A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

AS
BIOLOGY
Paper 1
7401/1

Tuesday 19 May 2020 Afternoon

Time allowed: 1 hour 30 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]

JUN207401101

For this paper you must have:
- **a ruler with millimetre measurements**
- **a scientific calculator.**

INSTRUCTIONS

- **Use black ink or black ball-point pen.**
- **Answer ALL questions.**
- **You must answer the 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).**
- **Show all your working.**
- **Do all rough work in this book. Cross through any work you do not want to be marked.**

INFORMATION

- **The marks for the questions are shown in brackets.**
- **The maximum mark for this paper is 75.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

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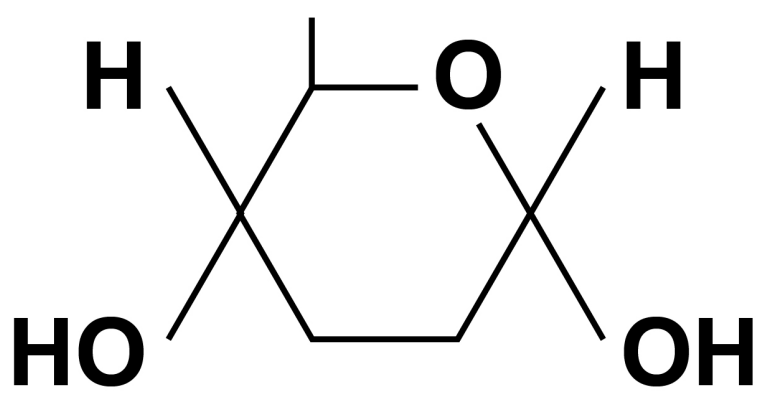
Answer ALL questions in the spaces provided.

0 1

FIGURE 1, on page 6, shows the structure of molecules found in organisms.

FIGURE 1

A



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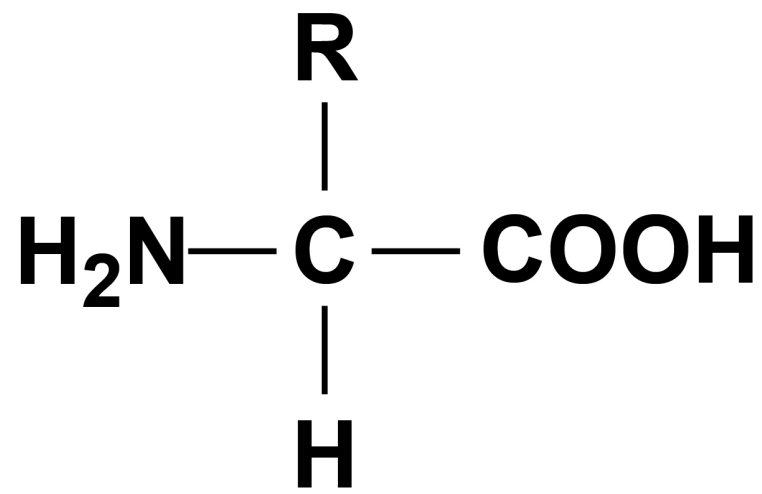

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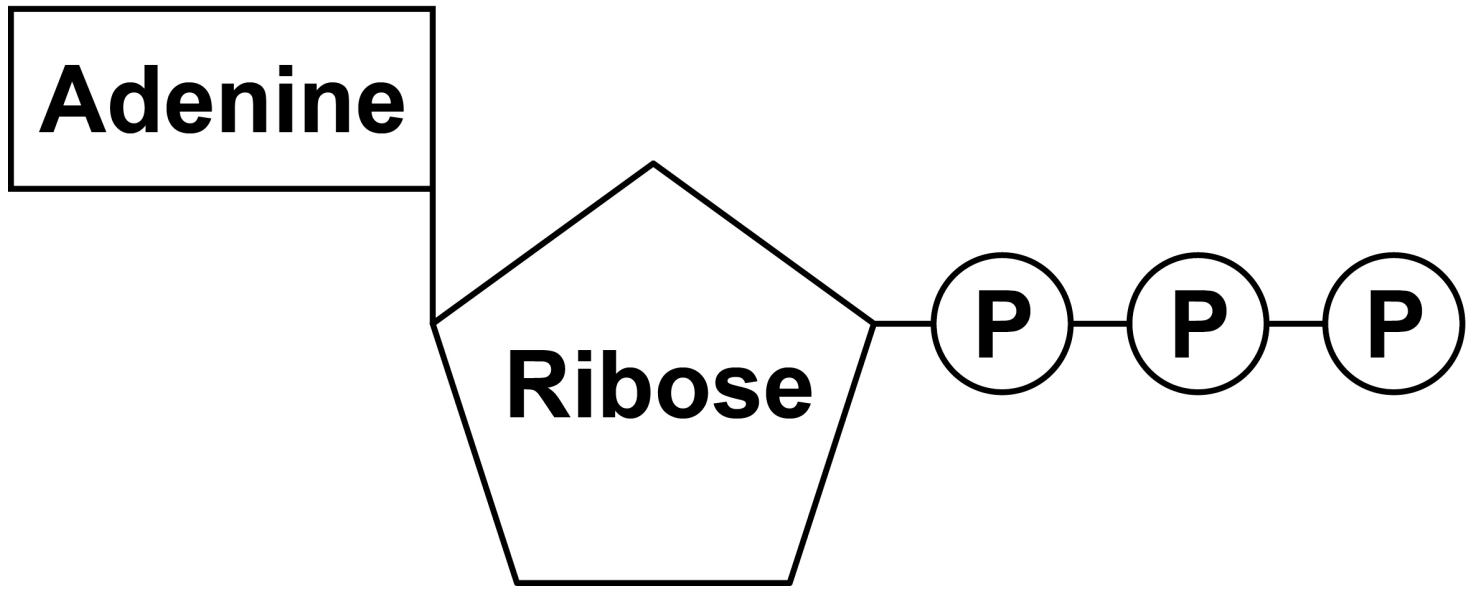

