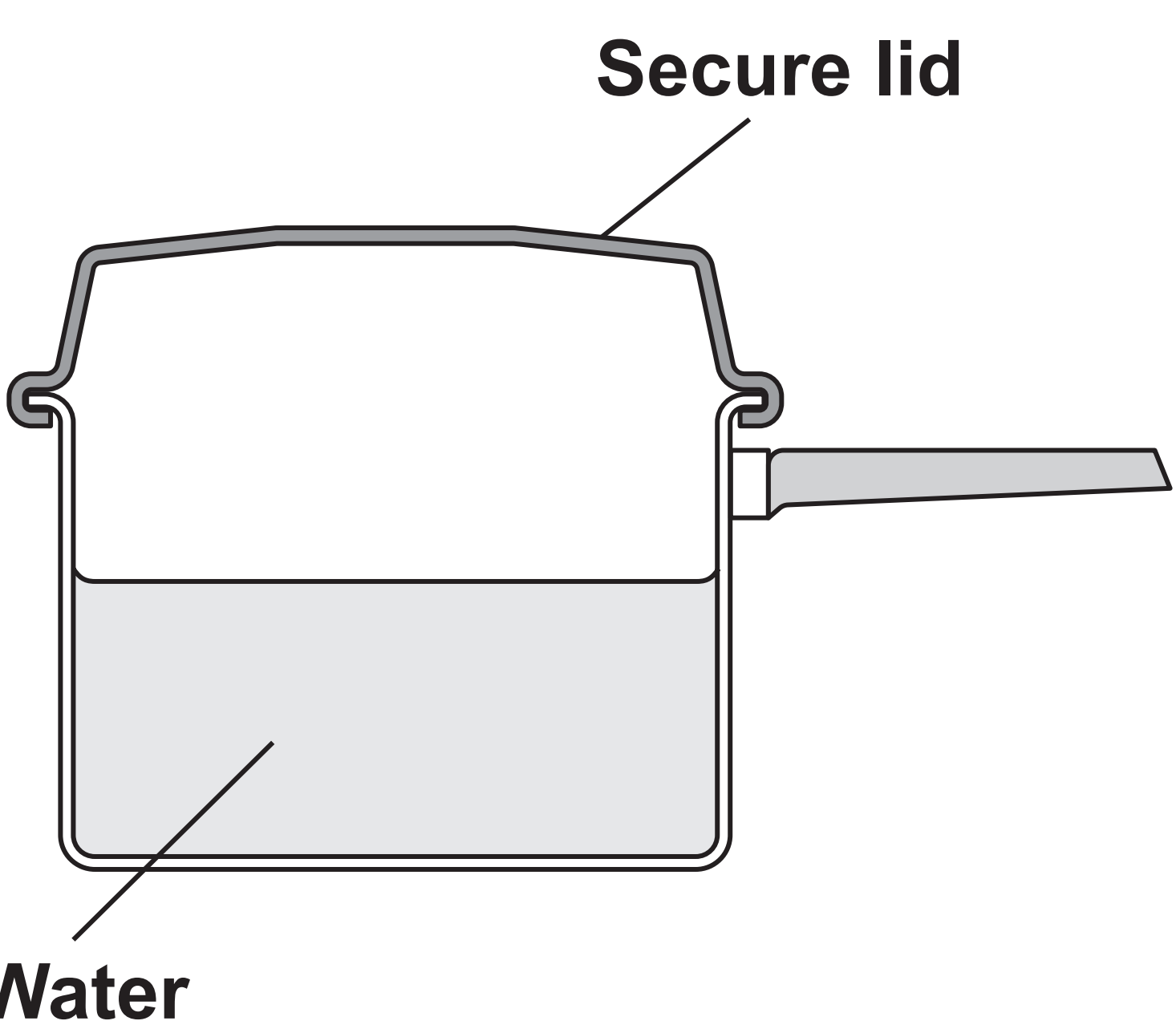
[Turn over]

Boiling water can be used to cook food.

Food can be cooked in a pressure cooker.

FIGURE 5 shows a pressure cooker.

FIGURE 5



0 2 . 6

What will happen to the water particles as the temperature of the water increases?

Tick (✓) ONE box. [1 mark]

- ☐ **The kinetic energy of the particles will decrease.**
- ☐ **The particles will hit each other less often.**
- ☐ **The particles will move faster.**

The pressure inside the pressure cooker changes during heating.

TABLE 2 shows the boiling point of the water in the pressure cooker at different pressures.

TABLE 2

Pressure in kPa	Boiling point in °C
101	100
150	112
200	120
280	131
360	141

0 2 . 7

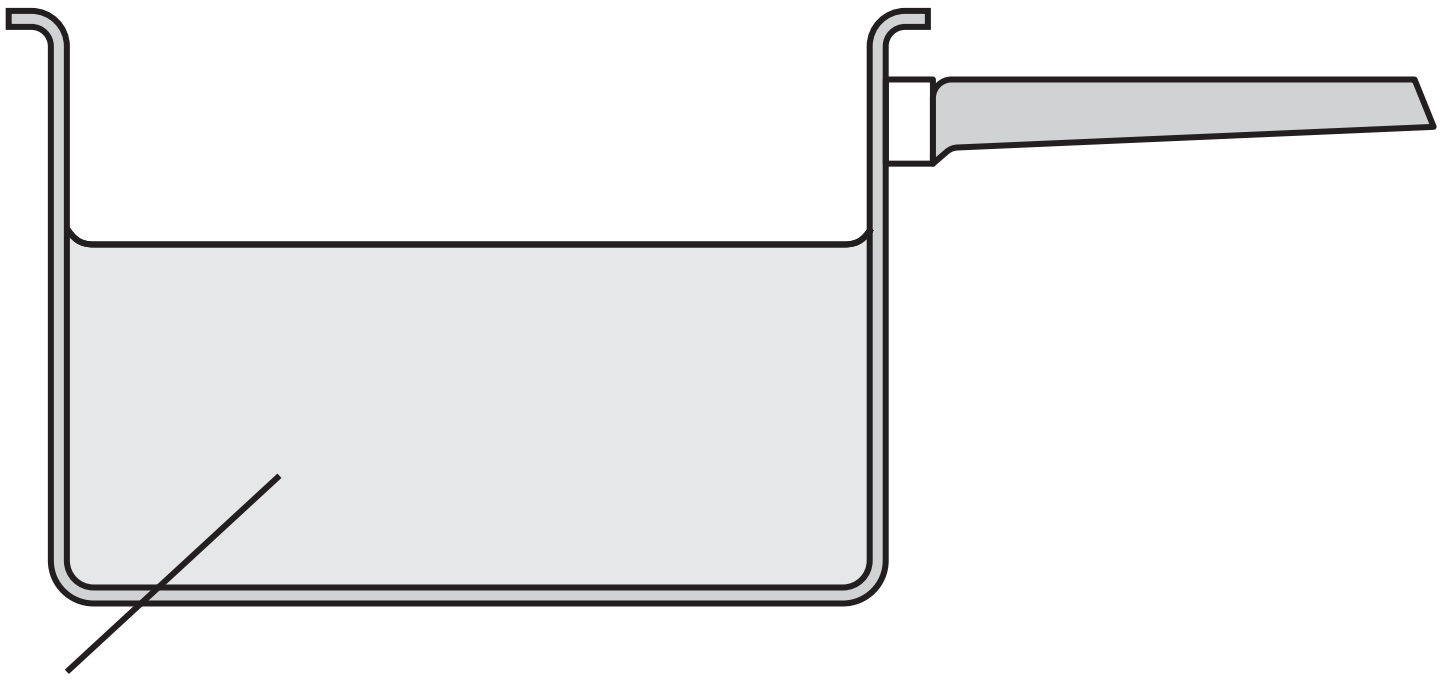
What happens to the boiling point of the water as the pressure in the pressure cooker increases?

Use TABLE 2, on the opposite page.
[1 mark]

0 2 . 8

FIGURE 6 shows a saucepan.

FIGURE 6



The boiling point of water in a saucepan is 100 °C.

