AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: SYNERGY

F

Foundation Tier Paper 2 Life and Environmental Sciences

Time allowed: 1 hour 45 minutes

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.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. Do not write outside the box around each page or 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.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

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.

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There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

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0 1 Hormones are released by glands.

0 1 . 1 Which organ system produces hormones?

[1 mark]

Tick (✓) **one** box.

Circulatory system ☐

Digestive system ☐

Endocrine system ☐

0 1 . 2 How are hormones transported around the body?

[1 mark]

Tick (✓) **one** box.

Through the bloodstream ☐

Through the muscles ☐

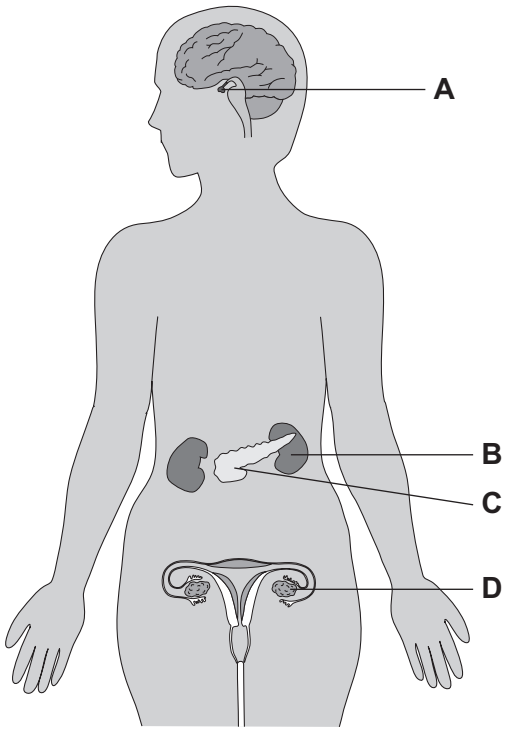
Through the nerves ☐

Question 1 continues on the next page

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

Figure 1



0 1 . 3 Which organ is the pituitary gland?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 1 . 4 Which organ produces oestrogen?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Do not write outside the box

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

0 1 . 5 Which internal body condition is controlled by homeostasis?

[1 mark]

Tick (✓) **one** box.

Body temperature ☐

Muscle contraction ☐

Nerve impulses ☐

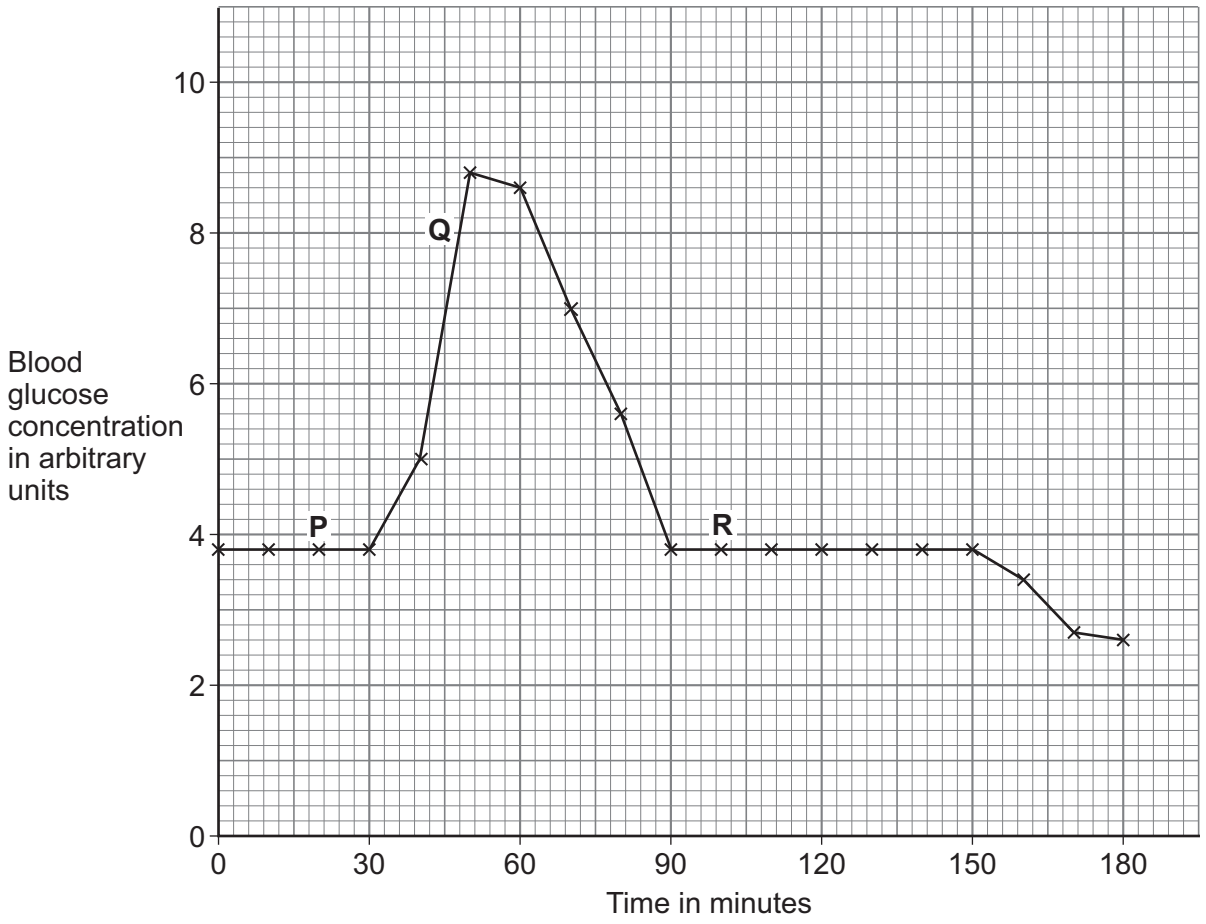
Question 1 continues on the next page

Do not write outside the box

Homeostasis also controls blood glucose concentration.

