



Surname \_\_\_\_\_

Other Names \_\_\_\_\_

Centre Number \_\_\_\_\_

Candidate Number \_\_\_\_\_

Candidate Signature \_\_\_\_\_

I declare this is my own work.

**GCSE  
COMBINED SCIENCE: SYNERGY**

**H**

**8465/2H**

**Higher Tier**

**Paper 2 Life and Environmental Sciences**

**Time allowed: 1 hour 45 minutes**

**For this paper you must have:**

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

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

**[Turn over]**



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## 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
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The human circulatory system transports blood around the body.

0	1	.	1
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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
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Largest      circulatory system



Smallest

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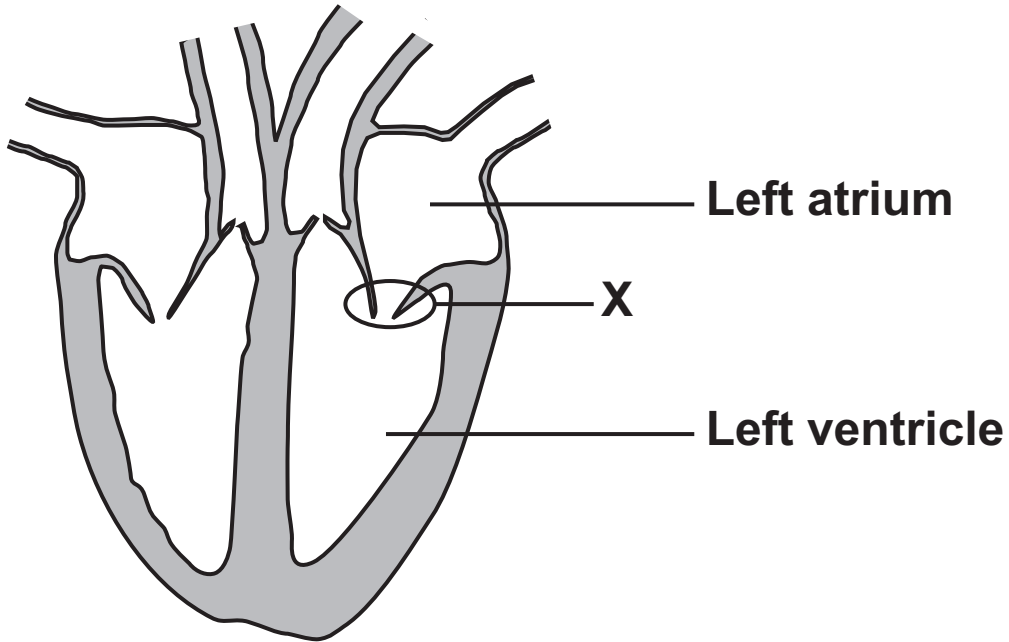
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FIGURE 1 shows a heart.

FIGURE 1



[Turn over]



0	1	.	2
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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	1	.	3
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**Explain why the wall of the left ventricle is thicker than the wall of the right ventricle. [2 marks]**

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0	1	.	4
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**What is the function of structure X shown in FIGURE 1, on page 5? [1 mark]**

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**[Turn over]**



0 1 . 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

0 1 . 6

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

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**[Turn over]**



01.7

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

TABLE 1 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 1

Stage of training programme	Heart rate in beats per minute	Stroke volume in cm <sup>3</sup>	Cardiac output in cm <sup>3</sup> 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 1, on the opposite page. [2 marks]

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[Turn over]







0	2
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Some plants have leaves with white areas and green areas.

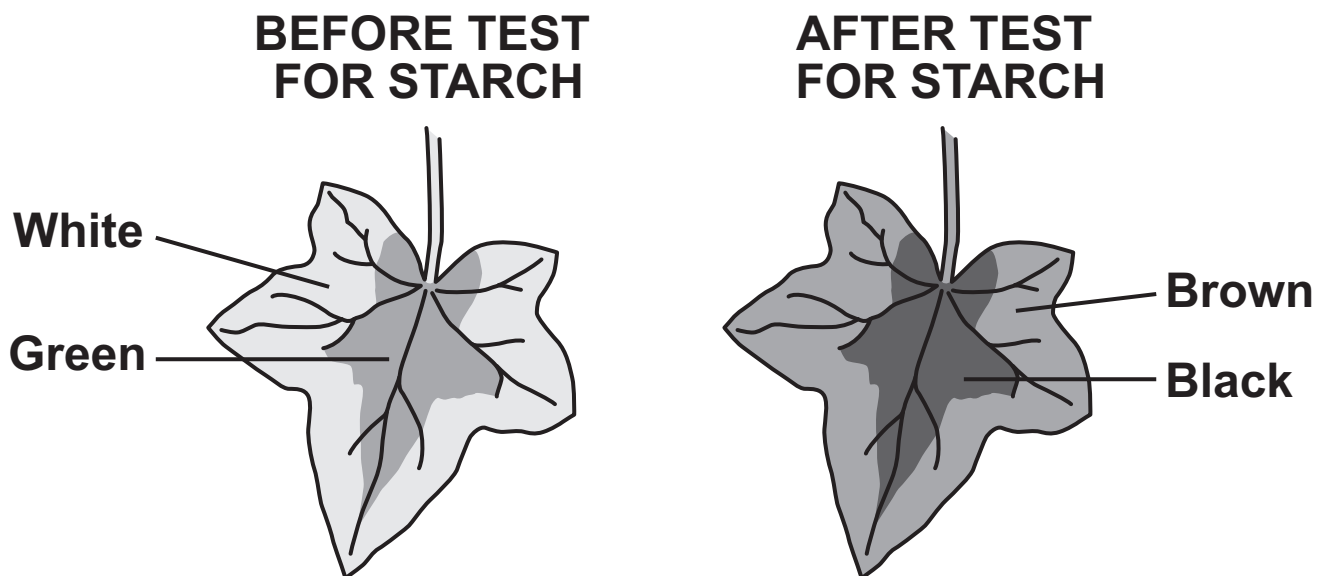
A student tested a leaf with white areas and green areas for starch.

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 2 shows the results.