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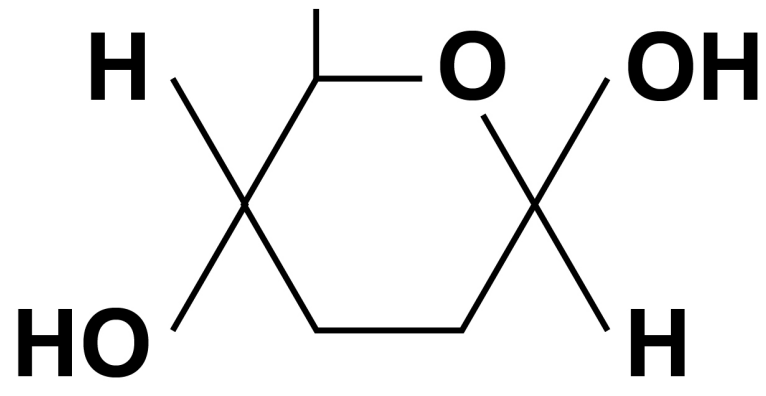

0 1 . 1

Complete TABLE 1 by putting the correct letter, A, B, C or D, in the box next to each statement. Each letter may be used once, more than once, or not at all. [4 marks]

TABLE 1

LETTER	STATEMENT
	is a monomer in an enzyme's active site
	is a monomer in cellulose
	is produced during photosynthesis and respiration
	forms a polymer that gives a positive result with a biuret test

8

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0 1 . 2

Raffinose is a trisaccharide of three monosaccharides: galactose, glucose and fructose. The chemical formulae of these monosaccharides are:

- **galactose = $C_6H_{12}O_6$**
- **glucose = $C_6H_{12}O_6$**
- **fructose = $C_6H_{12}O_6$**

Give the number of carbon atoms, hydrogen atoms and oxygen atoms in a molecule of raffinose. [1 mark]

Number of carbon atoms _____

Number of hydrogen atoms _____

Number of oxygen atoms _____

[Turn over]

0 1 . 3

A biochemical test for reducing sugar produces a negative result with raffinose solution.

Describe a biochemical test to show that raffinose solution contains a non-reducing sugar. [3 marks]

11

[Turn over]

8

1 1

0 2 . 1

Explain the arrangement of phospholipids in a cell-surface membrane. [2 marks]

0 2 . 2

Describe how an ester bond is formed in a phospholipid molecule. [2 marks]

0 2 . 3

State and explain the property of water that helps to prevent temperature increase in a cell. [2 marks]

Property _____

Explanation _____

_____

_____

_____

_____

_____

6

0 3 . 1

Describe how a phagocyte destroys a pathogen present in the blood. [3 marks]

0 3 . 2

Give TWO types of cell, other than pathogens, that can stimulate an immune response. [2 marks]