Figure 2 shows the change in blood glucose concentration in a person during 180 minutes.

Figure 2



0 1 . 6 When did the person start eating a meal?

Use **Figure 2**.

[1 mark]

Tick (✓) **one** box.

P ☐ **Q** ☐ **R** ☐

Do not write outside the box

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 box.

[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**.

[1 mark]

Tick (✓) **one** box.

P ☐ **Q** ☐ **R** ☐

0 1 . 9 What might have caused the fall in blood glucose concentration at 150 minutes?

[1 mark]

_____

_____

9

Do not write outside the box

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?

[1 mark]

Tick (✓) **one** box.

Gas ☐

Liquid ☐

Solid ☐

0 2 . 2 Complete the sentence.

Choose the answer from the box.

[1 mark]

10	**100**	**1000**

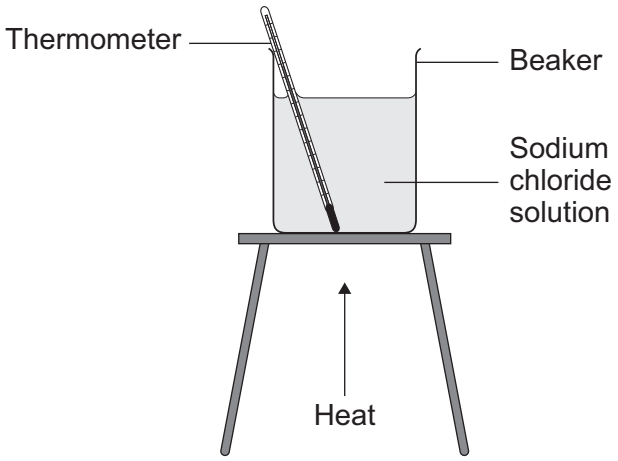
Sodium chloride is a liquid at _____ °C.

Do not write outside the box

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

Figure 3 shows the apparatus.

Figure 3



This is the method used.

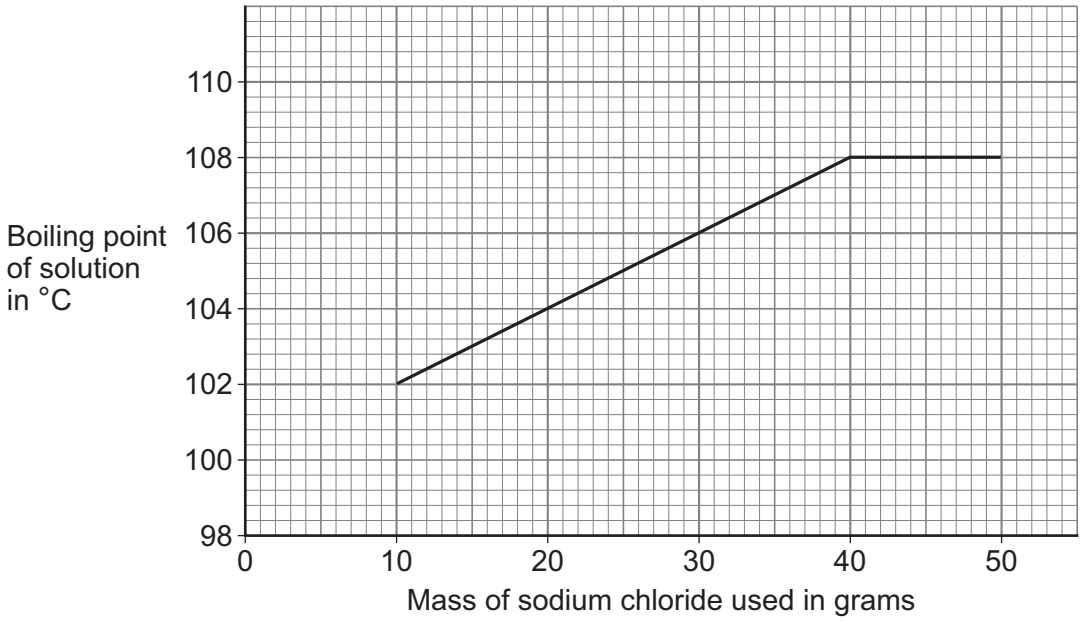
1. Add 100 cm^3 of water to a beaker.
2. Add 10 g of sodium chloride to the water.
3. Heat the beaker until the solution boils.
4. Record the boiling point of the solution.
5. Repeat steps 1 to 4 with different masses of sodium chloride.