FIGURE 2



0 2 . 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 2 . 2

Explain how the results in FIGURE 2, on the opposite page, provide evidence that the white area of the leaf did NOT contain chlorophyll. [3 marks]

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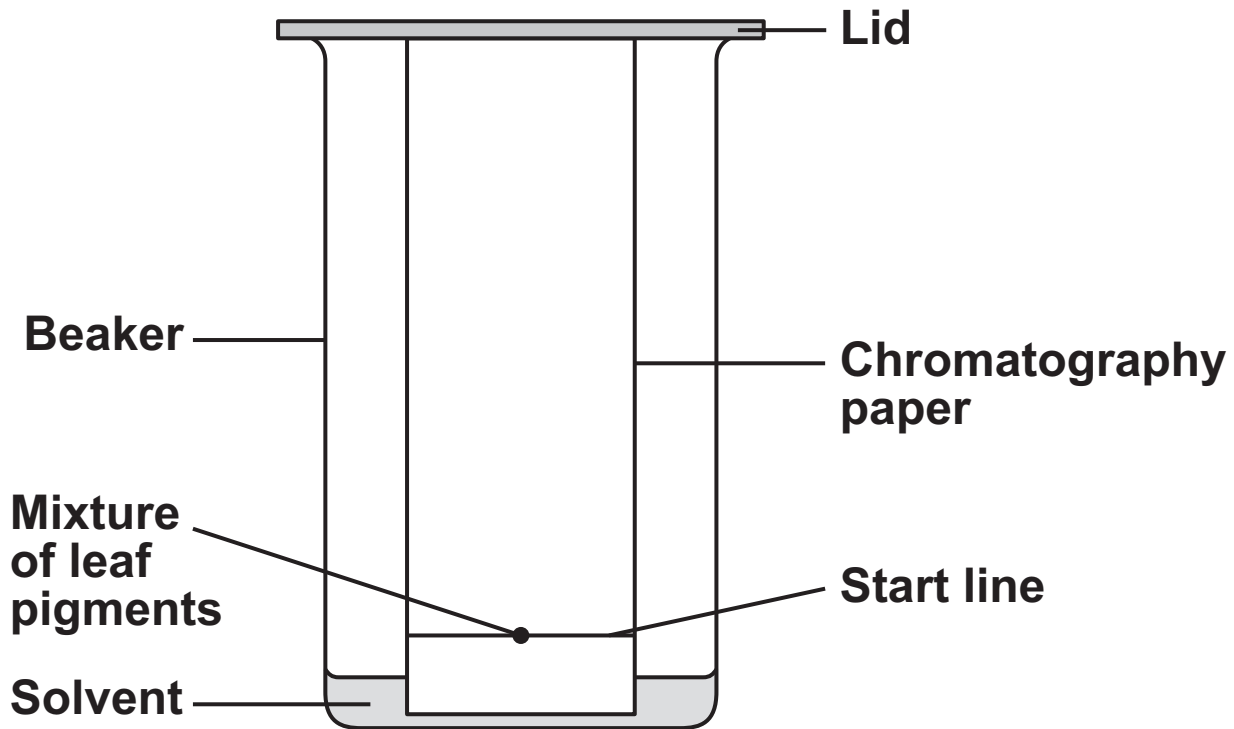
[Turn over]



The student investigated the coloured pigments in the leaf.

FIGURE 3 shows the apparatus.

FIGURE 3





0 2 . 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****Mobile phase****Beaker****Stationary phase****Chromatography  
paper****Mixture of leaf  
pigments****Solvent****[Turn over]**

**0 2 . 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 2 shows the results.

TABLE 2

Colour of leaf pigment	Distance moved by leaf pigment in mm	R <sub>f</sub> value
Orange	116	0.96
Brown	42	0.35
Green	33	0.27
Yellow	X	0.24





**TABLE 3** shows the range of  $R_f$  values for known leaf pigments.

**TABLE 3**

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 2 . 6

The student used TABLE 3 to identify the leaf pigments in their investigation.

Which colour is the leaf pigment phaeophytin?

Use TABLE 2, on page 18, and TABLE 3. [1 mark]

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0	2	.	7
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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

[Turn over]



0	3
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**Waves transfer energy.**

0	3	.	1
---	---	---	---

**Radio waves are transmitted from a radio station and absorbed by a radio receiver.**

**What is created in the radio receiver when the radio waves are absorbed?**

**Tick (✓) ONE box. [1 mark]**

**An alpha particle**

**An alternating current**

**An ultraviolet wave**

**An X-ray**

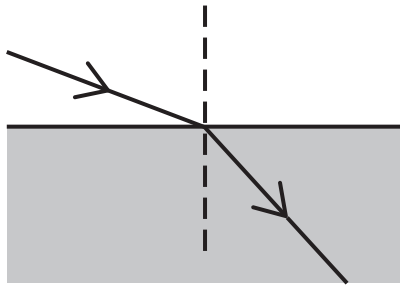


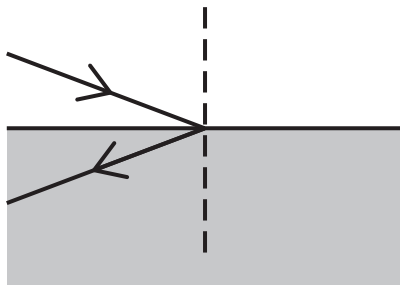
03.2

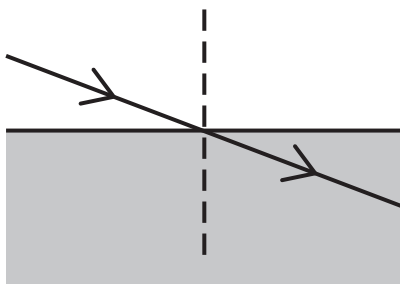
Radio waves may be refracted when they travel from one substance into another substance.

Which diagram shows the refraction of a radio wave?

Tick (✓) ONE box. [1 mark]







[Turn over]



When the radio receiver is switched on, a sound wave is produced.