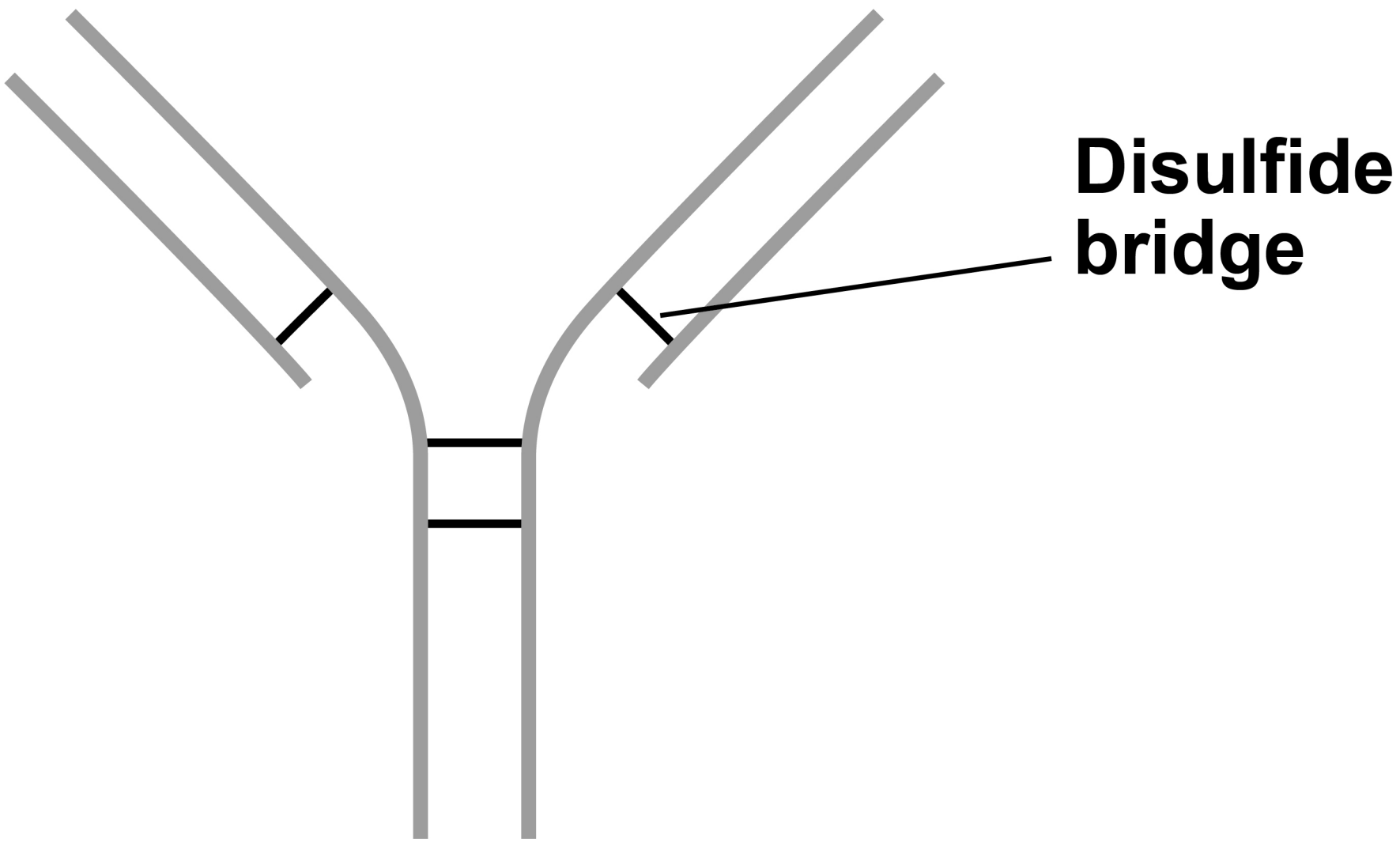
1 _____

2 _____

0 3 . 3

FIGURE 2 shows the structure of an antibody.

FIGURE 2



Label FIGURE 2 with an X to show where an antigen-antibody complex forms. [1 mark]

0 3 . 4

A disulfide bridge is labelled in FIGURE 2.

What is the role of the disulfide bridge in forming the quaternary structure of an antibody? [1 mark]

_____

_____

_____

[Turn over]

7

0 4 . 1

Eukaryotic cells produce and release proteins.

Outline the role of ORGANELLES in the production, transport and release of proteins from eukaryotic cells.

Do NOT include details of transcription and translation in your answer.
[4 marks]

[Turn over]

FIGURE 3 is a transmission electron micrograph of a plant cell.

FIGURE 3

0 4 . 2

Suggest why a nucleus is NOT visible in FIGURE 3. [1 mark]

0 4 . 3

Name the organelles labelled S and T in FIGURE 3. [1 mark]

Organelle S _____

Organelle T _____

[Turn over]

0 4 . 4

Give ONE advantage of viewing a biological specimen using a transmission electron microscope compared with using a scanning electron microscope. [1 mark]

BLANK PAGE

[Turn over]