Question 2 continues on the next page

Do not write outside the box

Figure 4 shows the results.

Figure 4



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**.

[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

Do not write outside the box

0 2 . 4 Describe the pattern of the results in **Figure 4**.

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 box.

[3 marks]

°C	**kg**	**J**	**J/kg**

Energy = _____ Unit _____

Question 2 continues on the next page

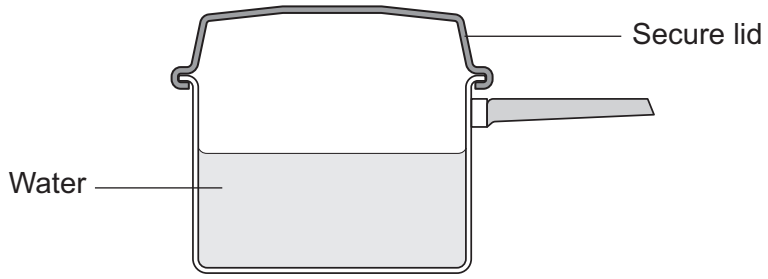
Do not write outside the box

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?

[1 mark]

Tick (✓) **one** box.

The kinetic energy of the particles will decrease. ☐

The particles will hit each other less often. ☐

The particles will move faster. ☐

Do not write outside the box

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**.

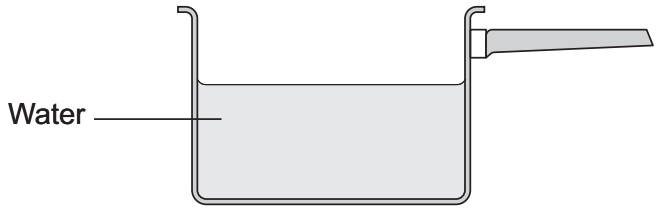
[1 mark]

Question 2 continues on the next page

Do not write outside the box

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]

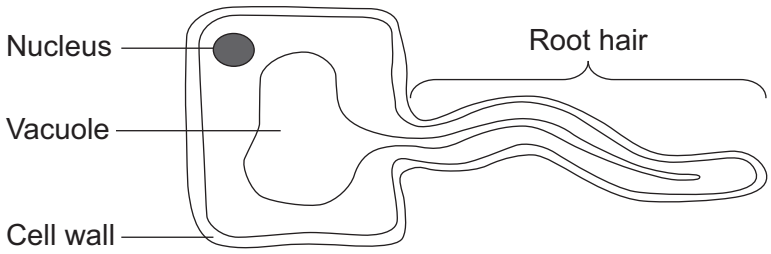
15

Do not write outside the box

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 box.

[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**.

[2 marks]

_____

_____

_____

_____

Question 3 continues on the next page

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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?

[1 mark]

Tick (✓) **one** box.

- Fungal disease ☐
- Predators ☐
- Water ☐

0 3 . 5 Soil contains magnesium ions.

Which substance in plants contains magnesium?

[1 mark]

Tick (✓) **one** box.

- Chlorophyll ☐
- Glucose ☐
- Starch ☐

Do not write outside the box

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**.

[4 marks]

11

Turn over ▶

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0 4 A student used a ripple tank to investigate water waves.

0 4 . 1 What type of wave is a water wave?

[1 mark]

Tick (✓) **one** box.

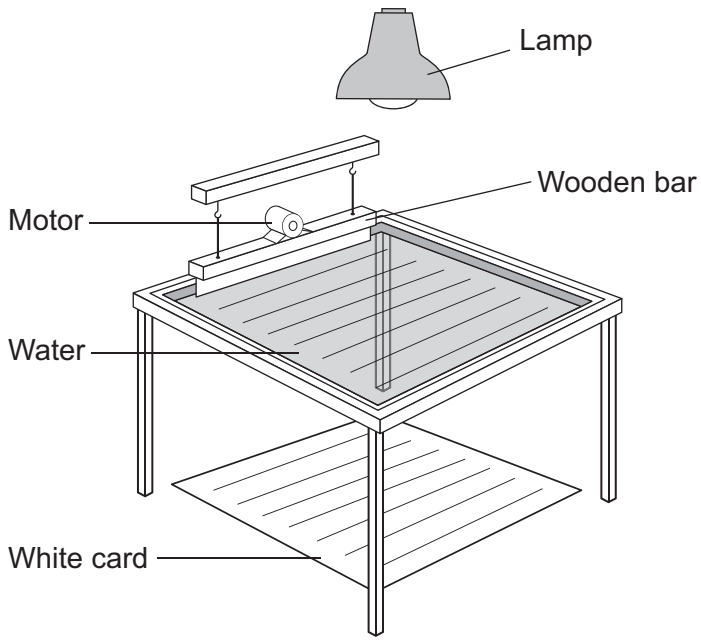
A sound wave ☐

A transverse wave ☐

An electromagnetic wave ☐

Figure 8 shows the ripple tank.