Explain ONE advantage of using a pressure cooker instead of a saucepan to cook food. [2 marks]

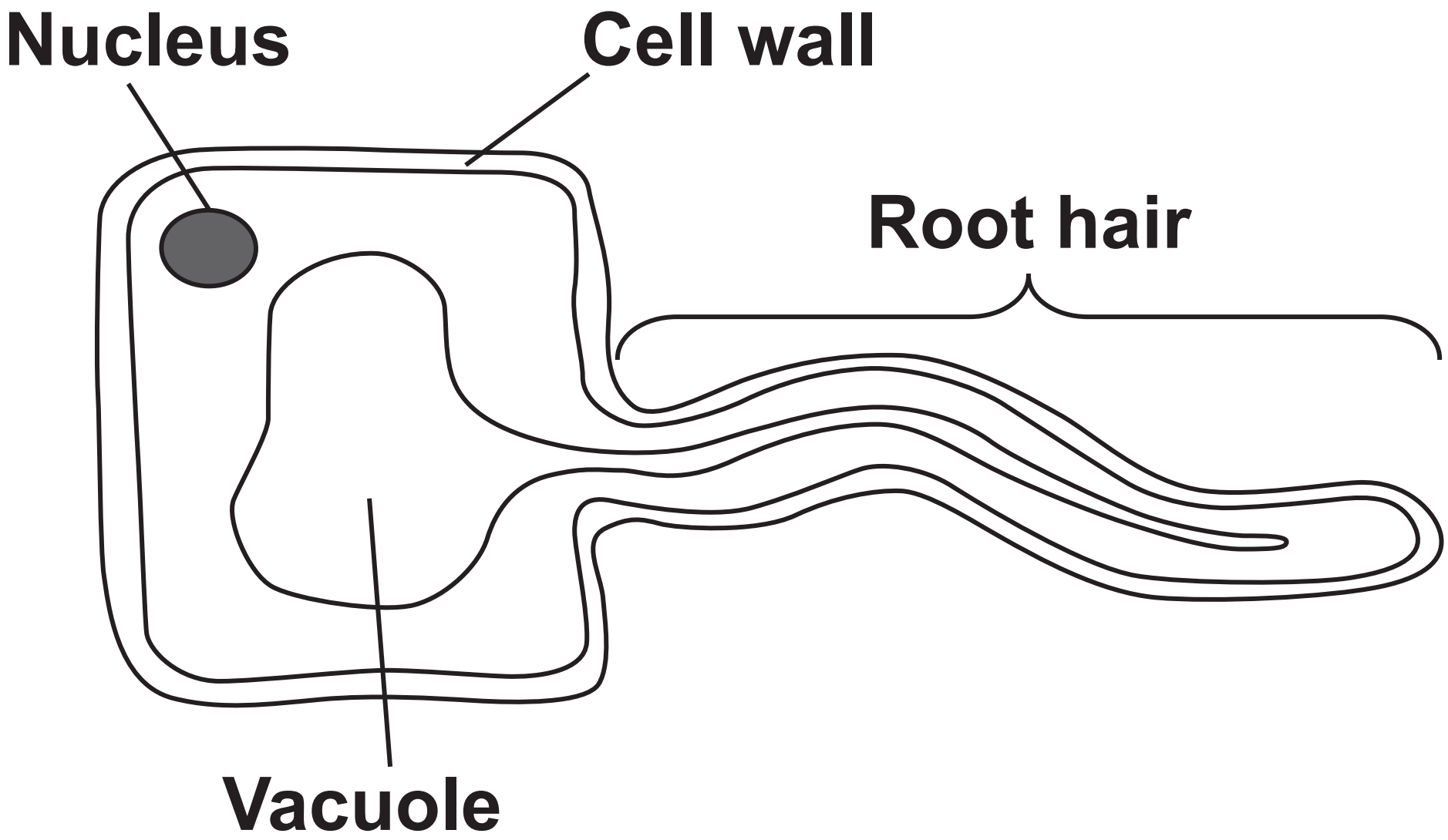
[Turn over]

0 3

Plants use root hairs to take in water and minerals from the soil.

FIGURE 7 shows a root hair cell.

FIGURE 7



0 3 . 1

Complete the sentence.

Choose the answer from the list. [1 mark]

evaporation

osmosis

photosynthesis

Water moves into the root hair cell by the process of _____ .

0 3 . 2

Explain the advantage to a plant of having root hairs.

Use FIGURE 7, on page 34. [2 marks]

0 3 . 3

Explain why root hair cells do NOT have chloroplasts. [2 marks]

Plants need minerals for healthy growth.

0 3 . 4

Minerals in the soil are an ABIOTIC factor that affects plant growth.

What is one other ABIOTIC factor that affects plant growth?

Tick (✓) ONE box. [1 mark]

- ☐ **Fungal disease**
- ☐ **Predators**
- ☐ **Water**

0 3 . 5

Soil contains magnesium ions.

Which substance in plants contains magnesium?

Tick (✓) ONE box. [1 mark]

☐ **Chlorophyll**

☐ **Glucose**

☐ **Starch**

0 3 . 6

Fertilisers contain minerals.

Fertilisers can be added to the soil.

TABLE 3 gives information about two different fertilisers.

TABLE 3

	FERTILISER A	FERTILISER B
Mass	500 g	500 g
Cost	£5.00	£7.00
Type	Powder	Liquid
How to use	Add 25 g of the powder evenly onto 1 m^2 of soil	Add one bottle cap of the liquid (25 g) to water in a watering can, then pour onto soil
When to use	Use every 3 months	Use every week

Both fertilisers can be used on the same plants and contain the same minerals.

Evaluate which fertiliser would be best for a gardener to buy and to use.

Use TABLE 3, on the opposite page.
[4 marks]

42

11

4 2

BLANK PAGE

[Turn over]

0 4

A student used a ripple tank to investigate water waves.

0 4 . 1

What type of wave is a water wave?

Tick (✓) ONE box. [1 mark]

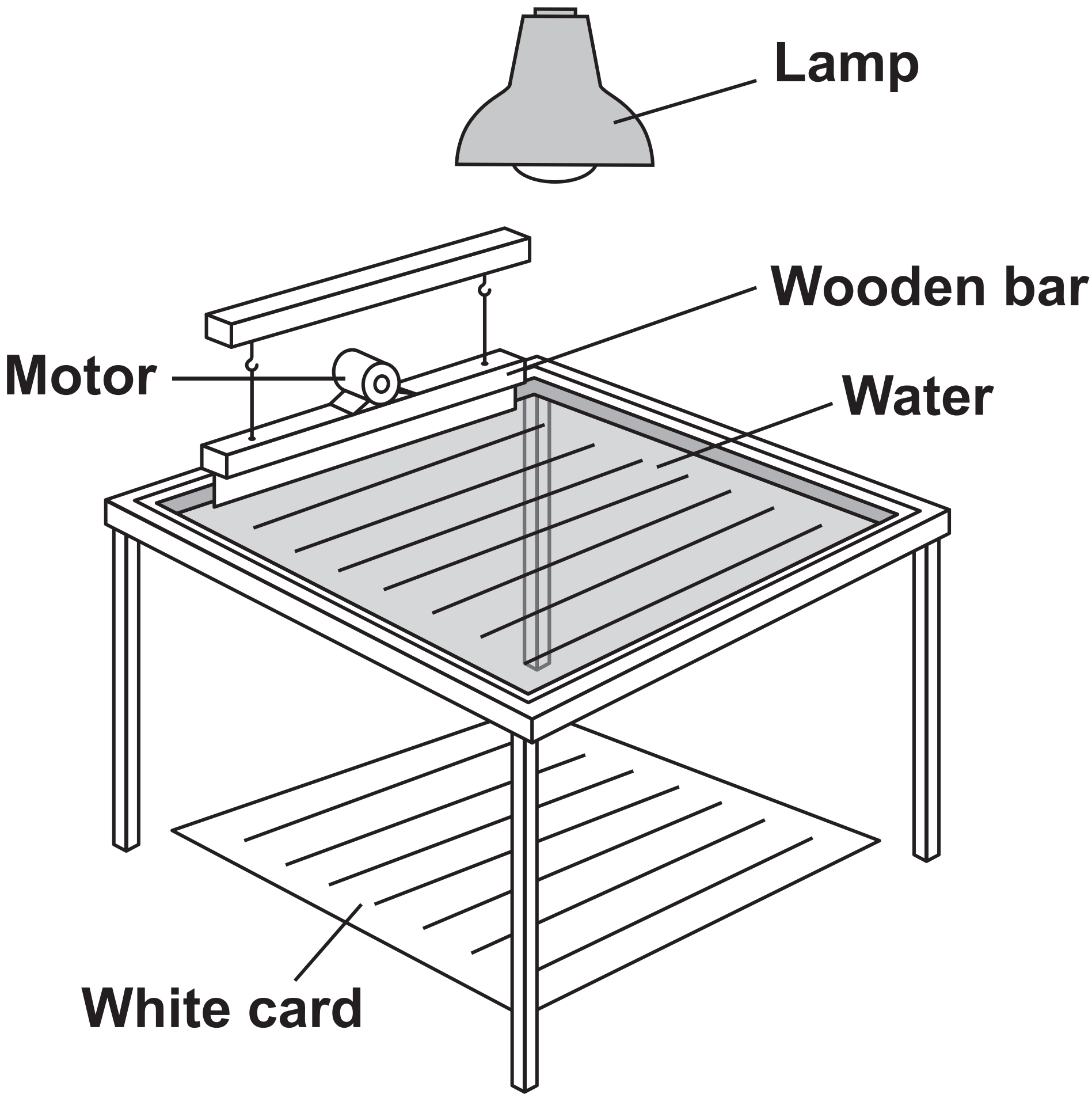
☐ **A sound wave**

☐ **A transverse wave**

☐ **An electromagnetic wave**

FIGURE 8 shows the ripple tank.

FIGURE 8



[Turn over]

0 4 . 2

Describe how the water waves are produced in the ripple tank. [1 mark]

0 4 . 3

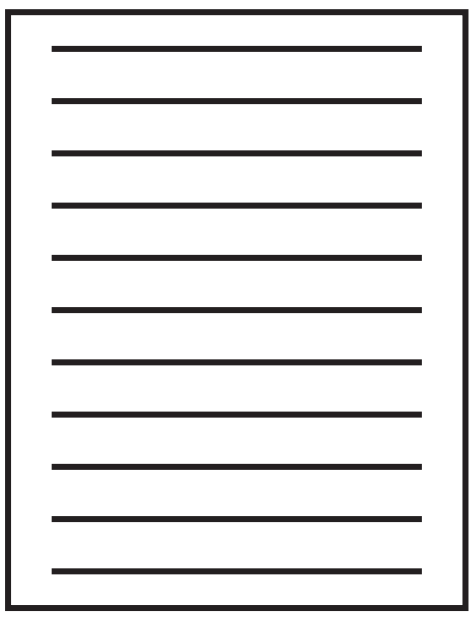
The student counted the number of waves reaching the end of the tank.

