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.

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.

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 _____

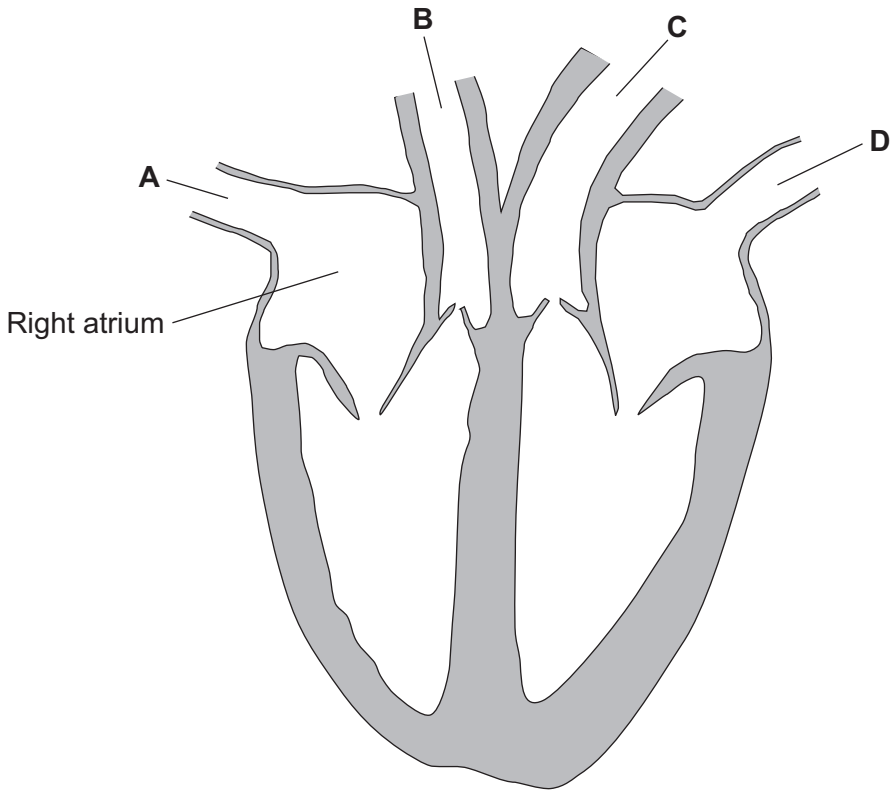
_____

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

Do not write outside the box

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 ☐

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

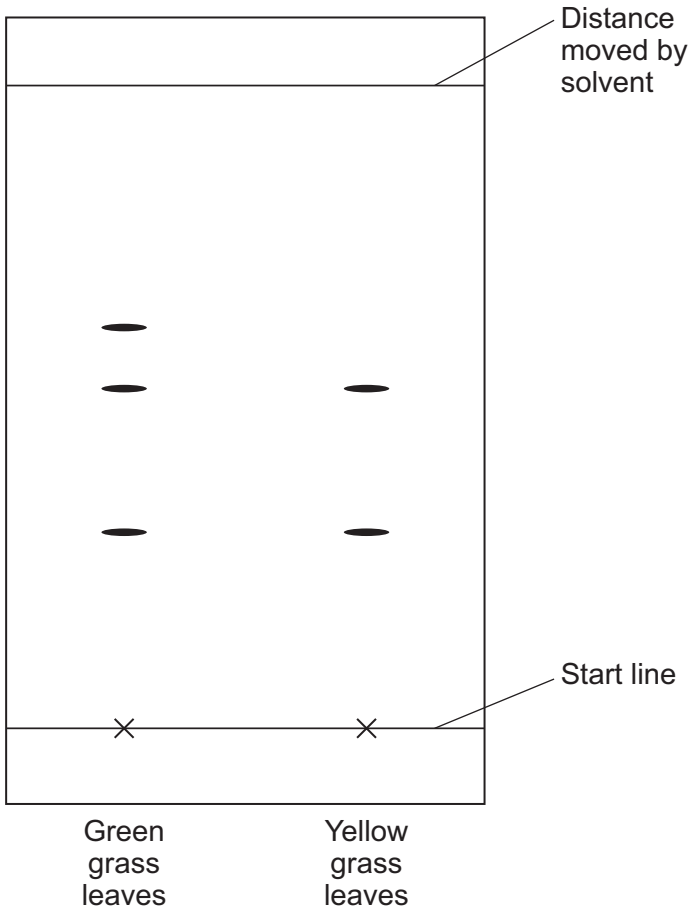
Question 2 continues on the next page

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.