Figure 8



Do not write outside the box

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]

_____

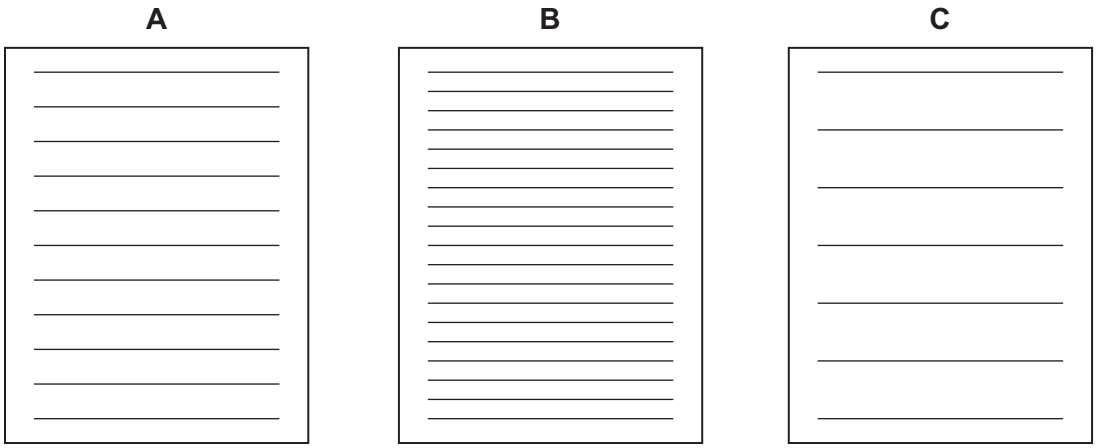
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Question 4 continues on the next page

Do not write outside the box

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

Figure 9



0 4 . 4 Which pattern in **Figure 9** shows the waves with the greatest frequency?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

Reason _____

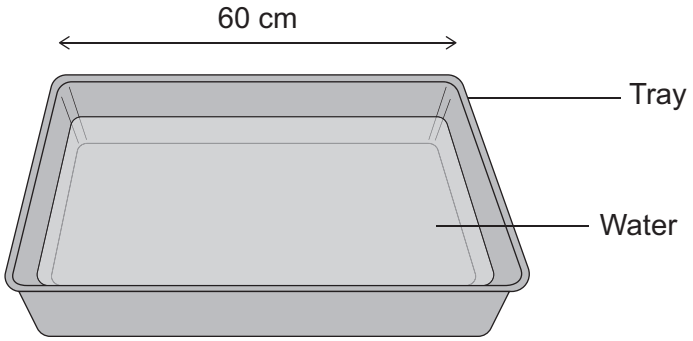
_____

Do not write outside the box

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

Figure 10 shows the apparatus.

Figure 10



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]