What other measurement is needed to calculate the frequency of the waves? [1 mark]

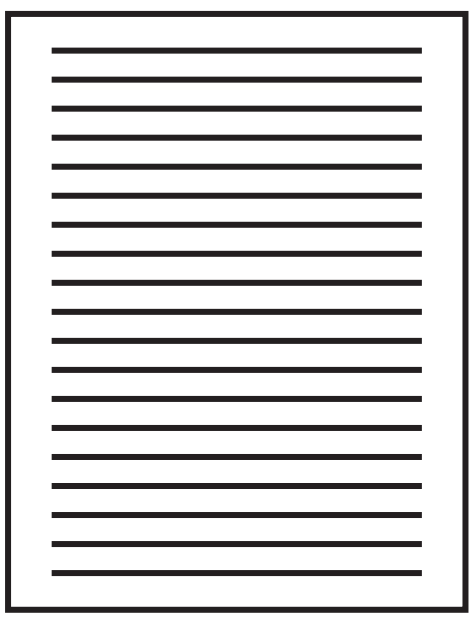
FIGURE 9 shows three different wave patterns produced on the white card.

FIGURE 9

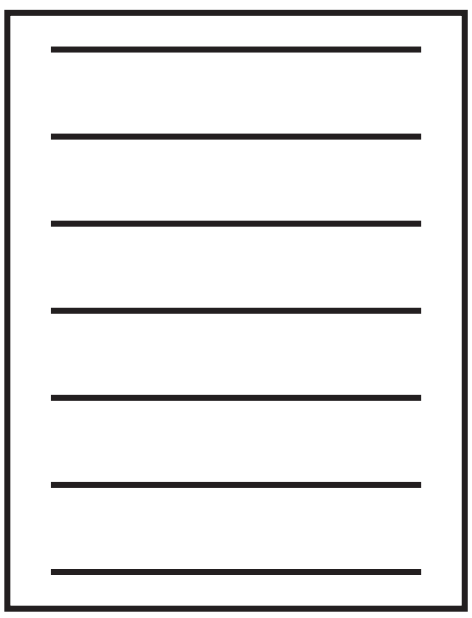
A



B



C



[Turn over]

0 4 . 4

Which pattern in FIGURE 9, on page 47, shows the waves with the greatest frequency?

Give a reason for your answer.

Tick (✓) ONE box. [2 marks]

☐ **A**

☐ **B**

☐ **C**

Reason _____

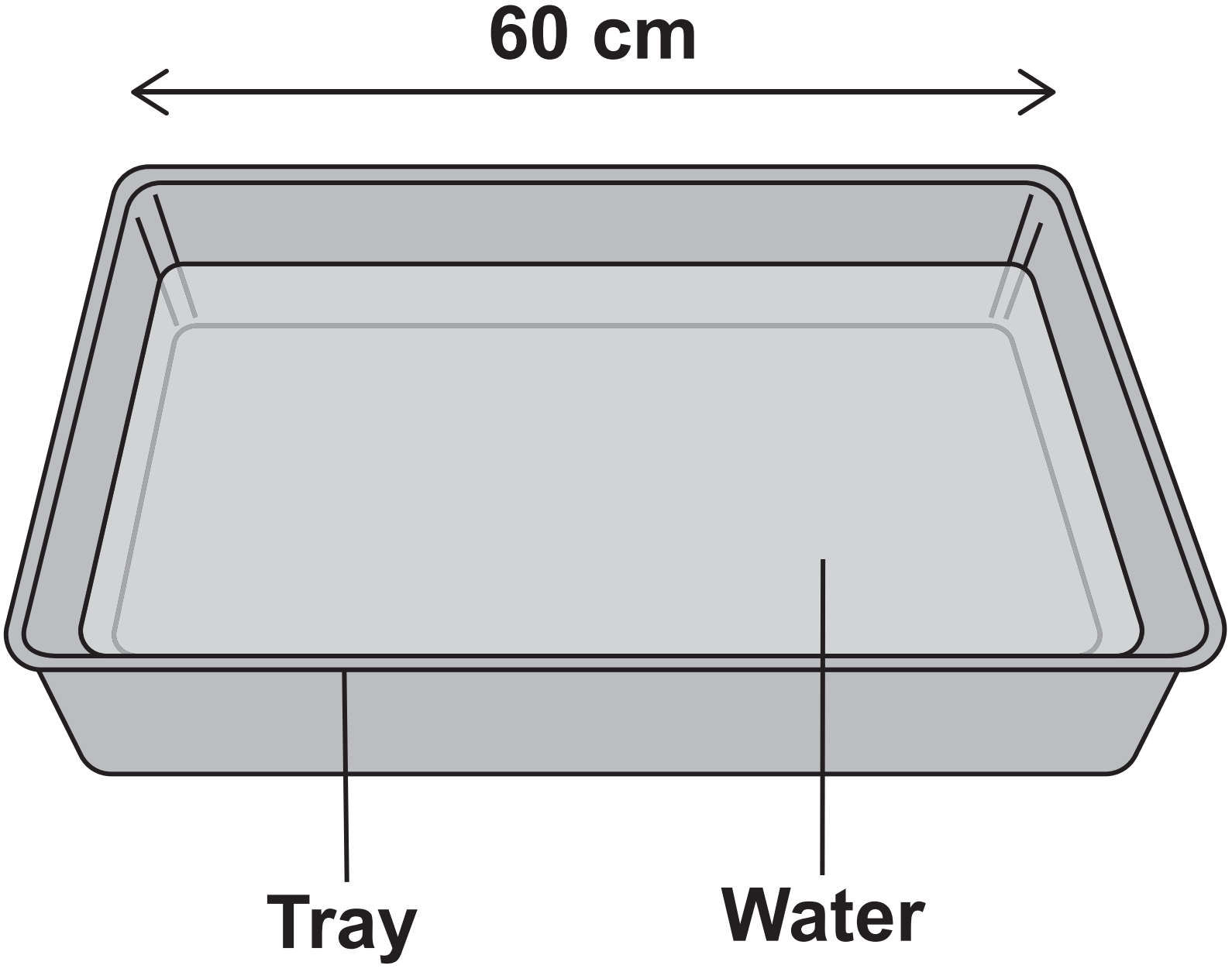
_____

_____

Another student investigated how the depth of water in a tray affected the speed of water waves.

FIGURE 10 shows the apparatus.

FIGURE 10



[Turn over]

This is the method used.

1. Pour water at room temperature into a tray to a depth of 5 mm.

2. Lift one end of the tray 5 cm and then let it go.

3. Measure the time taken for the water wave to move across the tray.

4. Calculate the speed of the water wave.

5. Repeat steps 1 to 4 with different depths of water.

0 4 . 5

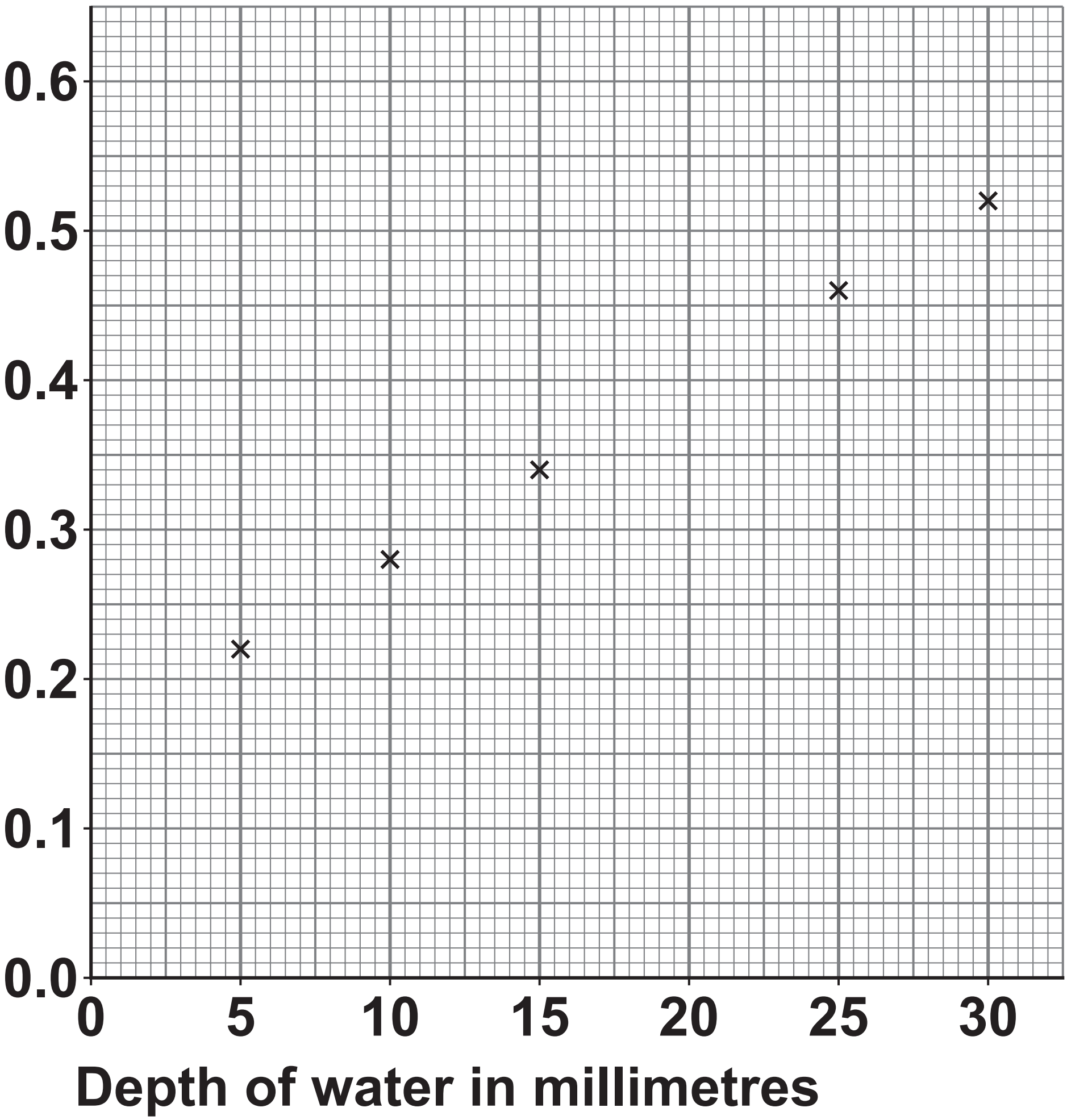
Give ONE control variable in the student's investigation. [1 mark]