0 3 . 3

Give TWO differences between radio waves and sound waves. [2 marks]

1 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_





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**[Turn over]**



03.4

TABLE 4 shows the speed of sound in different substances at two different temperatures.

TABLE 4

<b>SUBSTANCE</b>	<b>Temperature of substance in °C</b>	<b>Speed of sound in metres per second</b>
<b>Air</b>	<b>1</b>	<b>332</b>
<b>Air</b>	<b>20</b>	<b>344</b>
<b>Steel</b>	<b>1</b>	<b>5002</b>
<b>Steel</b>	<b>20</b>	<b>5136</b>
<b>Water</b>	<b>1</b>	<b>1411</b>
<b>Water</b>	<b>20</b>	<b>1465</b>



**Give THREE conclusions about the effect of temperature and the type of substance on the speed of sound waves. [3 marks]**

**1** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**2** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**3** \_\_\_\_\_

\_\_\_\_\_

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**[Turn over]**

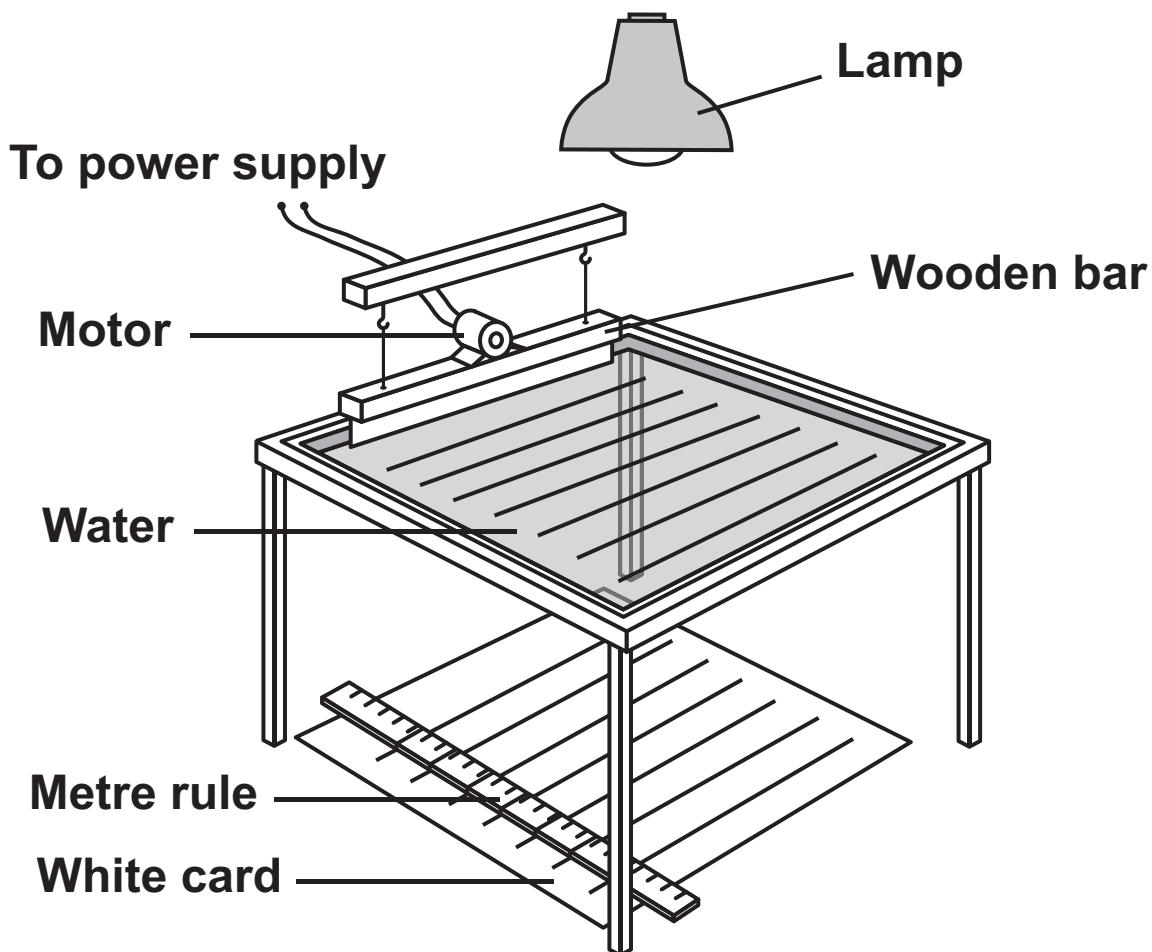


**03.5**

A teacher used a ripple tank to show how varying the frequency affected the wavelength of water waves.

FIGURE 4 shows the apparatus.

FIGURE 4



This is the method used.

1. Turn on the lamp.
2. Adjust the power supply so that the wooden bar vibrates with a frequency of 10 Hz to produce waves on the water.





0 4

A tumour is a group of abnormal cells that form a lump.

0 4 . 1

Give ONE factor that causes cells to form tumours. [1 mark]

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0 4 . 2

Tumours can be benign or malignant.

Malignant tumours are cancers.

Give TWO ways a malignant tumour is different from a benign tumour. [2 marks]

1

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2

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**Scientists tested a new drug to treat tumours in mice.**

**All the mice:**

- **had the same type of tumour**
- **were the same age**
- **were female.**

**This is the method used.**

1. **Inject the mice with a dose of 0.015 mg of the drug every day for 20 days.**
2. **Measure the volume of the tumour every 4 days.**
3. **Repeat steps 1 and 2 with new groups of mice using doses of:**
  - **0.030 mg of the drug**
  - **0.060 mg of the drug.**

**[Turn over]**



0	4	.	3
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Give TWO control variables the scientists should have used in the drug test.

Do NOT refer to the type of tumour, the age of the mice or the sex of the mice. [2 marks]

1 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

0	4	.	4
---	---	---	---

Some mice were used as a control group.