_____

_____

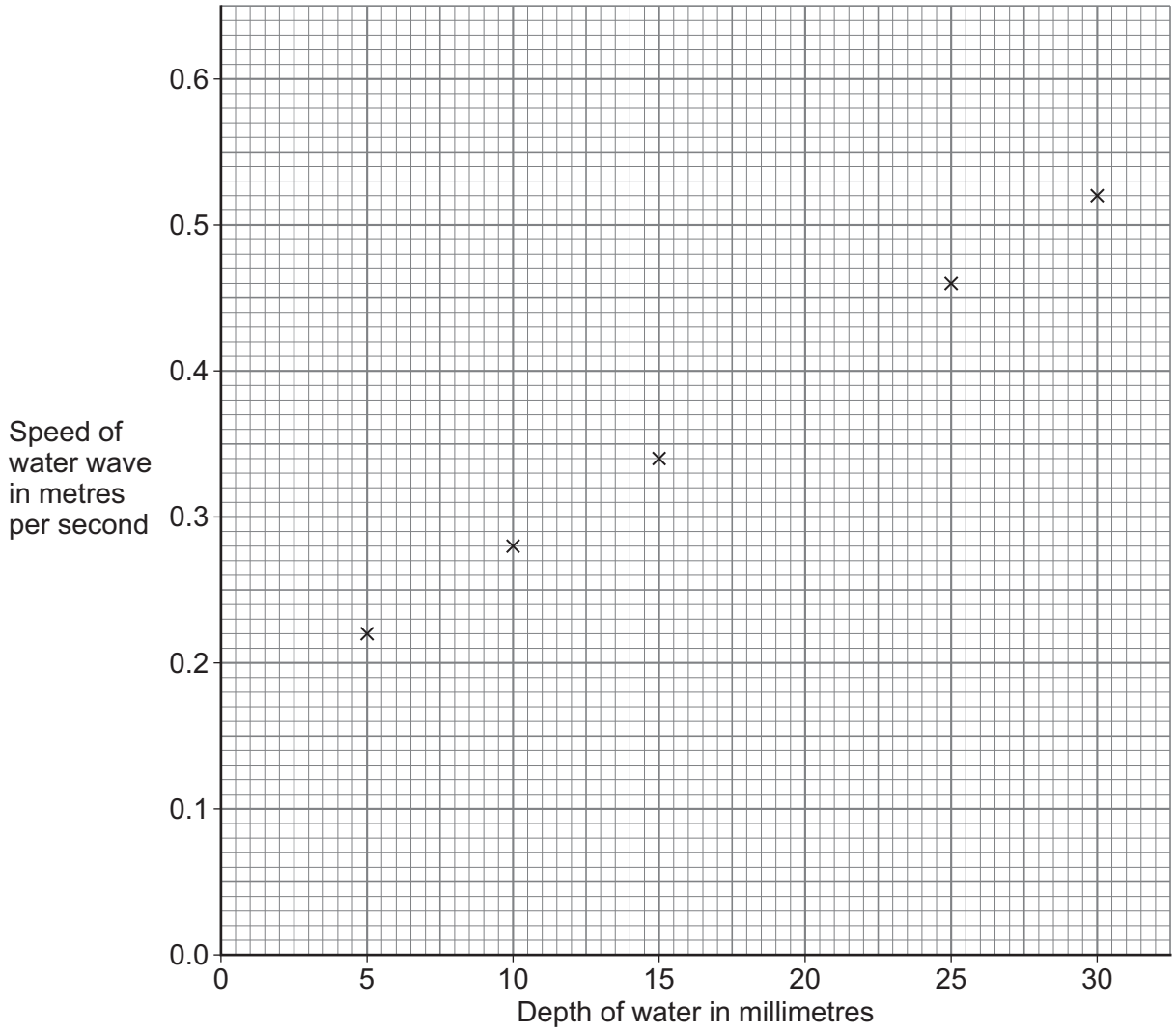
Question 4 continues on the next page

Do not write outside the box

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

Figure 11 shows the results.

Figure 11



0 4 . 6 Draw a line of best fit on **Figure 11**.

[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

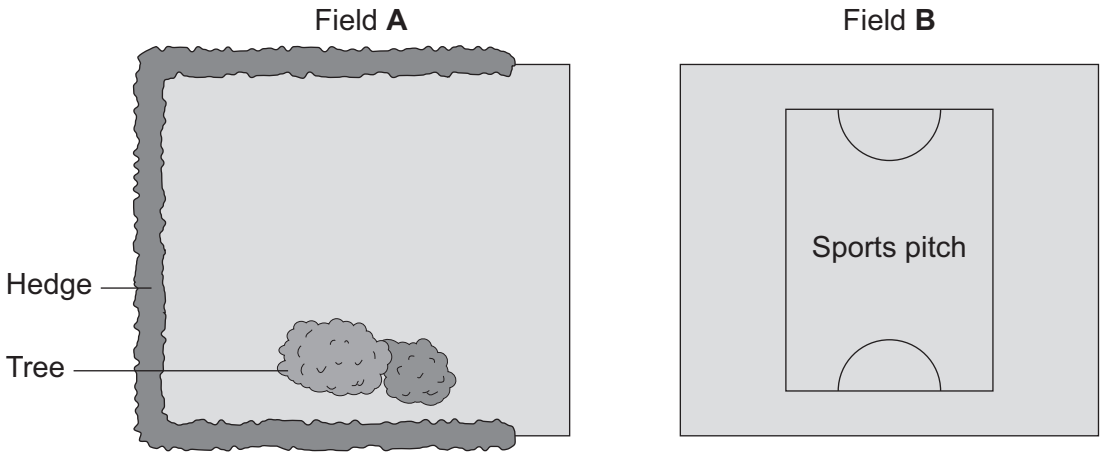
8

Do not write outside the box

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**.

0 5 . 1 The student used a quadrat to count the number of plants.

What is a quadrat?

[1 mark]

Tick (✓) **one** box.

An identification chart ☐

A square frame ☐

A tape measure ☐

Question 5 continues on the next page

Turn over ▶

Do not write outside the box

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**.

[2 marks]

X = _____

Do not write outside the box

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**.

[2 marks]

Area of field = _____ m^2

Total number of plants = _____

0 5 . 4 The mean number of plants in field **A** is greater than in field **B**.

Suggest **one** reason why.

[1 mark]

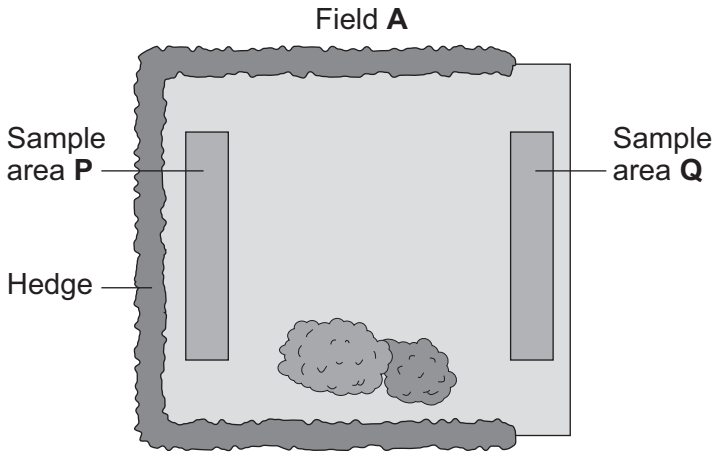
Question 5 continues on the next page

Do not write outside the box

A student did a different investigation in field **A**.

Figure 13 shows the areas sampled.

Figure 13



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

Do not write outside the box

0 5 . 5 Give **three** conclusions from the results in **Table 5**.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

0 5 . 6 Suggest **one** way to increase biodiversity in field **A**.

[1 mark]

_____

_____

10

Turn over for the next question

Do not write outside the box

0 6 Stem cells are found in human embryos and in meristem tissue.

0 6 . 1 Which organisms is meristem tissue found in?

[1 mark]

Tick (✓) **one** box.

