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

H

Higher Tier Paper 1 Life and Environmental Sciences

Tuesday 16 May 2023 Morning 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.

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.

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

Do not write outside the box

0 1 This question is about the blood and the circulatory system.

0 1 . 1 Give the functions of red blood cells, white blood cells and platelets.

[3 marks]

Red blood cells _____

_____

White blood cells _____

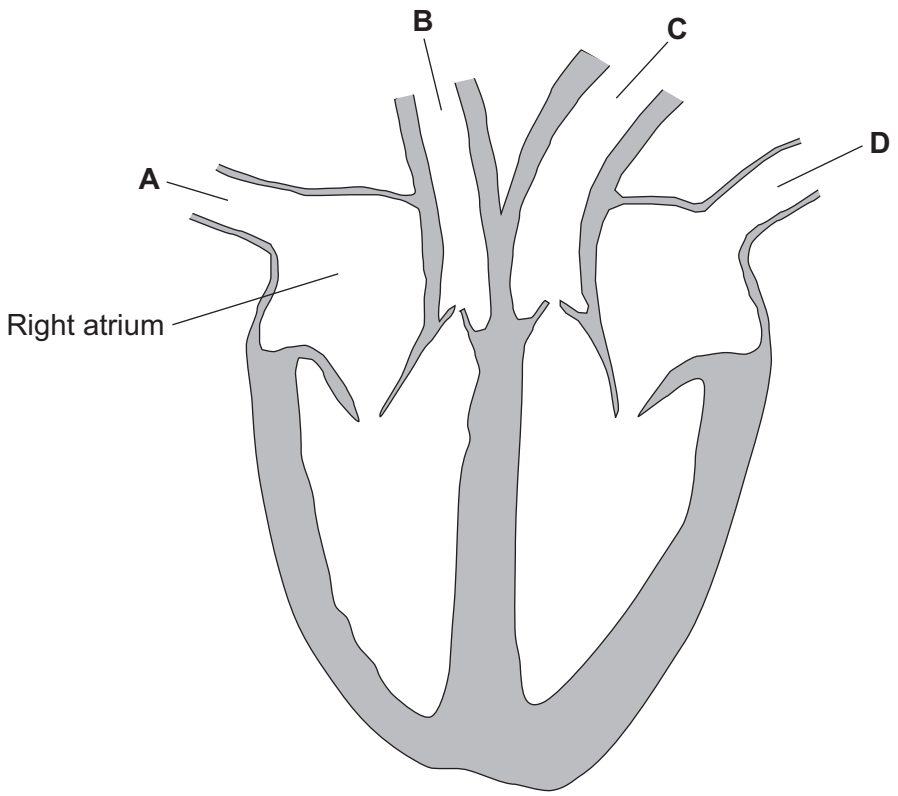
_____

Platelets _____

_____

Figure 1 shows a human heart.

Figure 1



Do not write outside the box

0 1 . 2 Draw **one** arrow on **Figure 1** to show the movement of the blood between the left atrium and the left ventricle.

[1 mark]

0 1 . 3 Which blood vessel carries blood from the lungs **into** the heart?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 1 . 4 Which blood vessel is the aorta?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 1 . 5 What structures prevent blood flowing in the wrong direction through the heart?

[1 mark]

_____

Question 1 continues on the next page

Do not write outside the box

0 1 . 6 Heart muscle cells obtain oxygen from the blood.

Which blood vessels exchange oxygen with heart muscle cells?

[1 mark]

Tick (✓) **one** box.

Arteries ☐

Capillaries ☐

Veins ☐

0 1 . 7 Heart rate is controlled by a group of cells called the pacemaker.

Where is the pacemaker in the heart?

[1 mark]

Tick (✓) **one** box.

Left atrium ☐

Left ventricle ☐

Right atrium ☐

Right ventricle ☐

Do not write outside the box

Carbon monoxide is a toxic gas.

0 1 . 8 Explain why an increase of carbon monoxide in the air increases heart rate.