Suggest what treatment was given to the control group.  
[1 mark]

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_





0	4	.	5
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Give ONE reason why the scientists used a control group. [1 mark]

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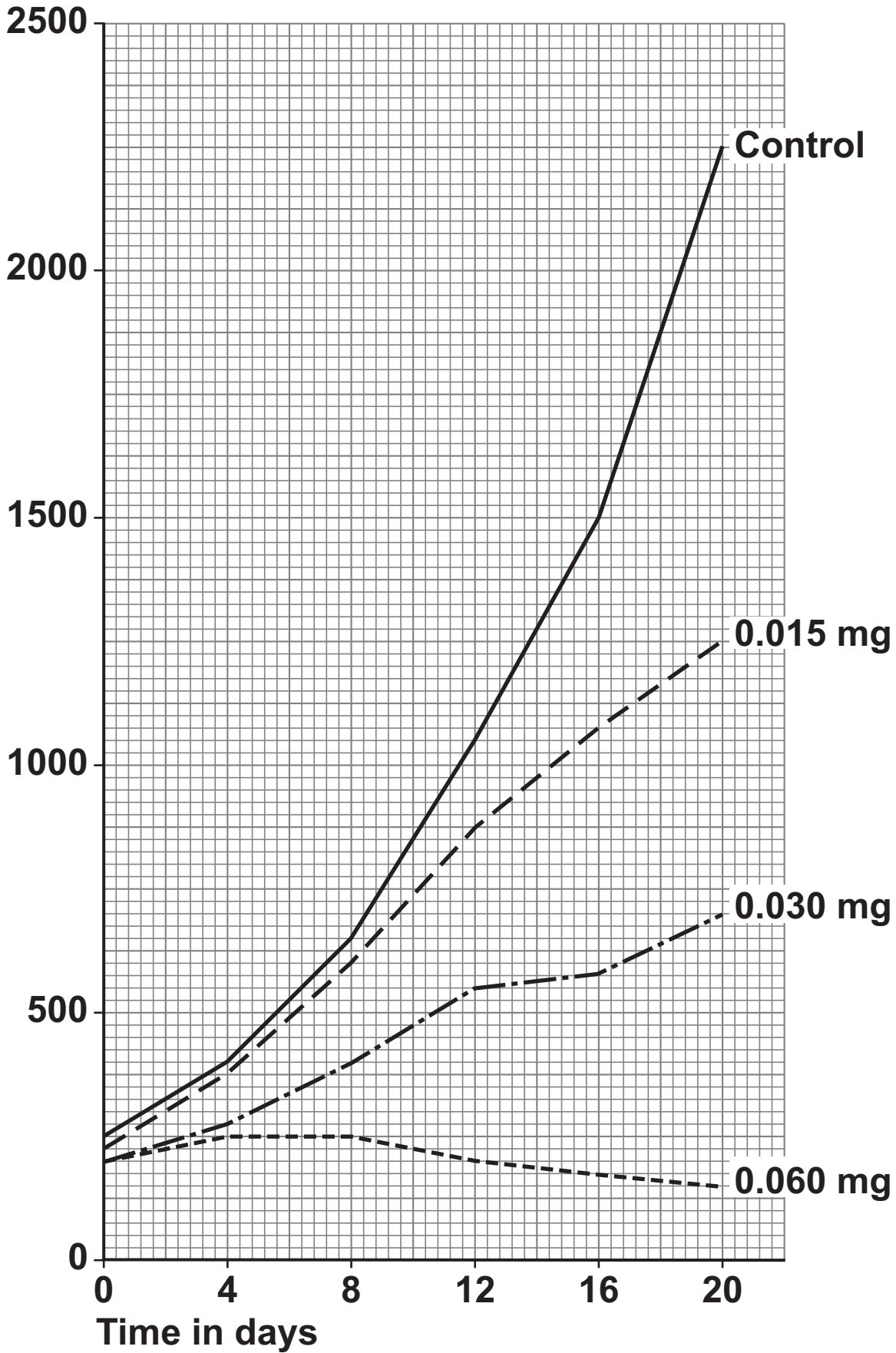
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FIGURE 5, on page 34, shows the results.

[Turn over]



FIGURE 5

Volume of tumour in  $\text{mm}^3$ 

0	4	.	6
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Calculate the percentage increase in the volume of the tumour in the control group between 0 and 20 days.  
[3 marks]

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Percentage increase = \_\_\_\_\_ %

[Turn over]



0 4 . 7

Give TWO conclusions about the effectiveness of the different doses of the drug.

Use FIGURE 5, on page 34. [2 marks]

1 \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2 \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

0 4 . 8

Suggest why the scientists measured the volume of the tumour instead of measuring the width of the tumour.  
[1 mark]

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



0	4	.	9
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The scientists tested the drug in two stages:

- stage 1: drug tested on pieces of tumour tissue
- stage 2: drug tested on mice with tumours.

What extra information will the scientists gain by testing the drug on mice at stage 2? [1 mark]

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14

[Turn over]