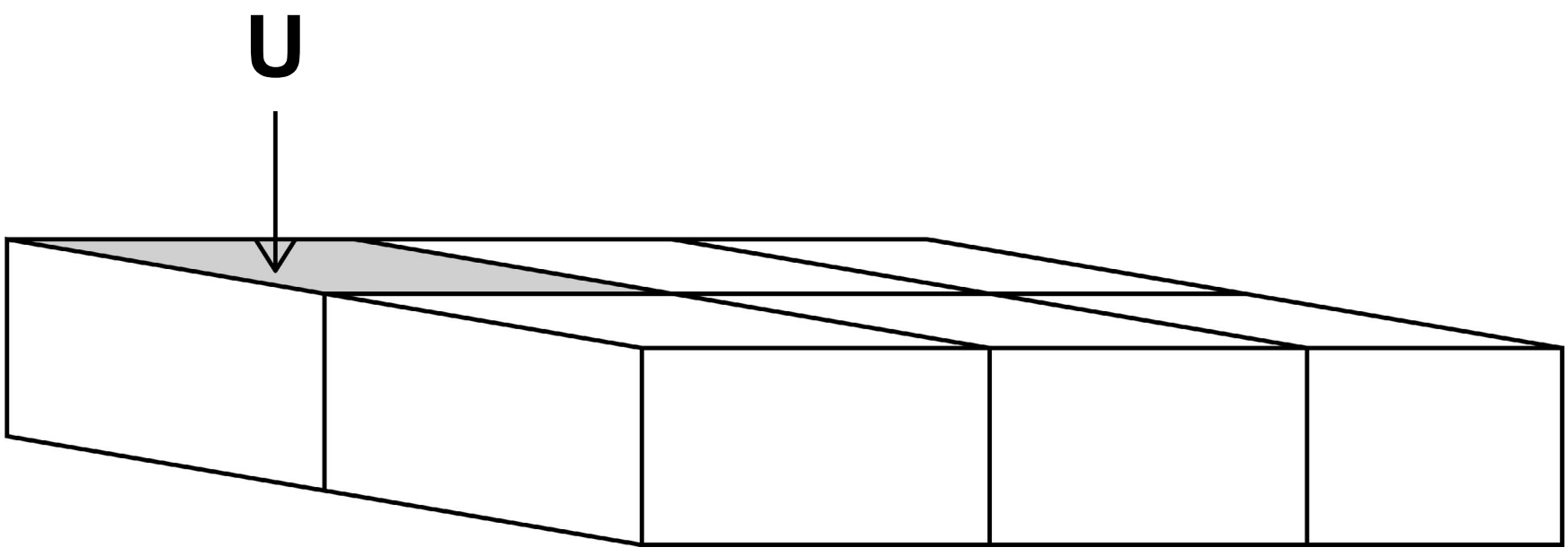
0 4 . 5

The cells in FIGURE 4 are part of a continuous layer of cells forming the upper surface of a leaf.

The shaded area of cell U is 150 μm^2

The total area of the upper surface of the leaf is 70.65 cm^2

FIGURE 4



Calculate the number of cells in the upper surface of the leaf.

Give the answer in standard form.

Assume that all these cells are identical in size.

Show your working. [2 marks]

Number of cells _____

[Turn over]

9

0 5 . 1

Describe and explain the mechanism that causes lungs to fill with air.
[3 marks]

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[Turn over]

A scientist observed sections of lung tissue using an optical microscope.

FIGURE 5 shows one of these sections.

K is an air-filled tube and L is a blood vessel.

FIGURE 5

This figure has been removed due to third-party copyright restrictions.

0 5 . 2

Identify the structures labelled K and L. [1 mark]

K _____

L _____

0 5 . 3

Two solutions often used to stain tissues are haematoxylin solution and iodine solution.

- **Haematoxylin solution stains DNA a blue colour.**
- **Iodine solution stains starch a blue-black colour.**

The scientist used haematoxylin solution and NOT iodine solution to stain the lung tissue.

Suggest why. [2 marks]

0 5 . 4

Scientists investigated the link between the lung disease asthma and three risk factors. They studied a large number of people. They recorded if the people had asthma and if they:

- **were obese**
- **burned wood indoors as a fuel**
- **lived in a house with a cat or dog.**

The scientists used a statistical test to calculate the probability of the link between asthma and each risk factor being due to chance.

TABLE 2 shows their results.

TABLE 2

Risk Factor	Probability (P value)
Obese	< 0.001
Burned wood indoors	= 0.06
Lived with a cat or dog	< 0.05

A student who looked at these results concluded that all three risk factors are linked with asthma. Evaluate this conclusion. [3 marks]

9

3 2

0 6 . 1

Describe how mRNA is produced from an exposed template strand of DNA.

Do NOT include DNA helicase or splicing in your answer. [3 marks]

0 6 . 2

Define the term exon. [1 mark]

TABLE 3 shows mRNA codons for some amino acids.

TABLE 3

Serine	Proline	Glycine	Threonine	Alanine
UCU	CCU	GGA	ACU	GCA
UCC	CCA	GGG	ACC	GCG

0 6 . 3

FIGURE 6 shows the DNA template nucleotide base sequence that determines the sequence of four amino acids.

FIGURE 6

AGG CGT CCT GGA

Use information from TABLE 3 and FIGURE 6 to give the amino acid sequence determined by this sequence of nucleotides. [1 mark]

_____

_____

[Turn over]

REPEAT OF FIGURE 6

AGG CGT CCT GGA

0 6 . 4

A mutation in the nucleotide sequence shown in FIGURE 6 resulted in the following amino acid sequence.

Serine Glycine Glycine Proline

A student concluded that the mutation involved the addition of one nucleotide within the sequence shown in FIGURE 6. Does information in this question support the student's conclusion? Give reasons for your answer. [2 marks]

[Turn over]

7

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0 7 . 1

Describe binary fission in bacteria.
[3 marks]

The cell growth rate of the bacterium 'Bacillus subtilis' is proportional to its mass immediately after binary fission.

FIGURE 7, on the opposite page, shows this relationship.

0 7 . 2

The mass of the bacterial cells was measured in femtograms (fg).