[3 marks]

_____

_____

_____

_____

_____

_____

0 1 . 9 A person was exposed to carbon monoxide in the air for 1 hour.

During the hour the person's heart rate increased from 80 beats per minute to 130 beats per minute.

Calculate the percentage increase in heart rate.

Use the equation:

$$\text{percentage increase} = \frac{\text{final heart rate} - \text{starting heart rate}}{\text{starting heart rate}} \times 100$$

[2 marks]

_____

_____

_____

_____

Percentage increase = _____ %

14

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0 2 A species of grass has the binomial name *Lolium perenne*.

0 2 . 1 What is the genus of the grass?

[1 mark]

_____

Grass leaves look green because of a green pigment found in chloroplasts.

0 2 . 2 Name the green pigment found in chloroplasts.

[1 mark]

_____

0 2 . 3 Which mineral ion is found in the green pigment in chloroplasts?

[1 mark]

Tick (✓) **one** box.

Magnesium ion ☐

Nitrate ion ☐

Sodium ion ☐

Do not write outside the box

An area of grass changed colour after being covered by a tent.

The colour of the grass changed from green to yellow.

Figure 2 shows the area of green grass and the area of yellow grass.

Figure 2

Green grass

Yellow grass

Question 2 continues on the next page

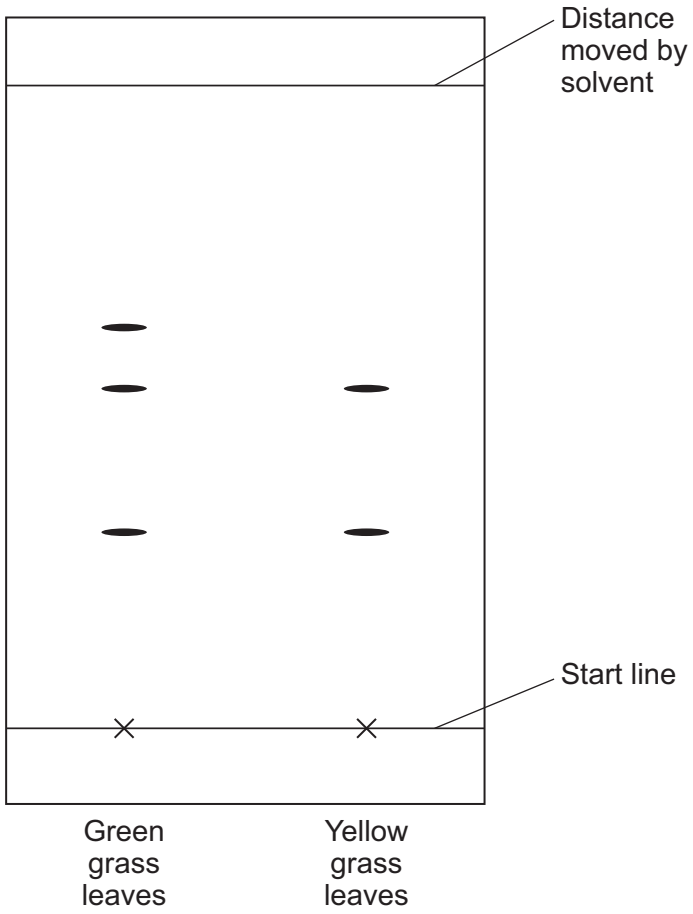
Do not write outside the box

A student used paper chromatography to investigate the pigments in grass leaves from:

- the area of green grass
- the area of yellow grass.

Figure 3 shows the results.

Figure 3



Do not write outside the box

0 2 . 4 The student crushed the grass leaves.

Describe a method to separate the pigments in the crushed grass leaves using paper chromatography.