The student calculated the speed of the waves at each depth.

FIGURE 11, on page 52, shows the results.

[Turn over]

FIGURE 11


Speed of water wave
in metres per second
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
5
10
15
20
25
30
Depth of water in millimetres

0 4 . 6

Draw a line of best fit on FIGURE 11, on the opposite page. [1 mark]

0 4 . 7

What is the speed of the water wave when the depth of the water is 20 mm?

Use FIGURE 11. [1 mark]

Speed of water wave = _____ metres per second

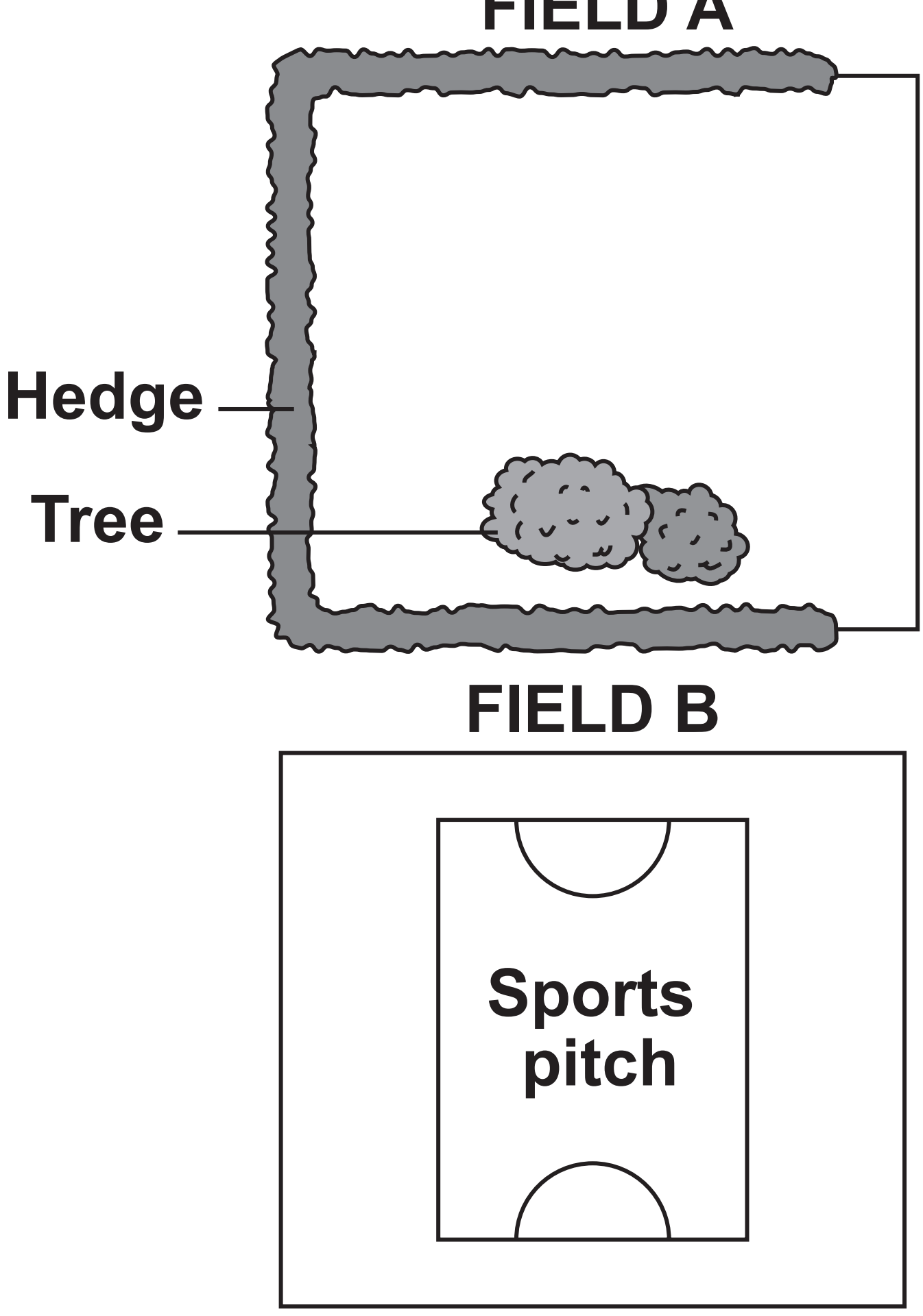
8

0 5

A student investigated the number of plants in two fields.

FIGURE 12 shows the fields.

FIGURE 12



This is the method used.

1. Place a quadrat randomly in field A.

2. Count the number of plants in the quadrat. Do NOT count grasses.

3. Repeat steps 1 and 2 another five times.

4. Repeat steps 1 to 3 in field B.

[Turn over]

0 5 . 1

The student used a quadrat to count the number of plants.

What is a quadrat?

Tick (✓) ONE box. [1 mark]

☐ **An identification chart**

☐ **A square frame**

☐ **A tape measure**

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[Turn over]

TABLE 4 shows the results.

TABLE 4

Quadrat number	Number of plants	
	Field A	Field B
1	4	2
2	6	1
3	3	2
4	8	2
5	7	2
6	2	3
Mean	X	2

0 5 . 2

Calculate mean value X in TABLE 4, on the opposite page. [2 marks]

X = _____

0 5 . 3

The area of the quadrat used was 1 m^2.

Field B was 100 m long and 90 m wide.

Calculate the total number of plants in field B.

You should calculate:

- **the area of the field**
- **the total number of plants.**

Use the data in TABLE 4, on page 58.
[2 marks]

_____

_____

Area of field = _____ m^2

_____

_____

Total number of plants = _____

[Turn over]

0 5 . 4

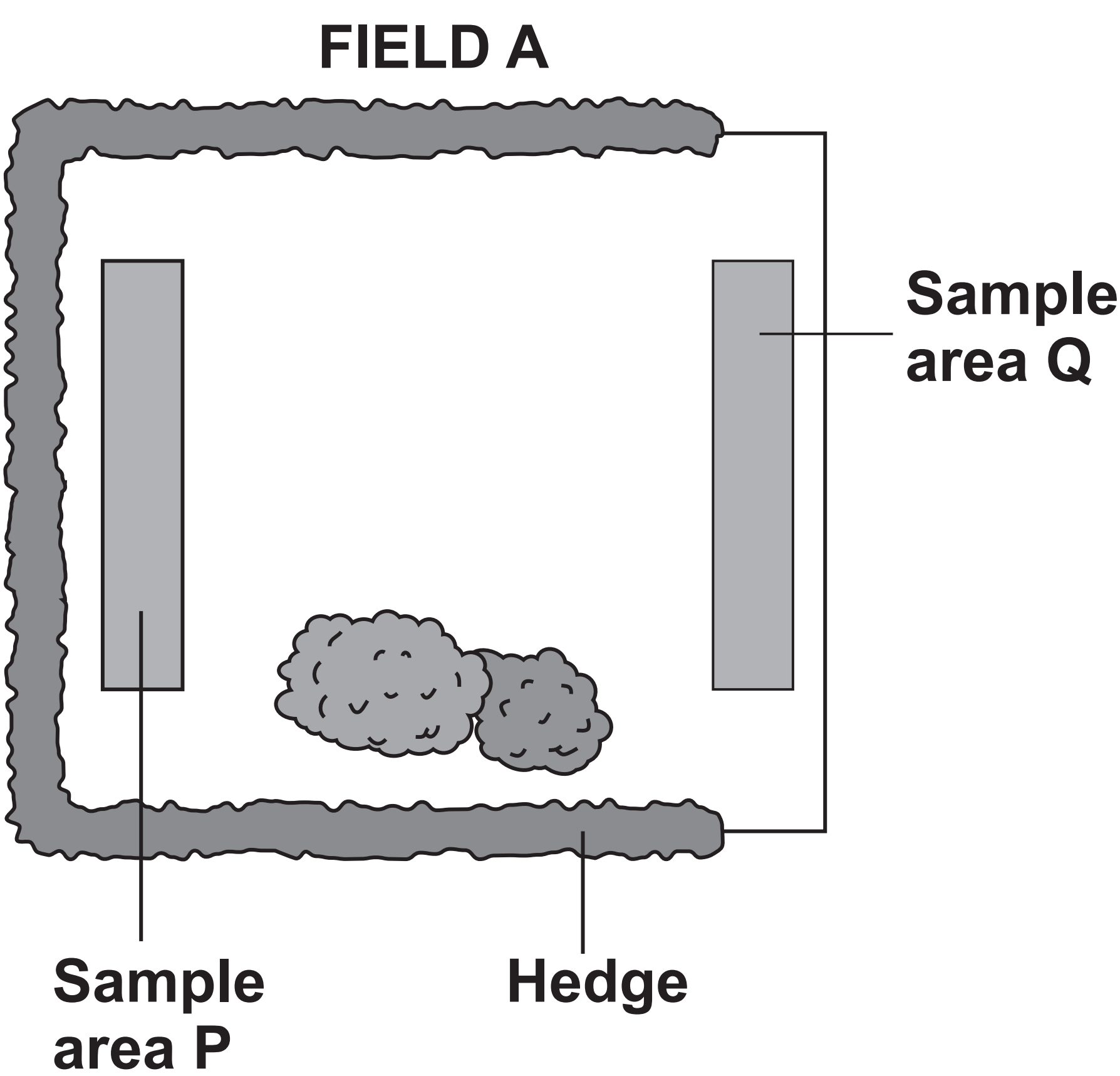
The mean number of plants in field A is greater than in field B.