0	5
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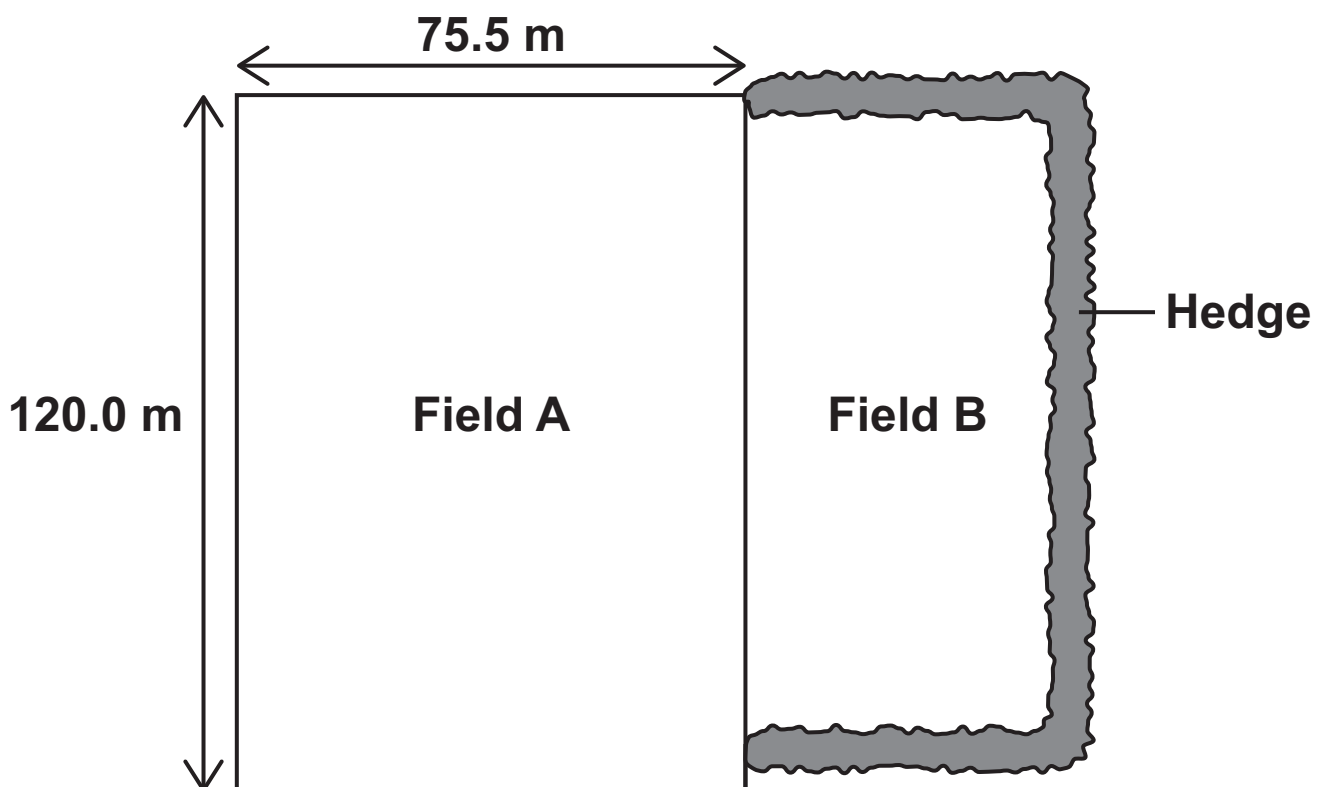
A student investigated the number of plants in two different fields.

This is the method used.

1. Place a quadrat randomly in field A.
2. Count the number of plants of each species in the quadrat. Do NOT count grasses.
3. Repeat steps 1 and 2 another 19 times.
4. Repeat steps 1 to 3 for field B.

FIGURE 6 shows the two fields.

FIGURE 6



0 5 . 1

Why should a random sampling method be used to sample the plants? [1 mark]

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0 5 . 2

The student counted dandelion plants.

The student used a 0.5 m × 0.5 m quadrat.

The mean number of dandelion plants in field A in FIGURE 6, on the opposite page, was 2.8 per quadrat.

Determine the total number of dandelion plants in field A. [4 marks]

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[Turn over]



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**Total number = \_\_\_\_\_**

**The student placed insect traps in the ground in field A and in field B.**

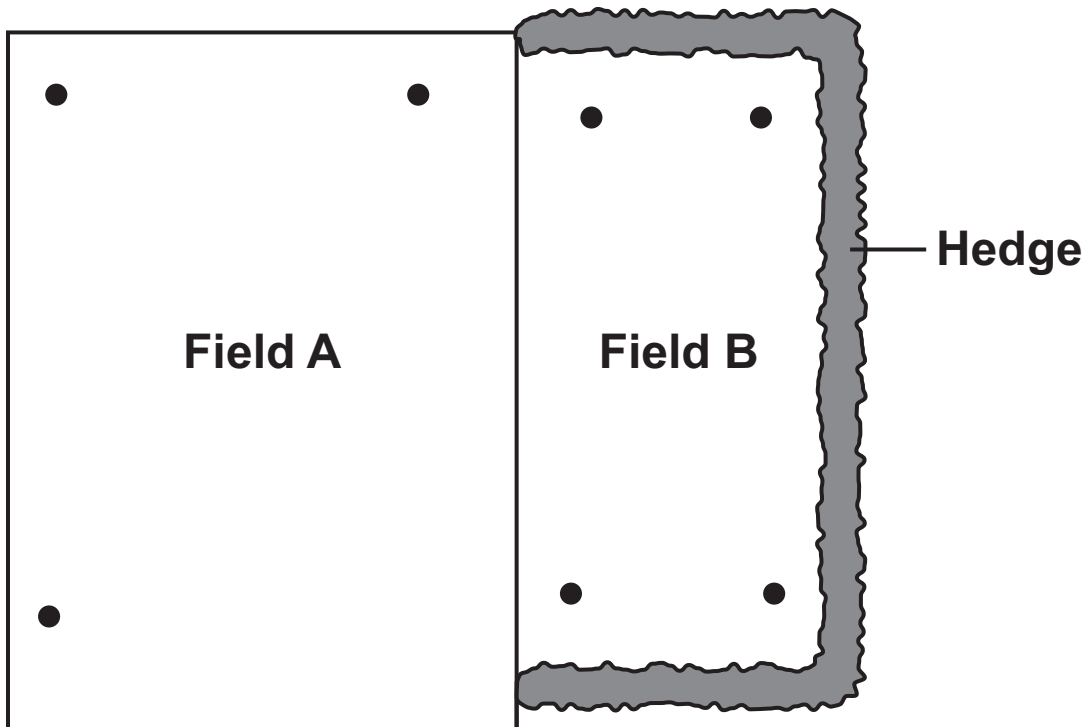
**The insect traps were used to estimate the total number of insects in each field.**