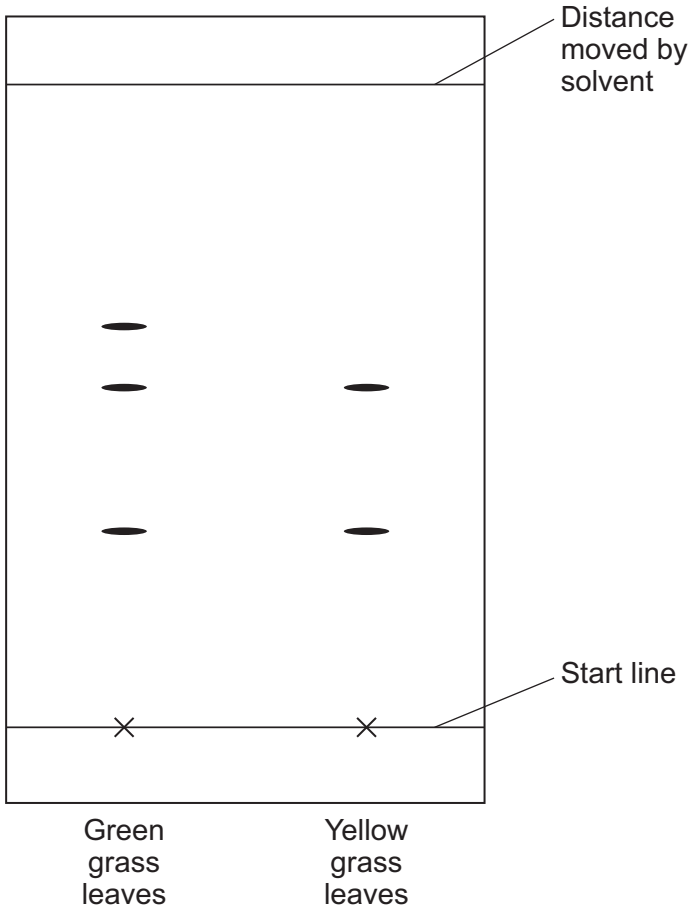
[6 marks]

Question 2 continues on the next page

Do not write outside the box

Figure 3 is repeated below.

Figure 3



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0 2 . 5 Determine the R_f value of the pigment that is found in green grass leaves but **not** found in yellow grass leaves.

Use the equation:

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

Use **Figure 3**.

[4 marks]

R_f = _____

0 2 . 6 There are fewer pigments in the yellow grass leaves than in the green grass leaves.

Suggest **one** reason why.

[1 mark]

_____

14

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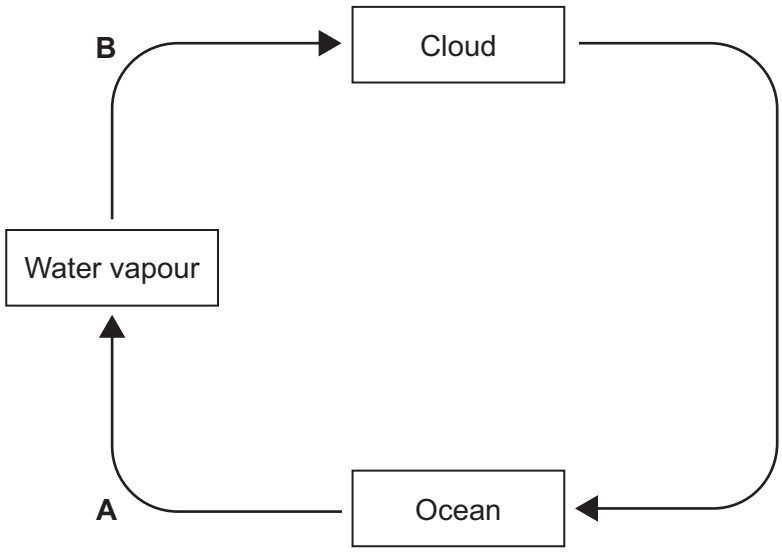
0 3 **Figure 4** shows part of the water cycle.

Figure 4



0 3 . 1 Name processes **A** and **B** shown on **Figure 4**.

[2 marks]

A _____

B _____

0 3 . 2 Water that is safe to drink is called potable water.

Give **two** methods used to sterilise potable water.

[2 marks]

1 _____

2 _____

Do not write outside the box

0 3 . 3 Explain why it is more expensive to produce potable water from sea water than from river water.