Suggest ONE reason why. [1 mark]

A student did a different investigation in field A.

FIGURE 13 shows the areas sampled.

FIGURE 13



[Turn over]

The student sampled:

- an area at the edge of the field next to the hedge, P
- an area at the edge of the field with NO hedge, Q.

TABLE 5 shows the results.

TABLE 5

Sample area	Number of plants	Number of species of plant	Number of species of insect
P	86	16	10
Q	102	3	4

0 5 . 5

Give THREE conclusions from the results in TABLE 5, on the opposite page. [3 marks]

1 _____

_____

2 _____

_____

_____

3 _____

_____

_____

[Turn over]

0 5 . 6

Suggest ONE way to increase biodiversity in field A. [1 mark]

_____

_____

10

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[Turn over]

0 6

Stem cells are found in human embryos and in meristem tissue.

0 6 . 1

Which organisms is meristem tissue found in?

Tick (✓) ONE box. [1 mark]

☐ **Animals**

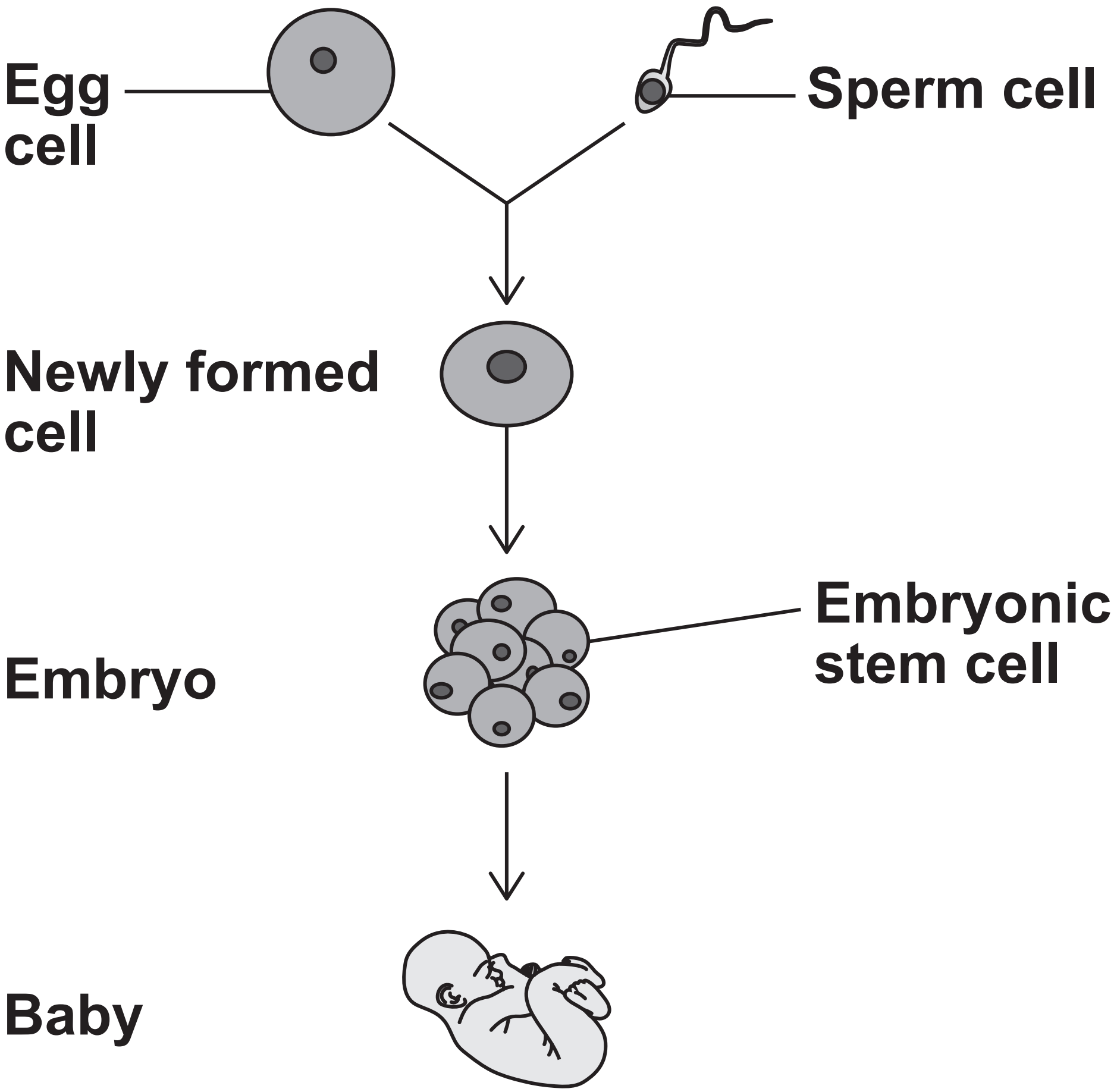
☐ **Bacteria**

☐ **Plants**

New cells are produced during the formation of an embryo.

FIGURE 14 shows how a human baby is formed.

FIGURE 14



[Turn over]

0 6 . 2

Complete the sentences about the processes shown in FIGURE 14, on page 69.

Choose answers from the list. [3 marks]

differentiation

fertilisation

inbreeding

mitosis

variation

The egg cell and the sperm cell fuse together during _____ .

Stem cells are produced when the newly formed cell divides by _____

_____ .

Stem cells become specialised cells during the process of _____ _____ .

0 6 . 3

Some people believe using embryonic stem cells in medical research is unethical.

Give ONE reason why. [1 mark]

_____

_____

_____

[Turn over]

BLANK PAGE

0 6 . 4

Bone cells divide to repair damage.

Give ONE other reason why bone cells divide. [1 mark]

Scientists tested a new drug to treat tumours in mice.

All the mice had the same type of tumour.

This is the method used.

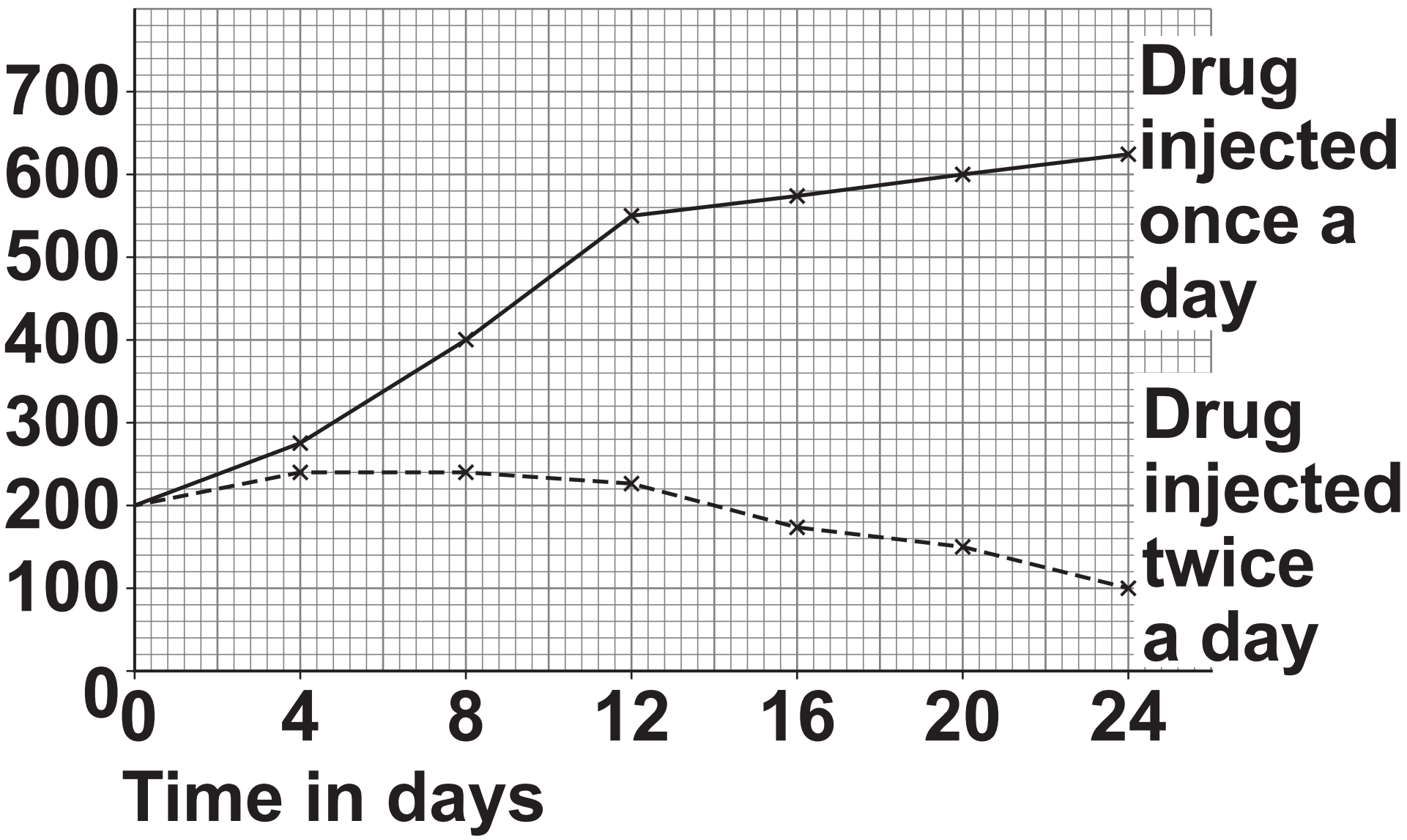
1. **Inject six mice with the drug once a day for 24 days.**