**FIGURE 7** shows the position of the insect traps in each field.

**FIGURE 7**



**KEY**

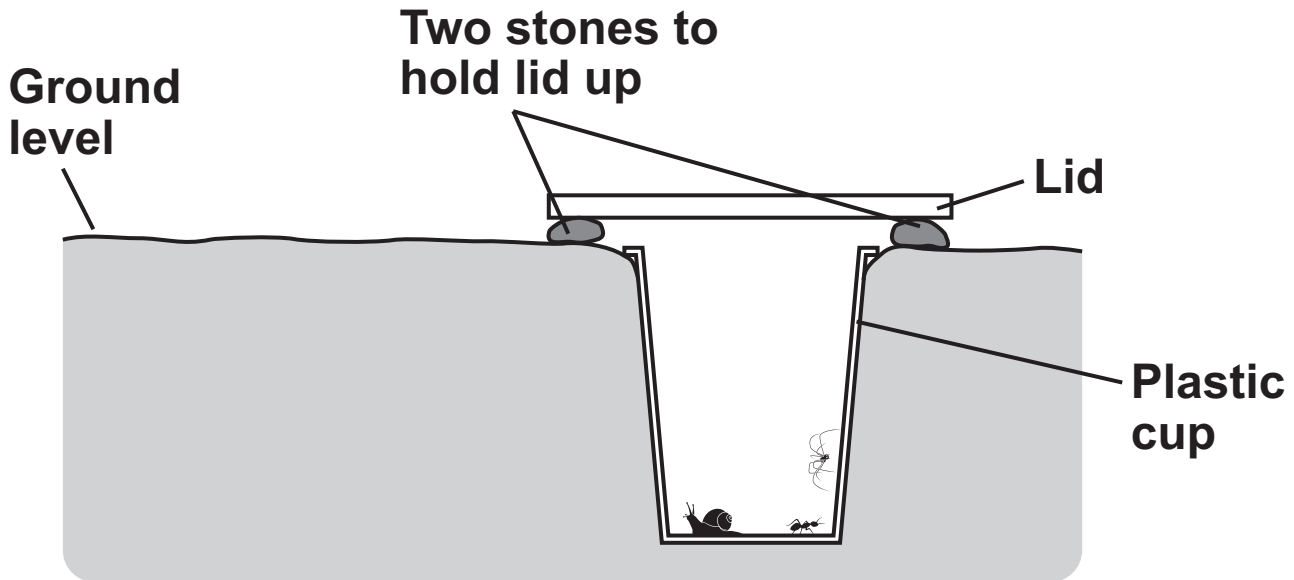
- Position of insect traps

[Turn over]



**FIGURE 8** shows the insect trap the student used.

**FIGURE 8**



**This is the method used.**

- 1. Place the insect traps in the fields as shown in FIGURE 7, on page 41, and FIGURE 8.**
- 2. Leave for 12 hours.**
- 3. Count the number of insects of each species in each trap.**
- 4. Repeat every 2 days for 6 days.**



0	5	.	3
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The method for estimating the total number of insects in field A and field B may NOT give valid results.

Suggest TWO reasons why. [2 marks]

1 \_\_\_\_\_  
\_\_\_\_\_

2 \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

[Turn over]



**0 5 . 4**

**TABLE 5** shows the results for all the plants and insects sampled.

**TABLE 5**

	Mean number of plants per quadrat	Number of different species of plant	Total number of insects	Number of different species of insect
<b>FIELD A</b>	10.7	3	75	3
<b>FIELD B</b>	10.6	16	130	2

**A student concluded:**

**‘There is greater biodiversity in field B than in field A.’**

**Give the reason why. [1 mark]**

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0	5	.	5
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There has been a decrease in the total number of birds in the UK since 1970.

Explain how planting more hedges would affect the number of birds. [2 marks]

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10

[Turn over]



0	6
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**Some mosquitos can transmit malaria.**

0	6	.	1
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**Describe how a mosquito transmits malaria. [2 marks]**

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**Scientists discovered a population of mosquitos living in the tunnels of the London Underground train system.**

**The mosquito 'C. pipiens' entered the tunnels when the London Underground was being built in the 1800s.**

**Some mosquitos were trapped in the tunnels.**



**TABLE 6** gives information about ‘C. pipiens’ mosquitos.

**TABLE 6**

<b>‘C. pipiens’ that live above ground</b>	<b>‘C. pipiens’ that live in the tunnels</b>
<b>Feed on the blood of birds during the spring and summer</b>	<b>Feed on the blood of rats throughout the year</b>
<b>Need to feed on blood before laying eggs</b>	<b>Do NOT need to feed on blood before laying eggs</b>
<b>Are NOT active in the autumn and winter</b>	<b>Stay active all year round</b>

**0 6 . 2**

**Suggest ONE reason why the mosquitos living in the tunnels stay active all year round. [1 mark]**

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**[Turn over]**



Some scientists believe that the mosquitos living in the tunnels have evolved into a new species.

06.3

Name the process that causes evolution. [1 mark]

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06.4

Explain how the mosquitos living in the tunnels could have evolved into a different species from those living above ground. [6 marks]