[2 marks]

_____

_____

_____

_____

Waste water must be treated to produce potable water.

0 3 . 4 Waste water from fields where crops are growing may contain chemicals.

Suggest **two** types of chemical from fields where crops are growing that must be removed from waste water.

[2 marks]

1 _____

2 _____

0 3 . 5 One step in sewage treatment is sedimentation to produce sewage sludge and effluent.

What further treatment is used on the sewage sludge and on the effluent?

[2 marks]

Sewage sludge _____

_____

Effluent _____

_____

10

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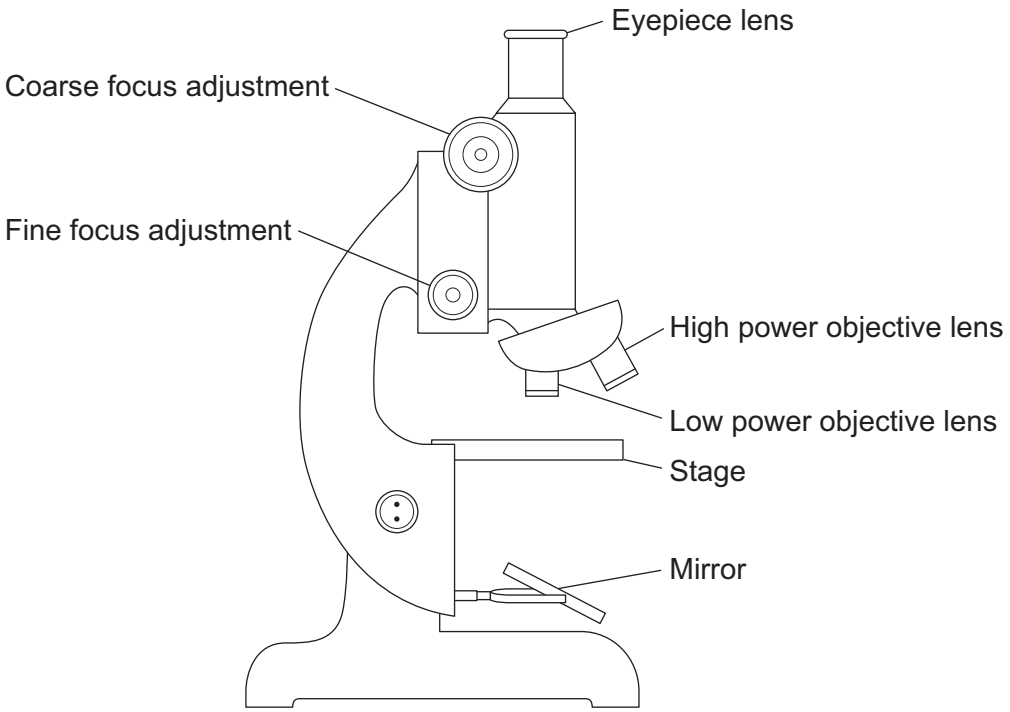
0 4 **Figure 5** shows a light microscope.

Figure 5



0 4 . 1 A student was given a prepared slide of cells.

Describe how the microscope in **Figure 5** could be used to view the cells with the high power objective lens.

[4 marks]

Do not write outside the box

0 4 . 2 Light microscopes are **not** used to view viruses.

What are **two** reasons why electron microscopes are used to view viruses?

[2 marks]

Tick (✓) **two** boxes.

- Electron microscopes are expensive to maintain ☐
- Electron microscopes can have a magnification of ×1 000 000 ☐
- Electron microscopes have a high resolving power ☐
- Viruses are not living organisms ☐
- Viruses are found and are replicated inside living cells ☐

0 4 . 3 Plant species **Q** is **not** resistant to one type of virus.

Explain how the process of natural selection could result in all plants of species **Q** having resistance to the virus.

[4 marks]

_____

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10

Turn over ▶

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0 5 Earwax is produced by specialised skin cells in the ear.

0 5 . 1 Suggest **one** advantage of producing earwax.