2. **Measure the volume of the tumour every 4 days.**

3. **Repeat steps 1 and 2, injecting a new group of mice with the drug twice a day.**

FIGURE 15 shows the results.

FIGURE 15



[Turn over]

0 6 . 5

Six other mice were given an injection that did not contain the drug.

Why did the scientists use mice that were NOT given the drug?

Tick (✓) ONE box. [1 mark]

- ☐ As a clinical trial
- ☐ As a control
- ☐ As an anomaly

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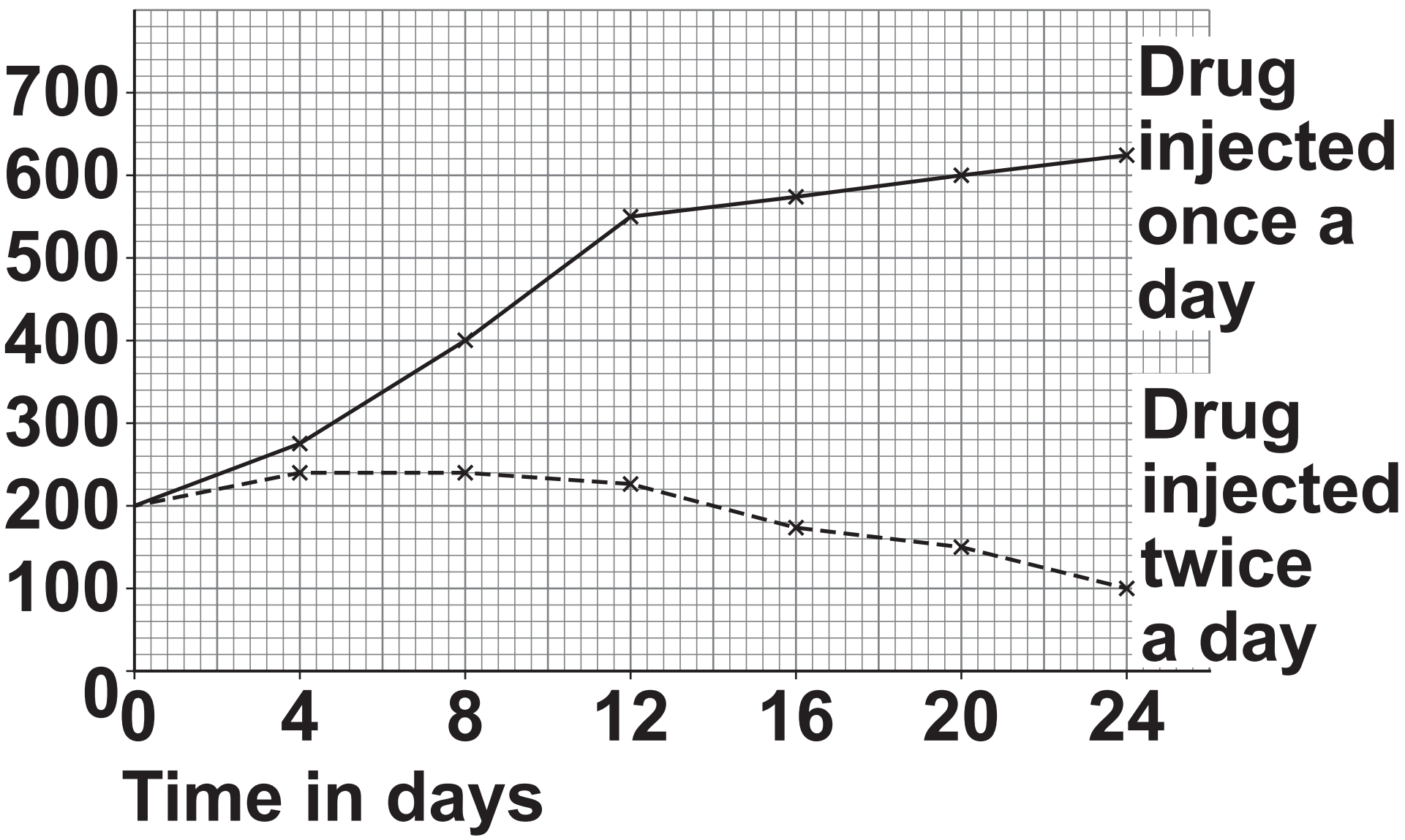
[Turn over]

FIGURE 15 is repeated from page 75.



0 6 . 6

Describe how the drug injected once a day AND the drug injected twice a day affected the volume of the tumour.

Use data from FIGURE 15, on the opposite page. [3 marks]

1

2

3

10

[Turn over]

0 7

The tawny owl is one species of bird.

The tawny owl can have grey feathers or brown feathers.

The colour of the feathers is determined by one gene.

The allele for brown feathers is dominant (B).

The allele for grey feathers is recessive (b).

0 7 . 1

What is the genotype of a tawny owl with grey feathers?

Tick (✓) ONE box. [1 mark]

☐ **BB**

☐ **Bb**

☐ **bb**

[Turn over]

0 7 . 2

Two tawny owls mate.

Complete FIGURE 16 to show the possible genotypes of the offspring. [1 mark]

FIGURE 16

		FEMALE OWL: B	FEMALE OWL: b
MALE OWL: B		BB	Bb
MALE OWL: b			

0 7 . 3

What is the probability of the offspring having brown feathers?

Use FIGURE 16, on the opposite page.

Tick (✓) ONE box. [1 mark]

- ☐ 25%
- ☐ 50%
- ☐ 75%
- ☐ 100%

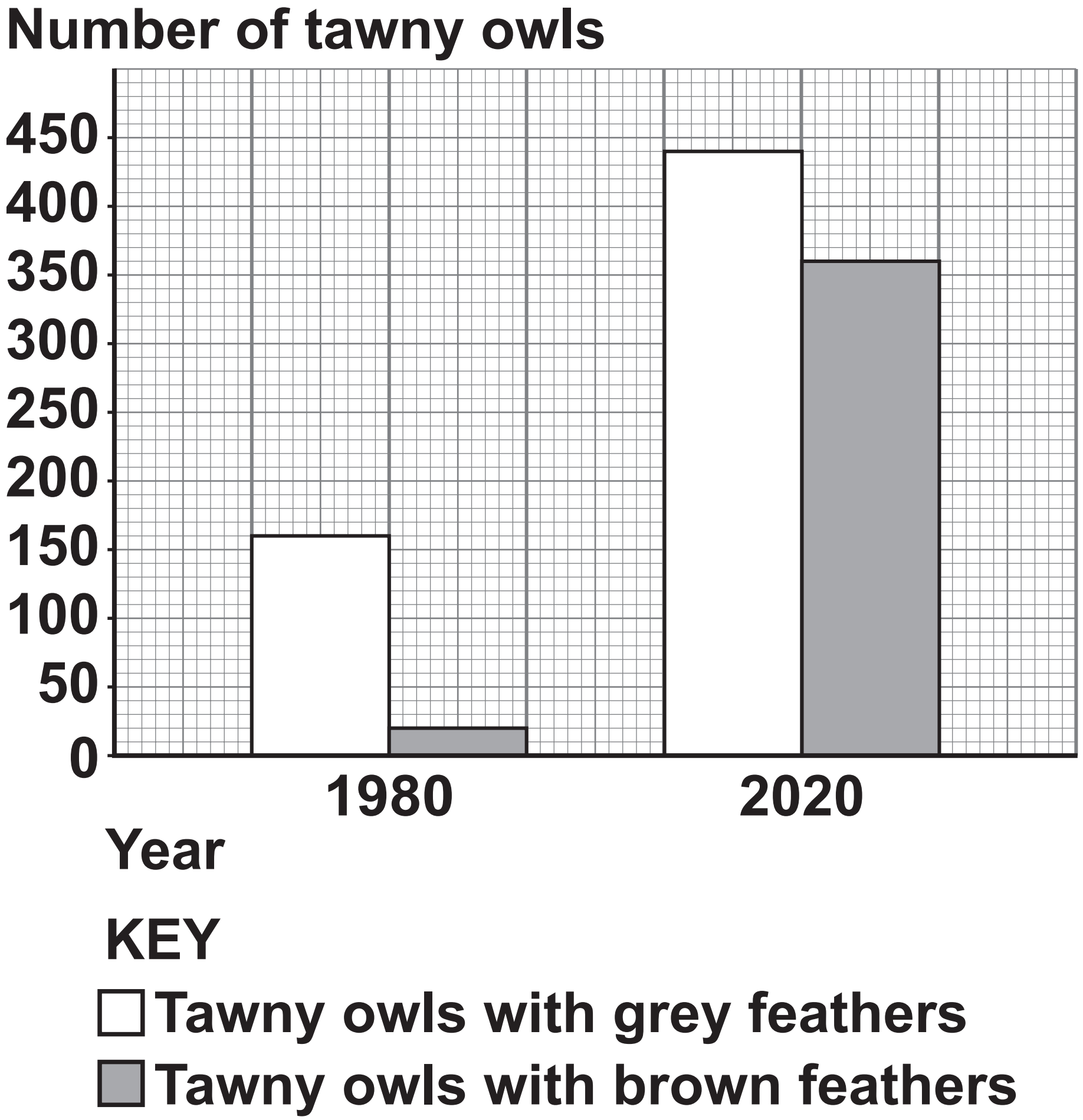
[Turn over]