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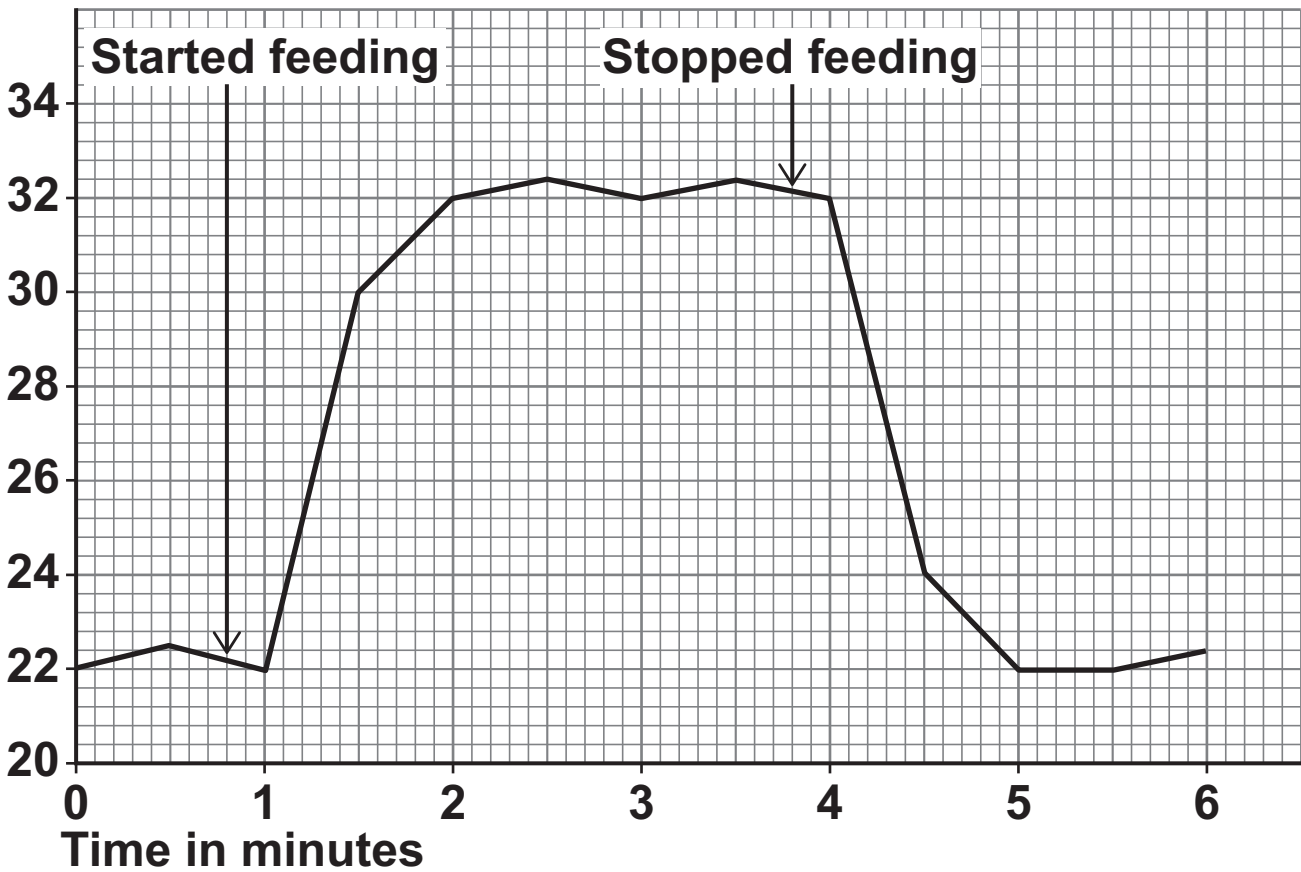
06.5

Most female mosquitos feed on the blood of animals before laying their eggs.

FIGURE 9 shows the change in the body temperature of a female mosquito while feeding on blood.

FIGURE 9

Body temperature  
of mosquito in °C





07

Matter can exist in different states.

TABLE 7 shows the melting points and boiling points of four substances.

TABLE 7

SUBSTANCE	Melting point in °C	Boiling point in °C
Carbon dioxide	-78	-78
Methane	-183	-162
Nitrogen	-210	-196
Water	0	100

07.1

Give the temperature at which nitrogen condenses.  
[1 mark]

\_\_\_\_\_ °C

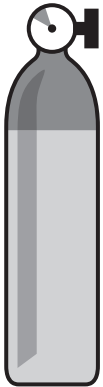


07.2

Nitrogen gas is transported in cylinders at high pressure.

FIGURE 10 shows a cylinder containing nitrogen gas.

FIGURE 10



What causes the pressure on the inside walls of the gas cylinder? [1 mark]

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[Turn over]



0	7	.	3
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**Carbon dioxide sublimates.**

**What happens when carbon dioxide sublimates?**

**Use TABLE 7, on page 52. [1 mark]**

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0	7	.	4
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**Solid carbon dioxide is used during the transport of frozen food.**

**Using solid carbon dioxide keeps the food cold for longer than using frozen water.**

**Suggest ONE other advantage of using solid carbon dioxide instead of using frozen water during the transport of frozen food. [1 mark]**

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0	7	.	5
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The planet Saturn has a moon called Titan.

The surface temperature of Titan is  $-179.6\text{ }^{\circ}\text{C}$ .

Features similar to rivers have been seen on Titan.

Which substance in TABLE 7, on page 52, could be the liquid in the rivers on Titan? [1 mark]

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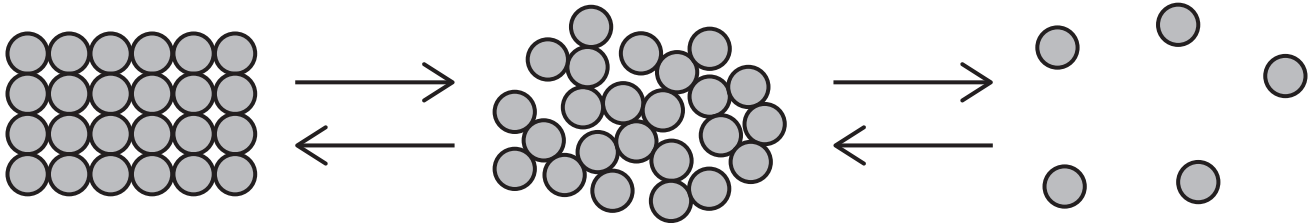
[Turn over]



07.6

FIGURE 11 shows a simple model which can be used to describe changes of state.

FIGURE 11



Give TWO limitations of using this model to describe changes of state. [2 marks]

1 \_\_\_\_\_

2 \_\_\_\_\_







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Specific latent heat of vaporisation = \_\_\_\_\_ J/kg

13



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**[Turn over]**



0	8
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Plants have different tissues that are adapted for special functions.

One plant tissue is meristem tissue.

Meristem tissue:

- is made of meristem stem cells
- is found in the growing areas of a plant
- contains the cells that divide as a plant grows.

FIGURE 12 shows how specialised leaf cells are produced from meristem cells.