[1 mark]

People produce either wet earwax or dry earwax.

The type of earwax people have is determined by one gene.

0 5 . 2 Define the term ‘gene’.

[2 marks]

Question 5 continues on the next page

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Scientists studied the type of earwax produced by a large number of parents and their offspring.

Table 1 shows the type of earwax of the parents and the number of offspring with each type of earwax.

Table 1

Phenotype of parents		**Number of offspring with**	
parent 1	**parent 2**	**wet earwax**	**dry earwax**
dry earwax	dry earwax	0	634
wet earwax	dry earwax	205	195
wet earwax	wet earwax	35	12

0 5 . 3 The allele for wet earwax is dominant.

Give the evidence from **Table 1** that shows the allele for wet earwax is dominant.

[1 mark]

_____

_____

Do not write outside the box

0 5 . 4 Consider the offspring born when one parent has wet earwax **and** one parent has dry earwax.

Explain the number of offspring with each type of earwax born to these parents.

Assume the parent with wet earwax is heterozygous.

Use **Table 1**.

You should:

- draw a Punnett square diagram
- identify each offspring phenotype
- explain the number of each type of offspring shown in **Table 1**.

Use the symbols:

E = allele for wet earwax

e = allele for dry earwax

[5 marks]

Explanation _____

_____

_____

9

Do not write outside the box

0 6 Carbon-12 ($^{12}_{6}C$) and carbon-14 ($^{14}_{6}C$) are isotopes of carbon.

Carbon-14 is radioactive.

0 6 . 1 How are the numbers and type of sub-atomic particles in carbon-14 **different** from the sub-atomic particles in carbon-12?

[1 mark]

0 6 . 2 Carbon-14 is formed in the atmosphere.

Carbon-14 reacts with oxygen to produce carbon dioxide.

Explain why **animal tissues** contain carbon-14

[5 marks]

Do not write outside the box

0 6 . 3 Carbon-14 emits beta radiation.

Complete the nuclear equation to show the radioactive decay of carbon-14

Use the periodic table.

[3 marks]

$$^{14}_{6}C \longrightarrow \; ^{__}_{__}e \; + \; ^{__}_{__}__$$

Question 6 continues on the next page

Do not write outside the box

In 1991 the frozen remains of a human body were found in a glacier.

The carbon-14 in the body was used to determine the age of the body.

The body was 5400 years old.

0 6 . 4 Explain why the body tissues had **not** decayed completely.

[2 marks]

_____

_____

_____

_____

0 6 . 5 The amount of carbon-14 in the body had decreased by 47%.

What is the half-life of carbon-14?

[1 mark]

Tick (✓) **one** box.

< 5400 years ☐ = 5400 years ☐ > 5400 years ☐

Do not write outside the box

0 6 . 6 A student made a statement about a sample of a different radioactive substance.

The student stated:

‘If the half-life of the radioactive substance is 30 years, a sample of the substance will not be radioactive after 60 years.’

Explain why the student’s statement is **not** correct.

[3 marks]

_____

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_____

15

Turn over for the next question

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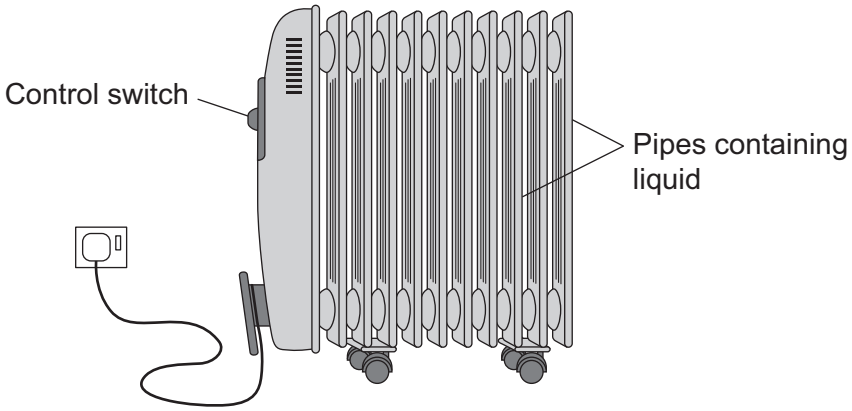
0 7 **Figure 6** shows an electric heater.