Scientists investigated the effect of climate change on the number of tawny owls with grey feathers and with brown feathers.

The investigation took place between 1980 and 2020.

FIGURE 17, on the opposite page, shows the results.

FIGURE 17



[Turn over]

0 7 . 4

The number of tawny owls with brown feathers in the population has increased since 1980.

Give TWO other conclusions from the data in FIGURE 17, on page 85. [2 marks]

1

2

0 7 . 5

Between 1980 and 2020 there was a decrease in the time the area was covered with snow.

The tawny owls with brown feathers are better camouflaged from their prey when there is no snow.

Explain how the increase in the number of tawny owls with brown feathers occurred through the process of natural selection. [4 marks]

88

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[Turn over]

0 8

The human circulatory system transports blood around the body.

0 8 . 1

The human circulatory system is made of different structures.

Give the structures in order of size from the largest to the smallest.

Choose answers from the box.

The first one has been completed for you. [1 mark]

heart	muscle cell	nucleus

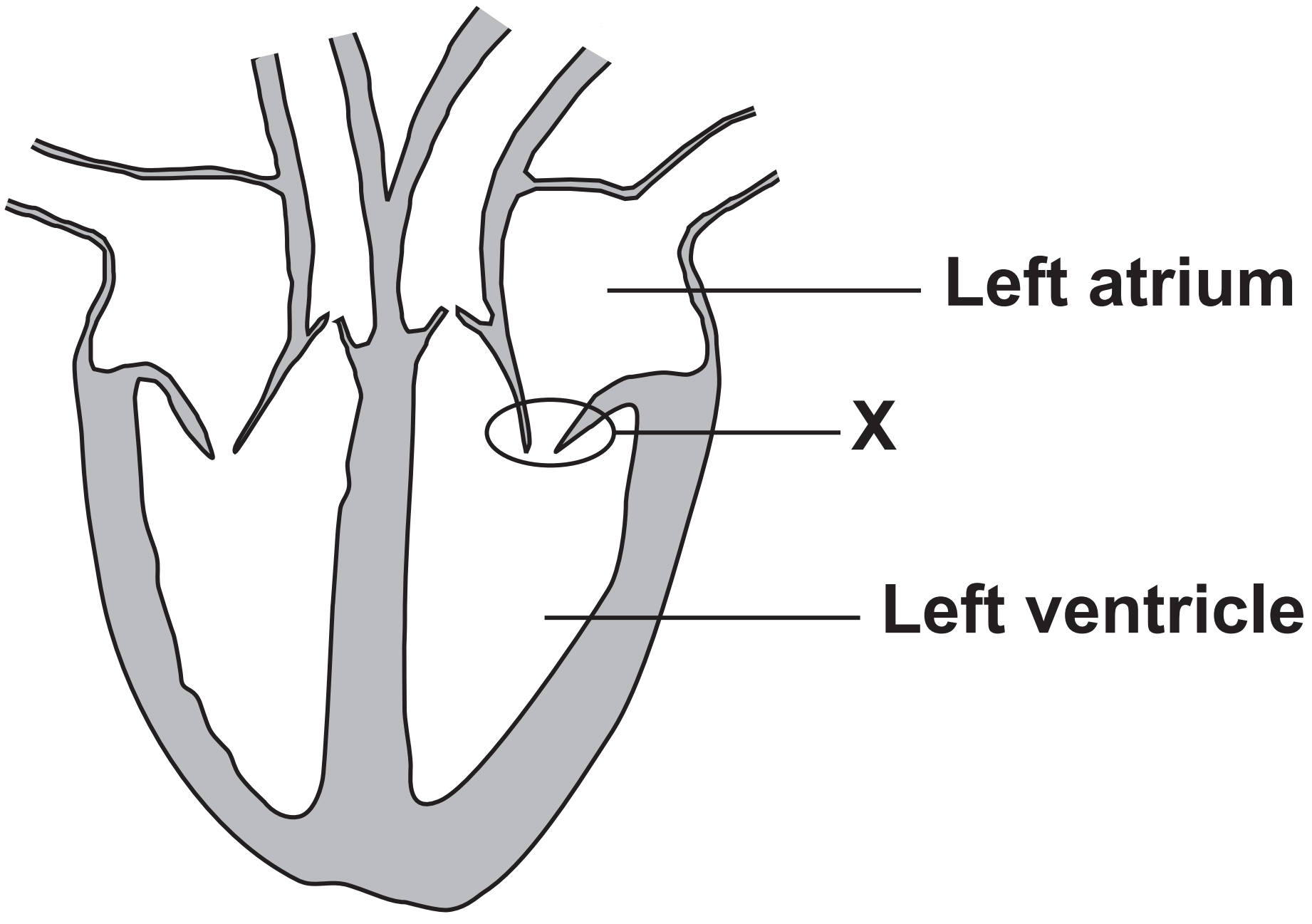
Largest

circulatory system

Smallest

FIGURE 18 shows a heart.

FIGURE 18



[Turn over]

0 8 . 2

The heart pumps blood from the body to the lungs.

Which route does blood travel through the heart?

Tick (✓) ONE box. [1 mark]

☐ **aorta → left atrium → left ventricle → pulmonary artery**

☐ **aorta → right atrium → right ventricle → pulmonary artery**

☐ **vena cava → left atrium → left ventricle → pulmonary artery**

☐ **vena cava → right atrium → right ventricle → pulmonary artery**

0 8 . 3

Explain why the wall of the left ventricle is thicker than the wall of the right ventricle. [2 marks]

0 8 . 4

What is the function of structure X shown in FIGURE 18, on page 91? [1 mark]

0 8 . 5

The heart contains a group of cells called the pacemaker.

Which part of the heart contains the pacemaker?

Tick (✓) ONE box. [1 mark]

- ☐ **Left atrium**
- ☐ **Left ventricle**
- ☐ **Right atrium**
- ☐ **Right ventricle**

[Turn over]

0 8 . 6

What is the function of the pacemaker?
[1 mark]

BLANK PAGE

[Turn over]

0 8 . 7

A person started an exercise training programme to improve their health.

TABLE 6 shows information about the person's heart.

- **Stroke volume is the volume of blood pumped out of the heart each beat.**
- **Cardiac output is the total volume of blood pumped out of the heart each minute.**

TABLE 6

Stage of training programme	Heart rate in beats per minute	Stroke volume in cm^3	Cardiac output in cm^3 per minute
Before	71	65	4615
After	57	81	4617

After the training programme the person's heart rate had decreased.

Explain the effect the training programme had on the person's CARDIAC OUTPUT.

Use TABLE 6, on the opposite page.
[2 marks]

0 8 . 8

Explain how diet and lifestyle can INCREASE THE RISK of poor health and non-communicable diseases. [6 marks]

[Turn over]

102

15

102

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[Turn over]

0 9

Some plants have leaves with white areas and green areas.

A student tested a leaf with white areas and green areas for starch.

This is the method used.

1. **Boil the leaf in ethanol.**

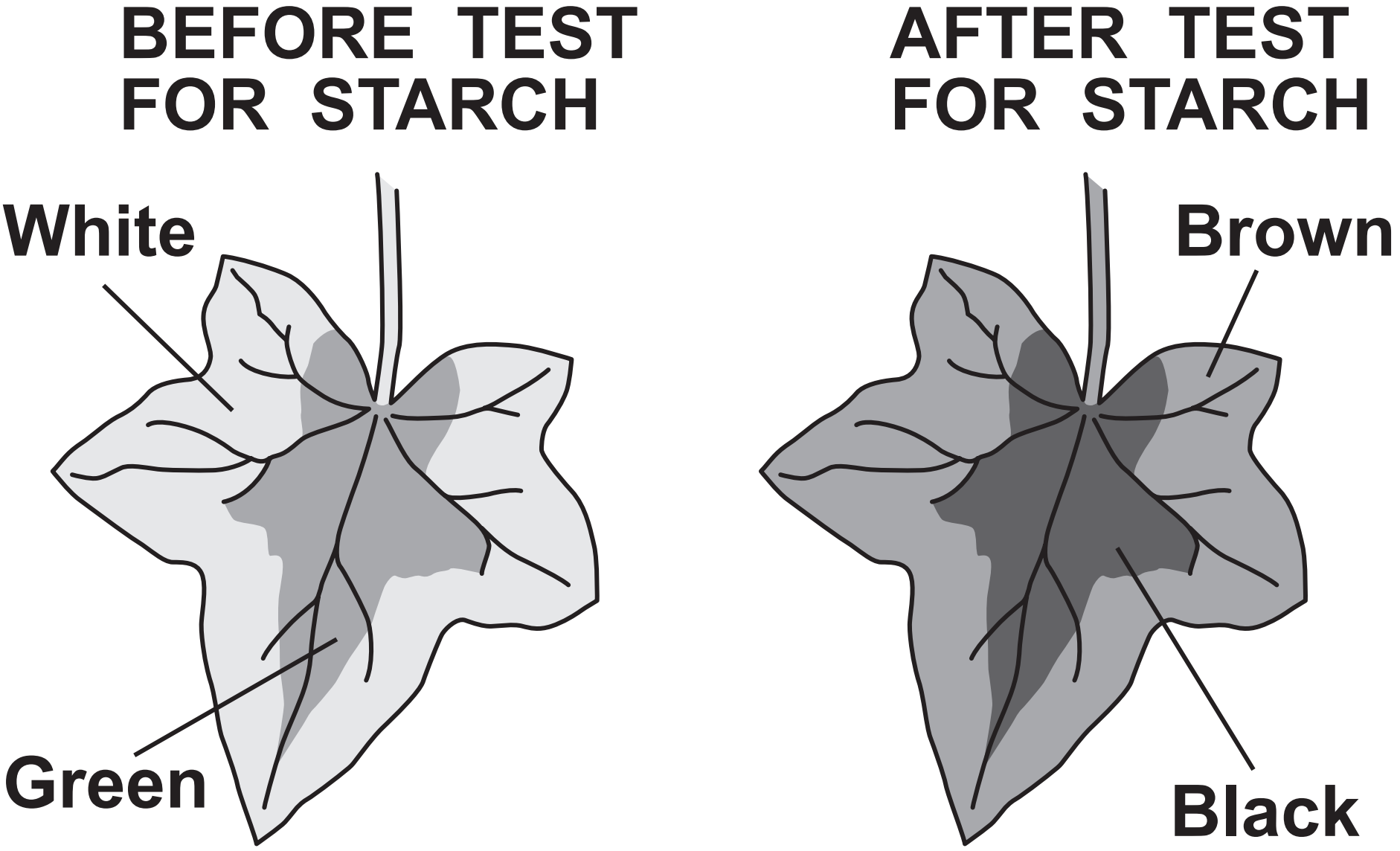
2. **Rinse the leaf in water.**

3. **Add iodine solution to the leaf.**

4. **Record the colour of each area of the leaf.**

FIGURE 19 shows the results.

FIGURE 19



[Turn over]

0 9 . 1

The student boiled the leaf in ethanol to remove the green colour from the leaf.

Why does the green colour need to be removed from the leaf before the leaf is tested for starch? [1 mark]

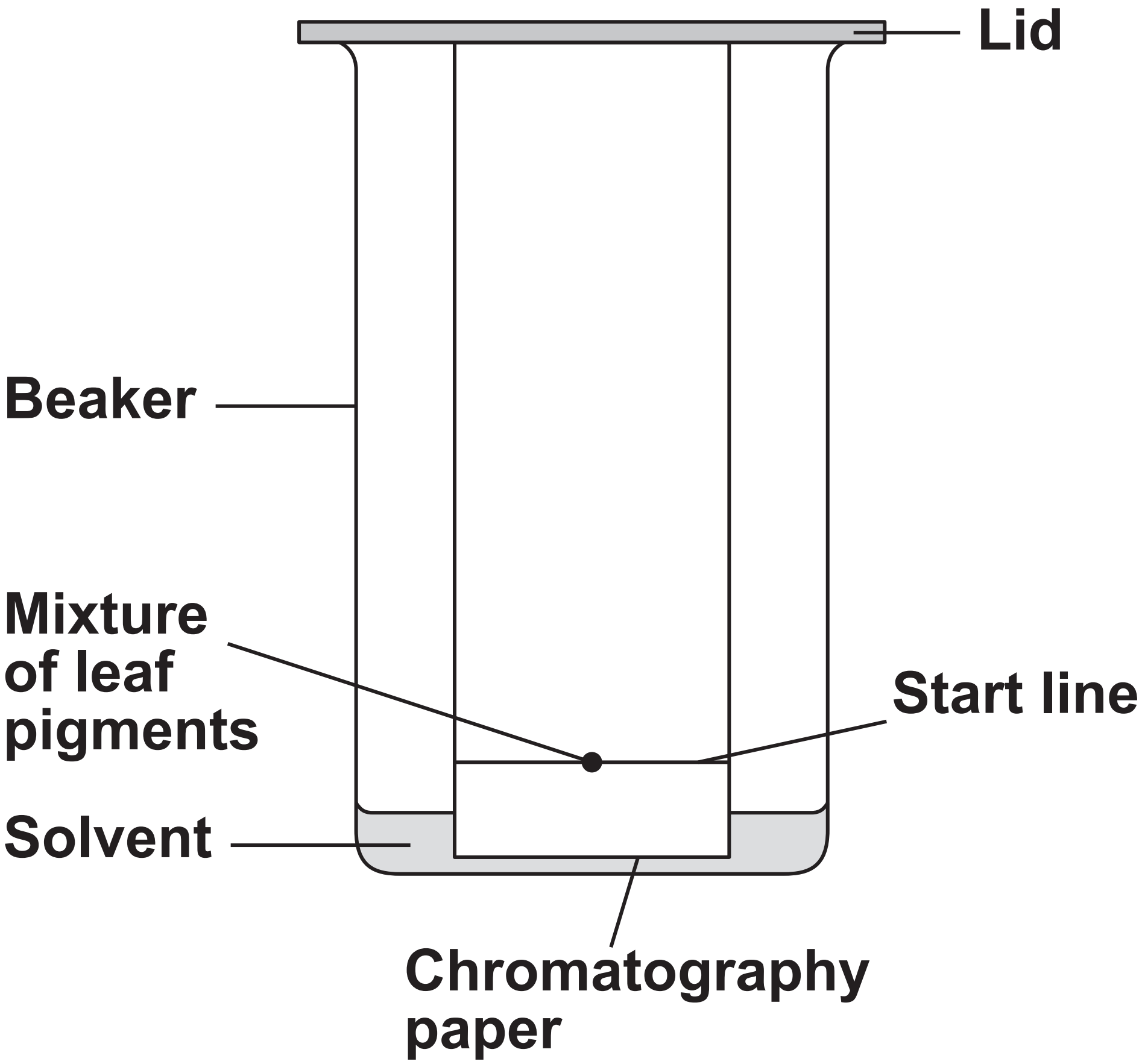
0 9 . 2

Explain how the results in FIGURE 19, on page 105, provide evidence that the white area of the leaf did NOT contain chlorophyll. [3 marks]

The student investigated the coloured pigments in the leaf.

FIGURE 20 shows the apparatus.

FIGURE 20



0 9 . 3

Chromatography involves a mobile phase and a stationary phase.

Draw ONE line from each phase to the identity of that phase in the investigation. [2 marks]

PHASE	IDENTITY OF PHASE
	Beaker
Mobile phase	Chromatography paper
Stationary phase	Mixture of leaf pigments
	Solvent

0 9 . 4

The student drew the start line in pencil.

Why did the student NOT draw the start line in ink? [1 mark]

TABLE 7 shows the results.

TABLE 7

Colour of leaf pigment	Distance moved by leaf pigment in mm	R_f value
Orange	116	0.96
Brown	42	0.35
Green	33	0.27
Yellow	X	0.24

0 9 . 5

Calculate X in TABLE 7, on the opposite page.

Use the equation:

$$R_f \text{ value} = \frac{\text{distance moved by leaf pigment}}{\text{distance moved by solvent}}$$

The distance moved by the solvent was 121 mm.

Give your answer to 2 significant figures.
[4 marks]

X (2 significant figures) = _____ mm

TABLE 8 shows the range of R_f values for known leaf pigments.

TABLE 8

Leaf pigment	Range of R_f values
Carotene	0.89 to 0.98
Chlorophyll a	0.20 to 0.30
Phaeophytin	0.33 to 0.40
Xanthophyll	0.04 to 0.28

[Turn over]

0 9 . 6

The student used TABLE 8, on page 113, to identify the leaf pigments in their investigation.

Which colour is the leaf pigment phaeophytin?

Use TABLE 7, on page 110, and TABLE 8.
[1 mark]

0 9 . 7

Another student did the investigation using the same leaf pigments.

The R_f values for the same pigments were different.

What is the reason for the difference?

Tick (✓) ONE box. [1 mark]

☐ **A different solvent was used.**

☐ **A greater volume of solvent was used.**

☐ **The solvent moved further.**

13

END OF QUESTIONS

Additional page, if required.
Write the question numbers in the left-hand margin.

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For Examiner's Use	
Question	Mark
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