Animals ☐

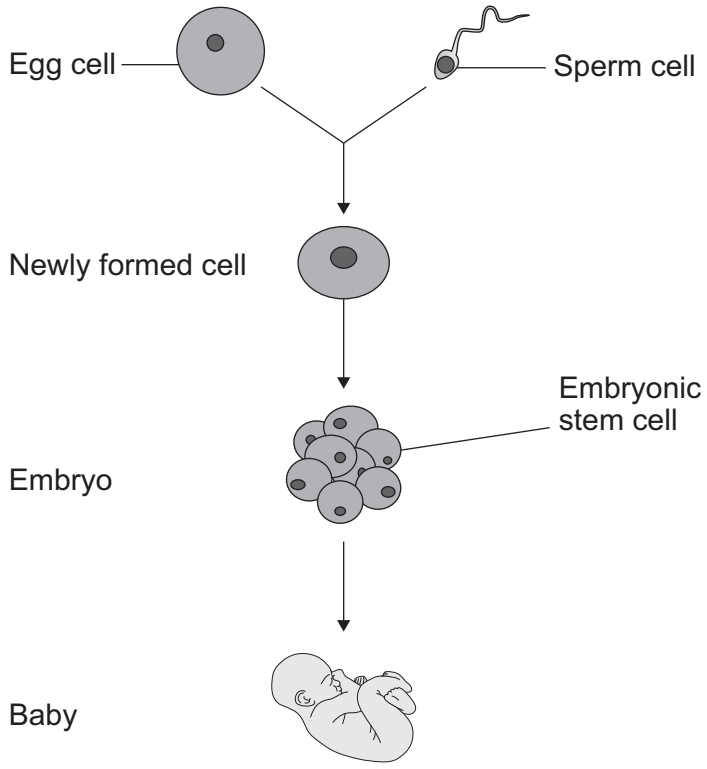
Bacteria ☐

Plants ☐

New cells are produced during the formation of an embryo.

Figure 14 shows how a human baby is formed.

Figure 14



Do not write outside the box

0 6 . 2 Complete the sentences about the processes shown in **Figure 14**.

Choose answers from the box.

[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]

_____

_____

0 6 . 4 Bone cells divide to repair damage.

Give **one** other reason why bone cells divide.

[1 mark]

_____

_____

Question 6 continues on the next page

Do not write outside the box

Scientists tested a new drug to treat tumours in mice.

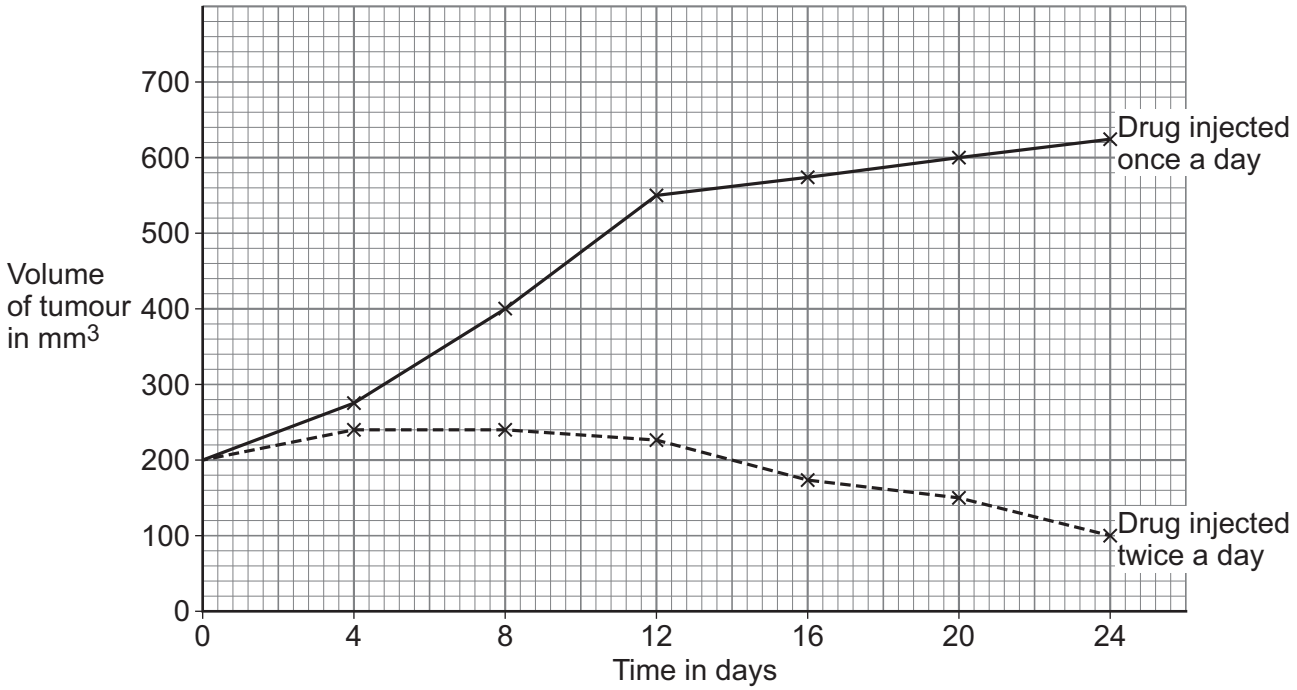
All the mice had the same type of tumour.