1 fg (femtogram) = 1×10^{-15} g

Place a tick (✓) in the box next to the number that is equal to 680 fg [1 mark]

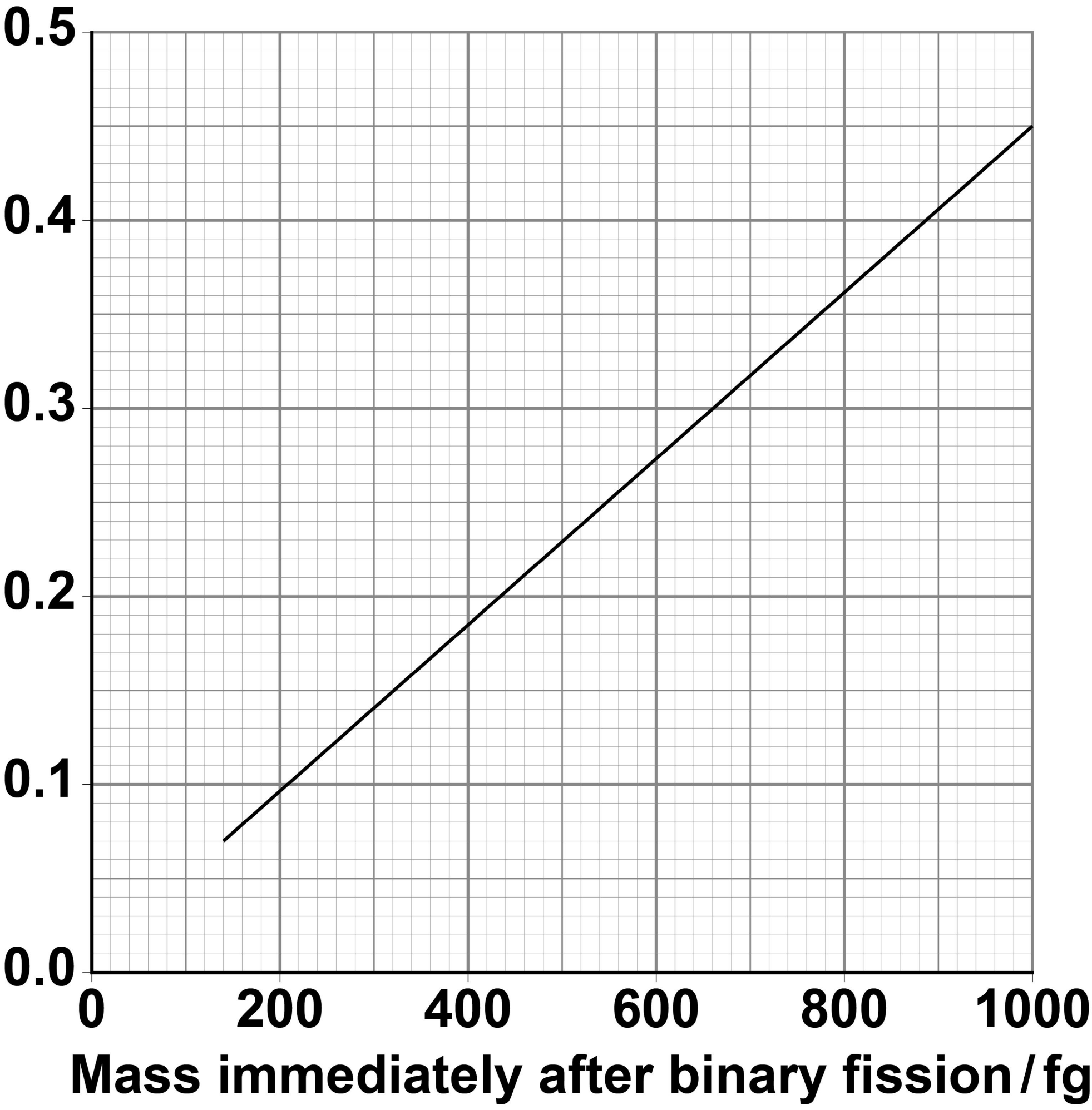
☐ 0.000 000 000 006 8 g

☐ 6.8×10^{-13} g

☐ 6.8×10^{-15} g

☐ 6.8×10^{-17} g

FIGURE 7



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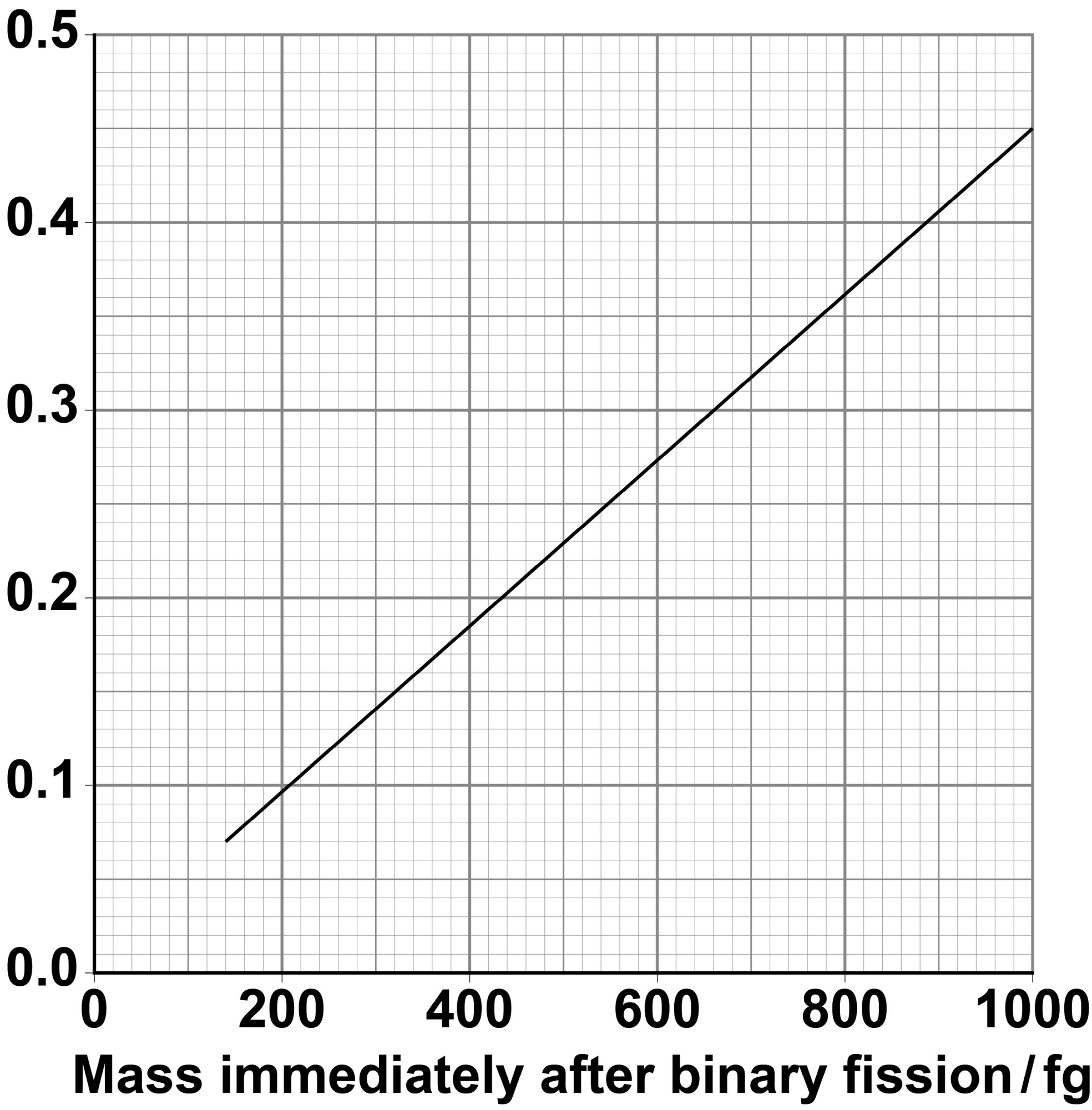
REPEAT OF FIGURE 7



A scientist determined the growth rate of a ‘B. subtilis’ cell by measuring its mass for 5 minutes.

In those 5 minutes, the cell’s mass increased by 90 fg

0 7 . 3

Use this information and FIGURE 7 to determine the mass of this cell immediately after binary fission.

Show your working. [2 marks]

Answer _____ fg

0 7 . 4

Suggest and explain how TWO environmental variables could be changed to increase the growth rate of these cells. [4 marks]

Suggestion 1 _____

Explanation _____

Suggestion 2 _____

Explanation

10

0 8

A scientist investigated birth mass in a population of babies. She determined the birth mass (*b*) of babies and grouped this information into different ranges of birth mass.

Her results are shown in TABLE 4.

TABLE 4

Birth mass *b* / kg	Range of mass / kg	Frequency density
$0.0 < b \leqslant 2.0$	2.0	5 000
$2.0 < b \leqslant 2.5$	0.5	20 000
$2.5 < b \leqslant 3.0$	0.5	90 000
$3.0 < b \leqslant 3.5$	0.5	260 000
$3.5 < b \leqslant 4.5$	1.0	200 000
$4.5 < b \leqslant 5.5$	1.0	20 000

Frequency density is calculated using this equation

$$\text{Frequency density} = \frac{\text{number of babies}}{\text{range of mass}}$$

[Turn over]