This type of heater is filled with a liquid.

Figure 6



0 7 . 1 The heater contained 5.0 kg of water.

When the heater was switched on, the temperature of the water in the heater increased to 75 °C.

The change in thermal energy of the water was 1260 kJ.

specific heat capacity of water = 4200 J/kg °C

Calculate the starting temperature of the water in the heater.

Use the Physics equations sheet.

[5 marks]

Starting temperature = _____ °C

Do not write outside the box

0 7 . 2 An identical heater contains 5.0 kg of oil instead of 5.0 kg of water.

specific heat capacity of oil = 1970 J/kg °C

specific heat capacity of water = 4200 J/kg °C

Explain the difference in the energy needed to cause the same temperature change in the oil and in the water.

[2 marks]

Question 7 continues on the next page

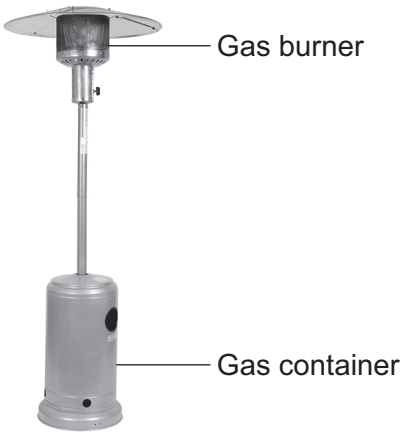
Do not write outside the box

0 7 . 3 Gas heaters may be used to heat gardens.

The gas is stored in a container with a fixed volume.

Figure 7 shows a gas heater.

Figure 7



On a sunny day the burner is **not** lit.

The temperature of the gas in the container increases.

Explain why the pressure inside the container changes.

[3 marks]

_____

_____

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10

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0 8 Xylem tissue and phloem tissue are found in plants.

Compare the structure **and** function of xylem tissue and phloem tissue.

[6 marks]

6

Turn over for the next question

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0 9 A student investigated the effect of surface area to volume ratio on diffusion.

The student used gel cubes with different surface area to volume ratios.

- The cubes contained indicator and an alkaline solution.
- The indicator was pink at the start of the investigation because the cubes were alkaline.
- As acid diffused into the cubes the indicator changed from pink to colourless.
- If acid had **not** diffused to the centre of the cube some of the cube would **not** have changed colour.

This is the method used.

1. Make a gel containing indicator and an alkaline solution.
2. Cut the gel into a cube with 1 cm long sides.
3. Place the cube in a beaker.
4. Cover the cube with acid.
5. After 5 minutes, remove the cube from the acid.
6. Cut the cube in half.
7. Measure the width of the area inside the cube that did **not** change colour.
8. Calculate the volume at the centre of the cube that did **not** change colour.
9. Repeat steps 3 to 8 with cubes of different sizes.

0 9 . 1 Give **two** control variables the student should have used.

Do **not** refer to time in your answer.

[2 marks]

1 _____

_____

2 _____

_____

Do not write outside the box

The student calculated the percentage of the volume of each cube that had changed colour.

Table 2 shows the results.

Table 2

Length of sides of cube in cm	Volume of cube that had NOT changed colour in cm^3	Percentage (%) of volume of cube that had changed colour
1	0	100
2	1	88
3	8	70
4	27	**X**

0 9 . 2 Calculate percentage **X** in **Table 2**.

[4 marks]

Percentage **X** = _____ %

Question 9 continues on next page

Do not write outside the box

The different sized cubes are a model for organisms of different sizes.

0 9 . 3 Explain why surface area to volume ratio is important to organisms of different sizes.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

0 9 . 4 Give **two** limitations of using cubes to model diffusion in organisms.

[2 marks]

1 _____

_____

2 _____

_____

12

END OF QUESTIONS

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