FIGURE 12



**Meristem cells divide and then form specialised cells.**

**0 8 . 1**

**Cells become specialised during process X.**

**Name process X. [1 mark]**

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**0 8 . 2**

**Describe TWO changes that can happen in a plant because meristem cells divide. [2 marks]**

**1** \_\_\_\_\_

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**2** \_\_\_\_\_

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**[Turn over]**

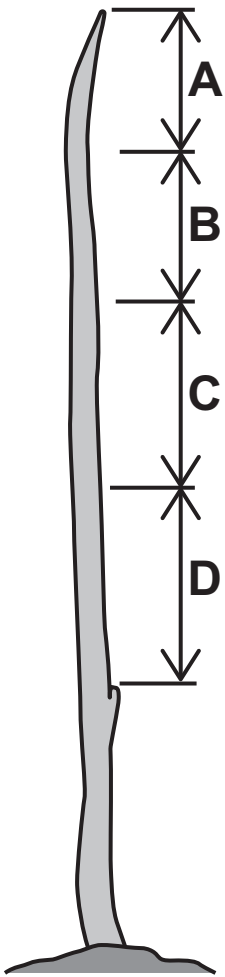


08.3

Scientists used a microscope to investigate cell division in a plant shoot.

FIGURE 13 shows the plant shoot.

FIGURE 13



The percentage of cells dividing by mitosis was estimated.

This is the method used.

1. Take a tissue sample from section A of the plant shoot and view 100 cells.
2. Count how many of the 100 cells are dividing by mitosis.
3. Repeat steps 1 and 2 for sections B, C and D of the plant shoot.

[Turn over]



TABLE 8 shows the results.

TABLE 8

Section of plant shoot	Percentage (%) of cells dividing by mitosis
A	13
B	4
C	0
D	0

Explain the results in TABLE 8. [2 marks]

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Phloem tissue and xylem tissue are part of a plant's transport system.

0 8 . 4

What is the name of the process that transports dissolved sugars around a plant? [1 mark]

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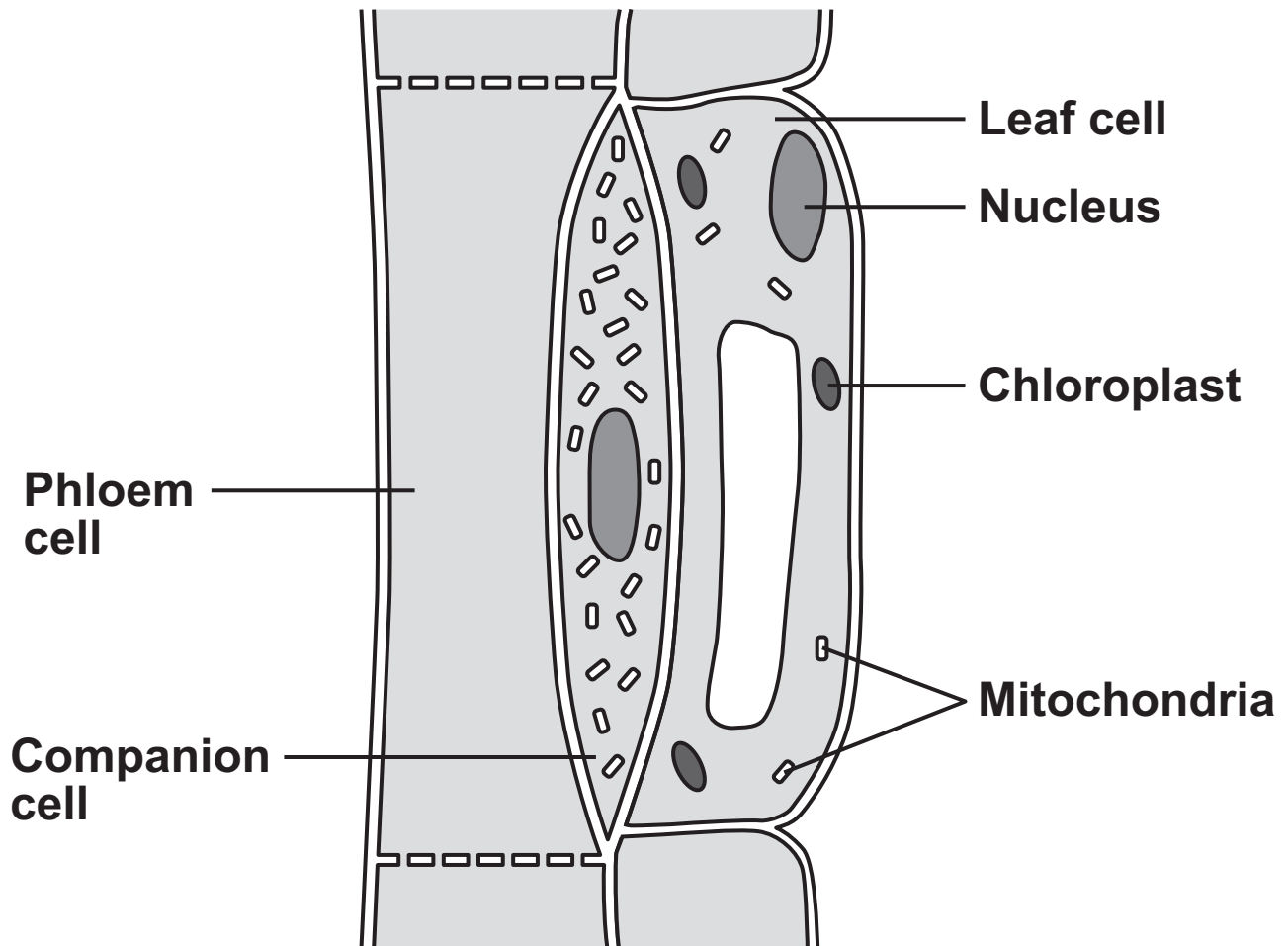
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[Turn over]



FIGURE 14 shows a section of phloem tissue in a leaf.

FIGURE 14



**0 8 . 5**

**Describe TWO ways the structure of phloem cells is different from the structure of xylem cells. [2 marks]**

**1** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**2** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**0 8 . 6**

**Dissolved sugar moves from the leaf cell into the phloem cell.**

**In FIGURE 14, on the opposite page:**

- **the concentration of sugar in the leaf cell is 4 mg per dm<sup>3</sup>**
- **the concentration of sugar in the phloem cell is 118 mg per dm<sup>3</sup>.**

**[Turn over]**











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For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
<b>TOTAL</b>	

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**G/LM/Jun22/8465/2H/E3**



7 2



2 2 6 G 8 4 6 5 / 2 H