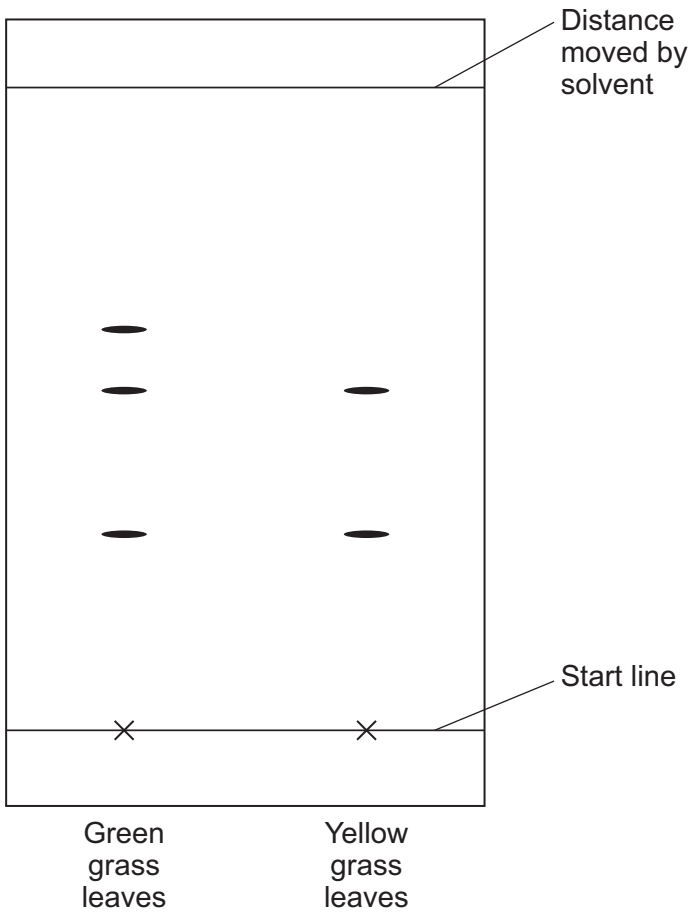
Describe a method to separate the pigments in the crushed grass leaves using paper chromatography.

[6 marks]

Question 2 continues on the next page

Figure 3 is repeated below.

Figure 3



Do not write outside the box

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.

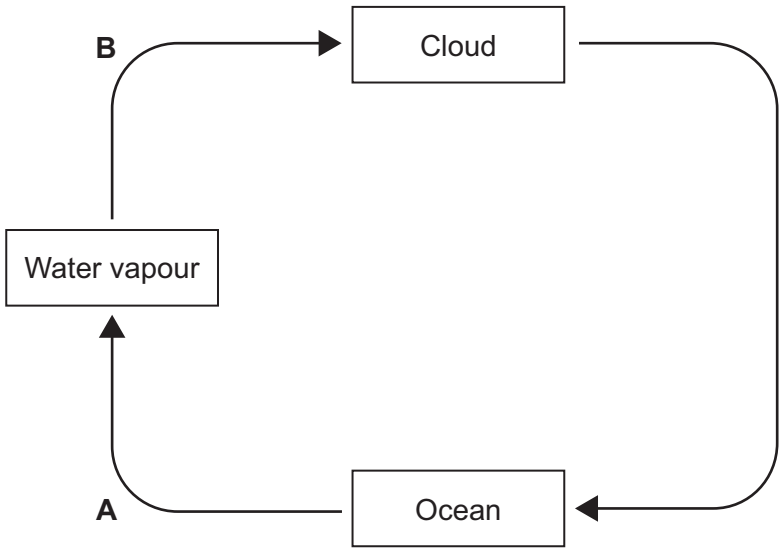
Suggest **one** reason why.