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



Do not write outside the box

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?

[1 mark]

Tick (✓) **one** box.

As a clinical trial ☐

As a control ☐

As an anomaly ☐

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**.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

10

Do not write outside the box

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?

[1 mark]

Tick (✓) **one** box.

BB ☐ **Bb** ☐ **bb** ☐

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	**b**
Male owl	**B**	BB	Bb
	b		

Do not write outside the box

0 7 . 3 What is the probability of the offspring having brown feathers?

Use **Figure 16**.

[1 mark]

Tick (✓) **one** box.

25% ☐ 50% ☐ 75% ☐ 100% ☐

Question 7 continues on the next page

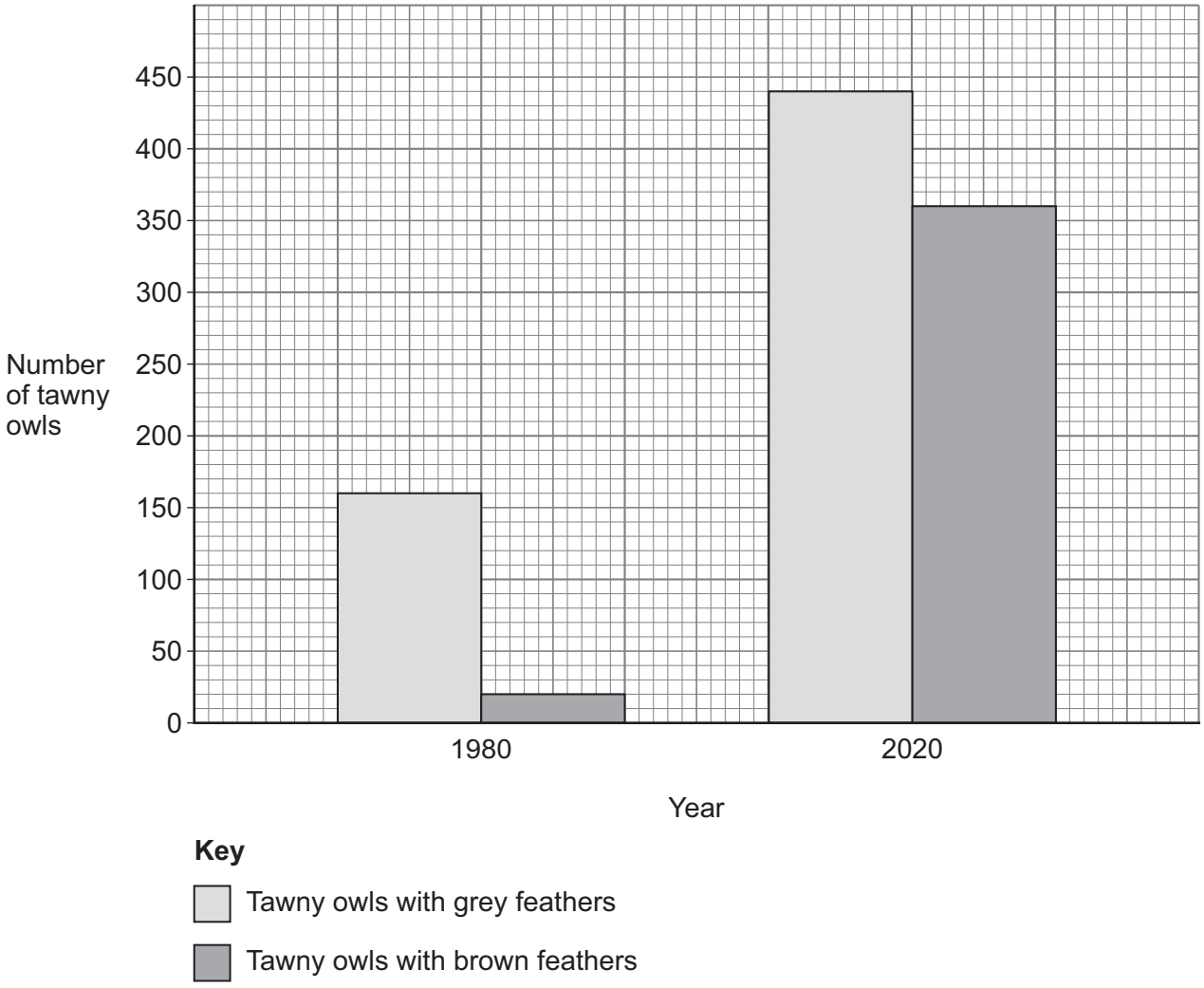
Do not write outside the box

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 shows the results.

Figure 17



Do not write outside the box

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**.

[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]

_____

_____

_____

_____

_____

_____

_____

_____

9

Do not write outside the box

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

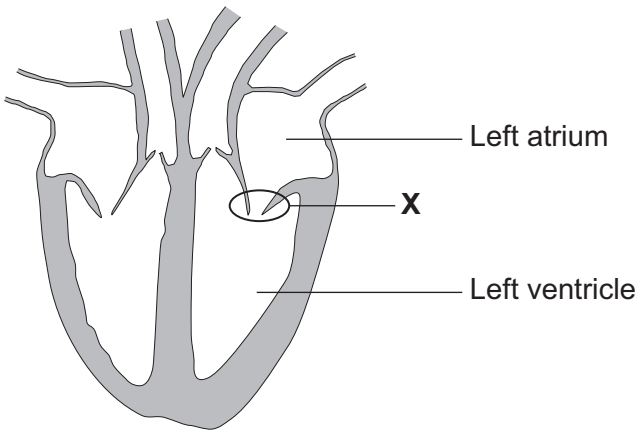
_____

_____

_____

Figure 18 shows a heart.

Figure 18



Do not write outside the box

0 8 . 2 The heart pumps blood from the body to the lungs.

Which route does blood travel through the heart?

[1 mark]

Tick (✓) **one** box.

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**?

[1 mark]

_____

_____

Question 8 continues on the next page

Do not write outside the box

0 8 . 5 The heart contains a group of cells called the pacemaker.

Which part of the heart contains the pacemaker?

[1 mark]

Tick (✓) **one** box.

Left atrium ☐

Left ventricle ☐

Right atrium ☐

Right ventricle ☐

0 8 . 6 What is the function of the pacemaker?

[1 mark]

_____

_____

Do not write outside the box

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**.

[2 marks]

Question 8 continues on the next page

Do not write outside the box

0 8 . 8 Explain how diet and lifestyle can **increase the risk** of poor health and non-communicable diseases.

[6 marks]

15

Do not write outside the box

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 9 Some plants have leaves with white areas and green areas.

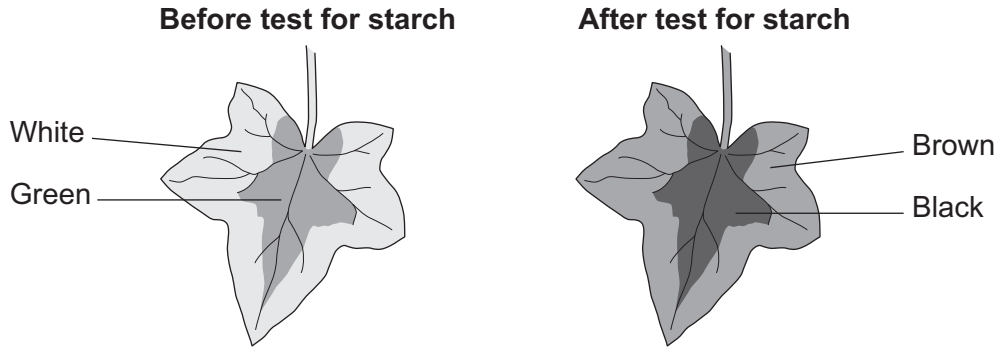
A student tested a leaf with white areas and green areas for starch.

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



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]

_____

_____

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0 9 . 2 Explain how the results in **Figure 19** provide evidence that the white area of the leaf did **not** contain chlorophyll.

[3 marks]

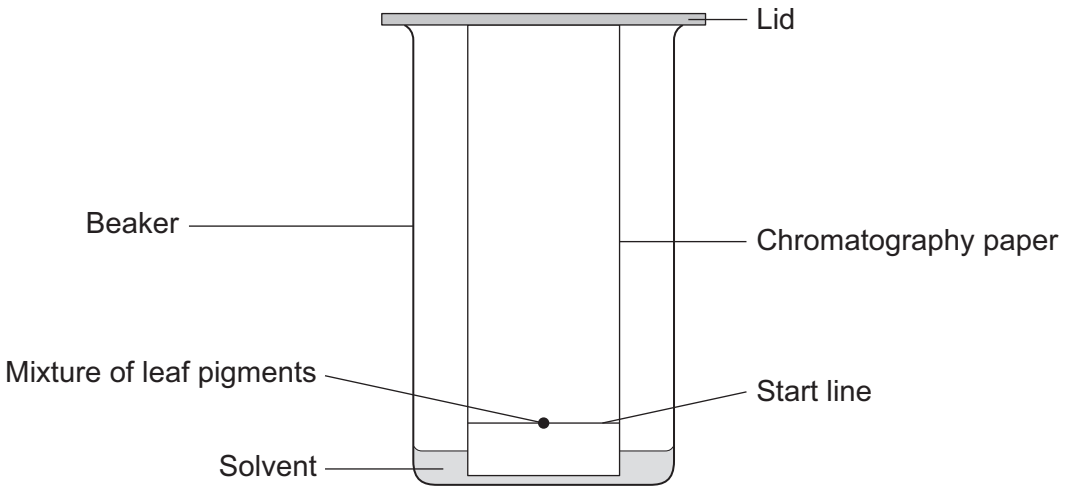
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The student investigated the coloured pigments in the leaf.

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

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0 9 . 4 The student drew the start line in pencil.

Why did the student **not** draw the start line in ink?

[1 mark]

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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**.

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

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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

0 9 . 6 The student used **Table 8** to identify the leaf pigments in their investigation.

Which colour is the leaf pigment phaeophytin?

Use **Table 7** 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?

[1 mark]

Tick (✓) **one** box.

A different solvent was used. ☐

A greater volume of solvent was used. ☐

The solvent moved further. ☐

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END OF QUESTIONS

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