0 8 . 1

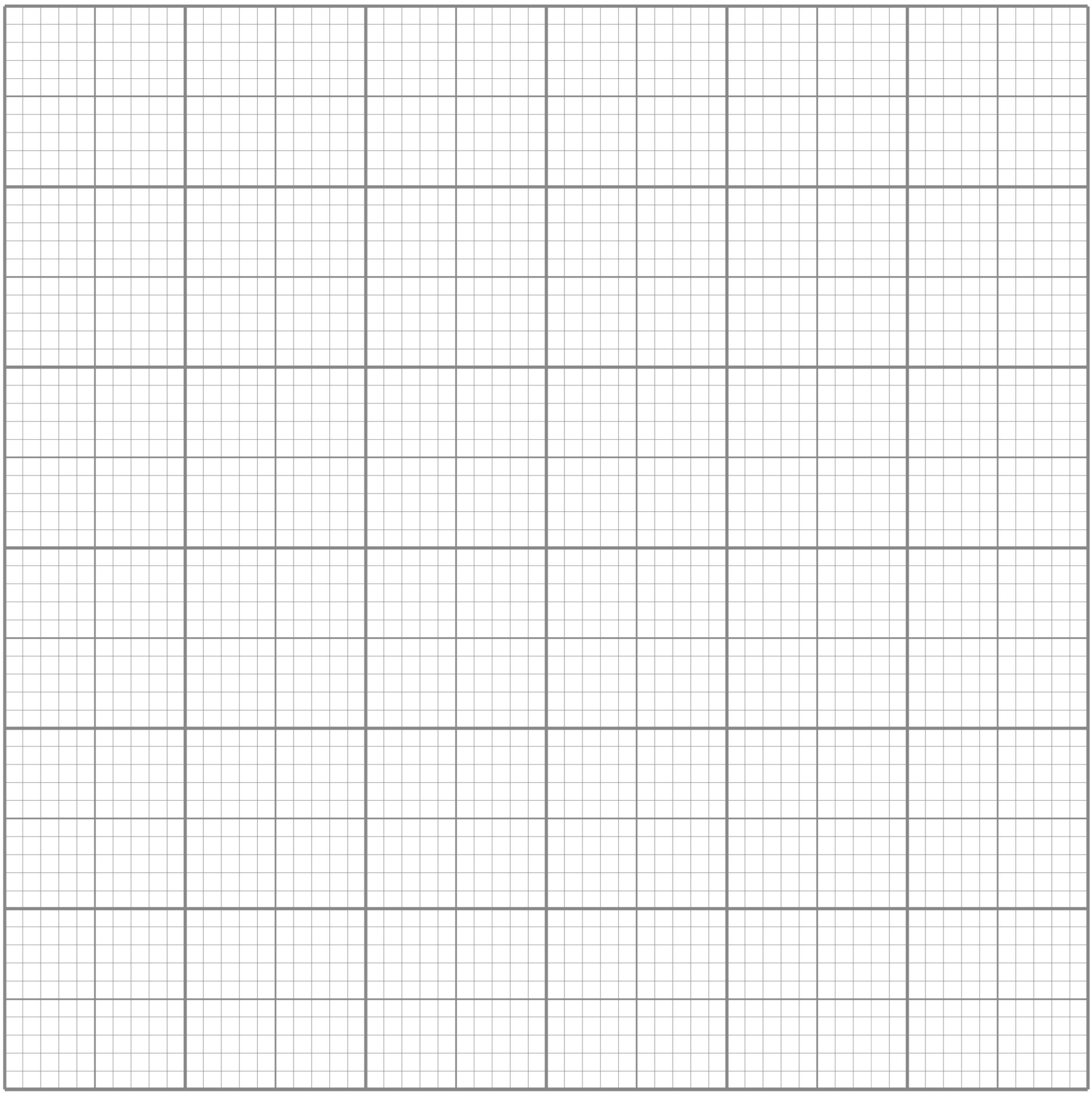
On the opposite page, draw on FIGURE 8 a SUITABLE chart to show the distribution of birth mass for this population of babies. [4 marks]

REPEAT OF TABLE 4

Birth mass b / kg	Range of mass / kg	Frequency density
$0.0 < b \leqslant 2.0$	2.0	5 000
$2.0 < b \leqslant 2.5$	0.5	20 000
$2.5 < b \leqslant 3.0$	0.5	90 000
$3.0 < b \leqslant 3.5$	0.5	260 000
$3.5 < b \leqslant 4.5$	1.0	200 000
$4.5 < b \leqslant 5.5$	1.0	20 000

FIGURE 8

Frequency density



Birth mass / kg

[Turn over]

REPEAT OF TABLE 4

Birth mass b / kg	Range of mass / kg	Frequency density
$0.0 < b \leqslant 2.0$	2.0	5 000
$2.0 < b \leqslant 2.5$	0.5	20 000
$2.5 < b \leqslant 3.0$	0.5	90 000
$3.0 < b \leqslant 3.5$	0.5	260 000
$3.5 < b \leqslant 4.5$	1.0	200 000
$4.5 < b \leqslant 5.5$	1.0	20 000

0 8 . 2

Babies with birth mass less than 2.5 kg are classified as low birth mass.

Use information in TABLE 4 and the equation to calculate the number of babies born with low birth mass in this population.

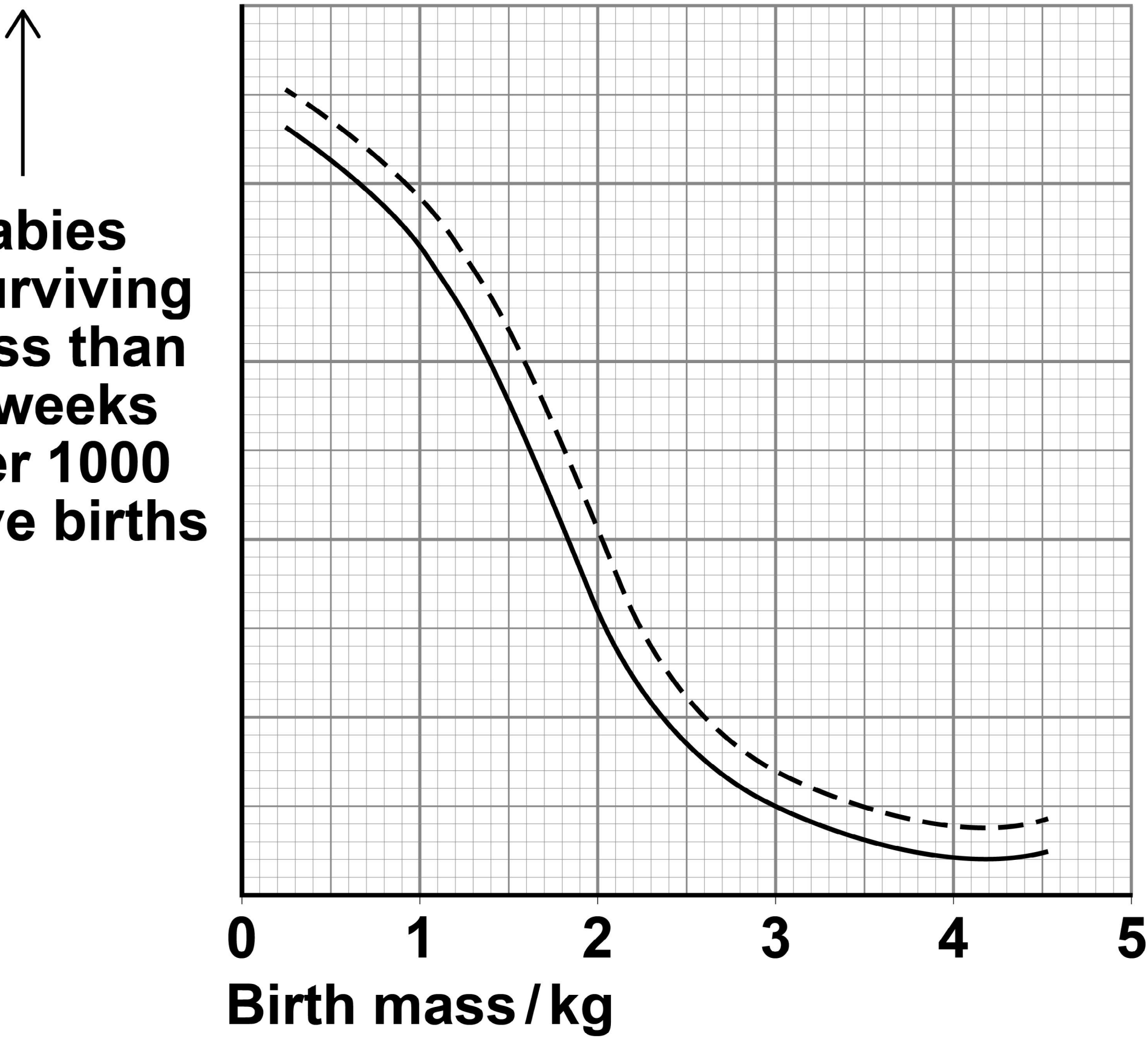
Show your working. [2 marks]

Answer _____

[Turn over]

The scientist also measured the relationship between birth mass and babies surviving less than 4 weeks. She determined if the mothers of these babies smoked cigarettes during pregnancy. Her results are shown in FIGURE 9.

FIGURE 9



KEY

– – – **Mothers who smoked cigarettes during pregnancy**

—— **Mothers who did not smoke cigarettes during pregnancy**

[Turn over]

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0 8 . 3

State THREE conclusions that can be drawn from the data in FIGURE 9, on page 53. [3 marks]

1

2

3

[Turn over]

9

0 9

Channel proteins called aquaporins enable water to be transported across membranes. Aquaporins are produced in cells when genes coding for the proteins are expressed. One aquaporin gene is called 'PIP1b'. The expression of 'PIP1b' in tobacco plant cells produces an aquaporin located in their cell membranes.

Scientists have produced genetically modified tobacco plants. The scientists inserted a gene from a different species into the DNA of tobacco plant cells. This gene causes an increase in the rate of transcription of the 'PIP1b' gene.

The scientists found that the stomatal density of leaves from tobacco plants with the inserted gene was greater than that of unmodified control plants.

In a different investigation, scientists measured the movement of potassium ions and water molecules through cell-surface membranes and vacuole membranes. They found 6 potassium ions moved for every 150 water molecules across vacuole membranes. They found 3 potassium ions moved for every 1500 water molecules across cell-surface membranes.

Use information from the passage and your own understanding to answer the questions.

[Turn over]

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0 9 . 1

Explain how the proteome of a cell from a genetically modified tobacco plant (lines 10–16) differs from that of a cell from an unmodified control tobacco plant. [2 marks]

0 9 . 2

Explain how an increase in the rate of transcription of the 'PIP1b' gene (lines 14–16) will affect the permeability of tobacco plant cell membranes to water. [2 marks]

0 9 . 3

Suggest and explain ONE advantage and ONE disadvantage of increased stomatal density on the growth of tobacco plant leaves (lines 17–20). [4 marks]

Advantage _____

Disadvantage _____

[Turn over]

0 9 . 4

How much greater is the ratio of movement of potassium ions to movement of water molecules across a vacuole membrane than across a cell-surface membrane (lines 21–31)? Show your working. [2 marks]

Answer _____

END OF QUESTIONS

10

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

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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