[1 mark]

14

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]

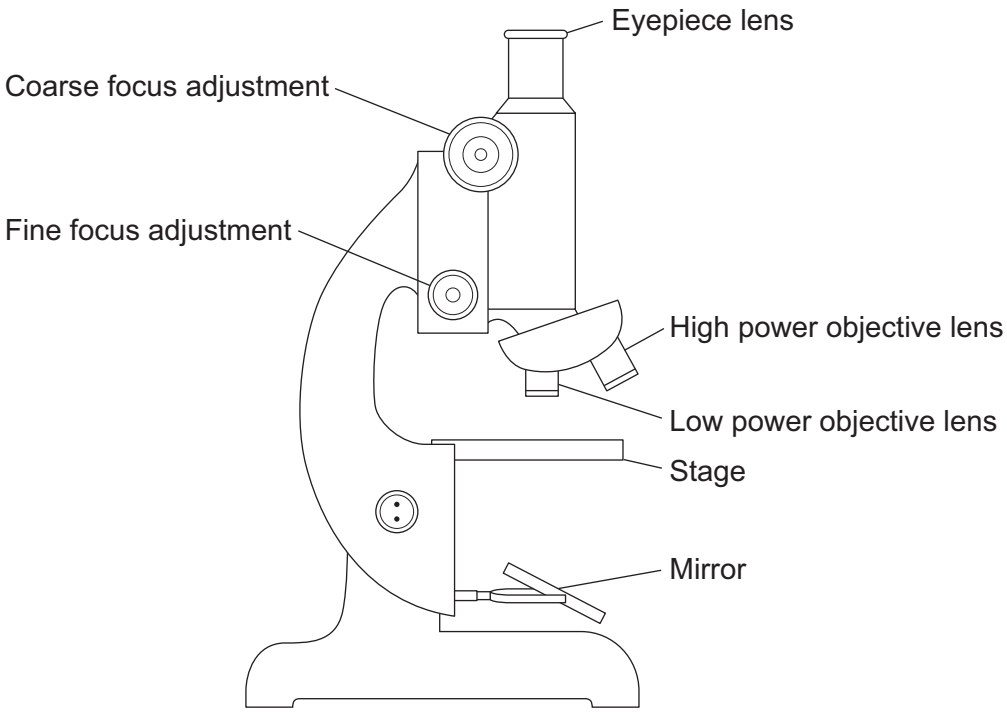
Sewage sludge _____

Effluent _____

10

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]

10

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

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

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]

15

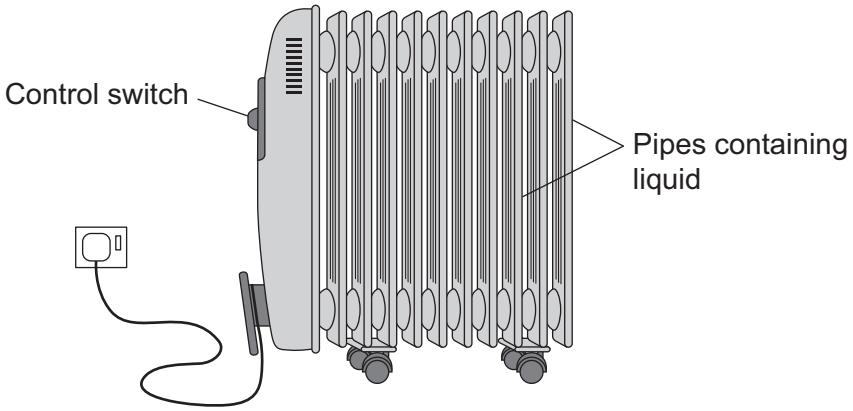
Turn over for the next question

Do not write outside the box

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

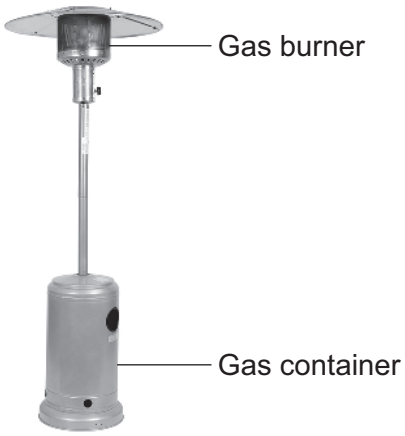
Do not write outside the box

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]

10

Do not write outside the box

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

Do not write outside the box

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 _____

_____

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

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

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

Do not write outside the box

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

Do not write outside the box

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

Do not write outside the box

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

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED