Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

AS
BIOLOGY

Paper 1

Tuesday 19 May 2020 Afternoon Time allowed: 1 hour 30 minutes

Materials

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

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the 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).
- 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.

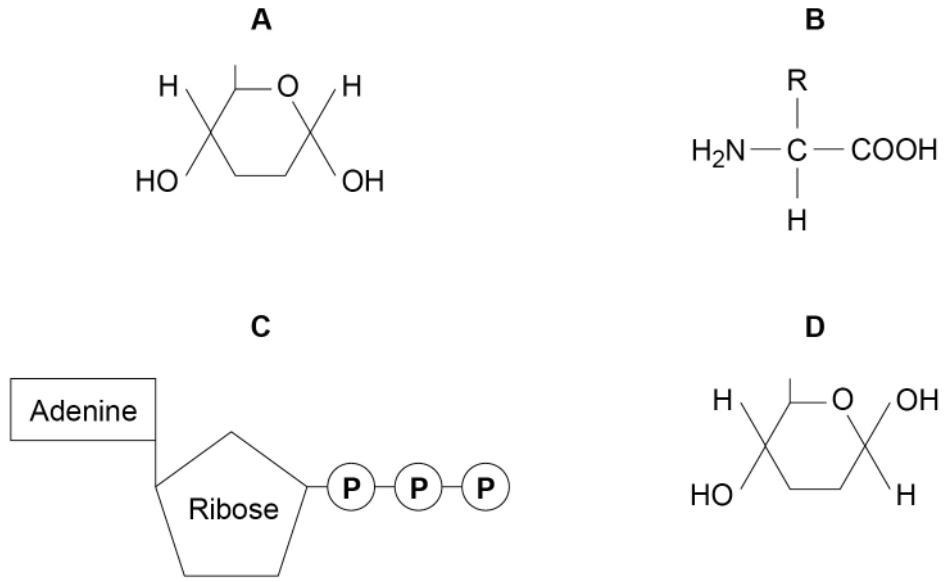
For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

Do not write outside the box

Answer **all** questions in the spaces provided.

0 1 **Figure 1** shows the structure of molecules found in organisms.

Figure 1



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

Do not write outside the box

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 _____

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]

_____

_____

_____

_____

_____

_____

_____

_____

_____

8

Do not write outside the box

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

Do not write outside the box

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 _____

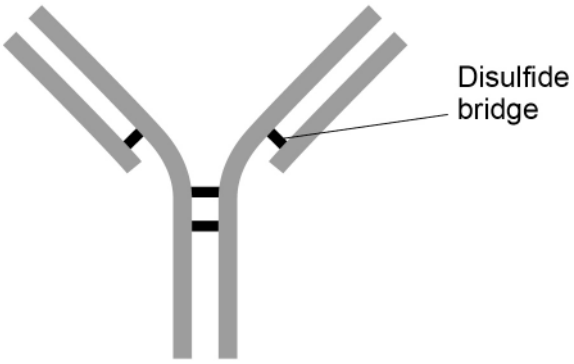
2 _____

Question 3 continues on the next page

Do not write outside the box

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]

7

Do not write outside the box

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.

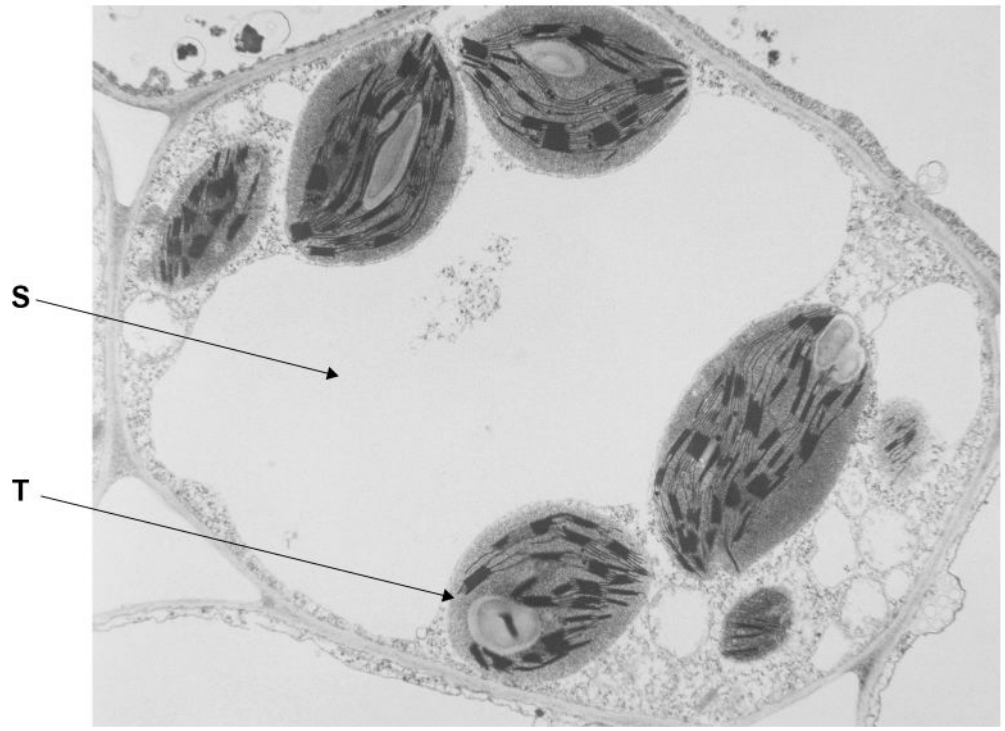
[4 marks]

Question 4 continues on the next page

Do not write outside the box

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** _____

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]

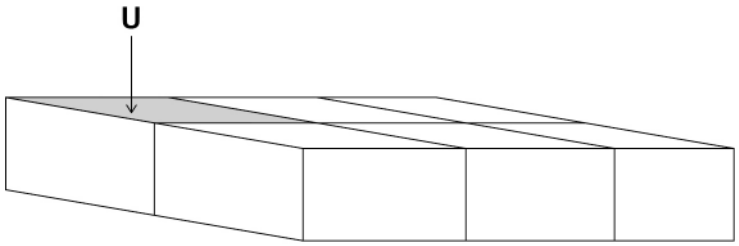
Do not write outside the box

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 _____

9

Do not write outside the box

0 5 . 1 Describe and explain the mechanism that causes lungs to fill with air.

[3 marks]

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.

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

Do not write outside the box

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]

_____

_____

_____

_____

_____

_____

Question 5 continues on the next page

Do not write outside the box

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

Do not write outside the box

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]

Question 6 continues on the next page

Do not write outside the box

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]

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]

7

Do not write outside the box

0 7 . 1 Describe binary fission in bacteria.

[3 marks]

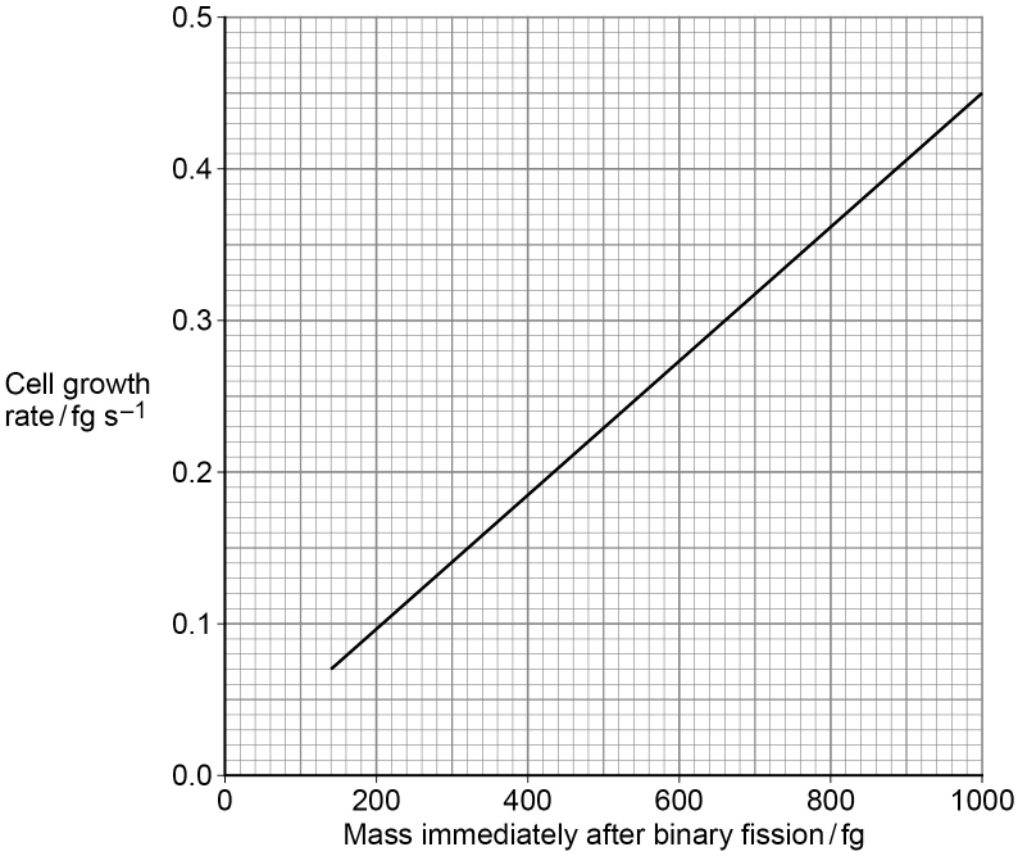
Question 7 continues on the next page

Do not write outside the box

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

Figure 7 shows this relationship.

Figure 7



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 ☐

Do not write outside the box

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

Turn over ►

Do not write outside the box

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

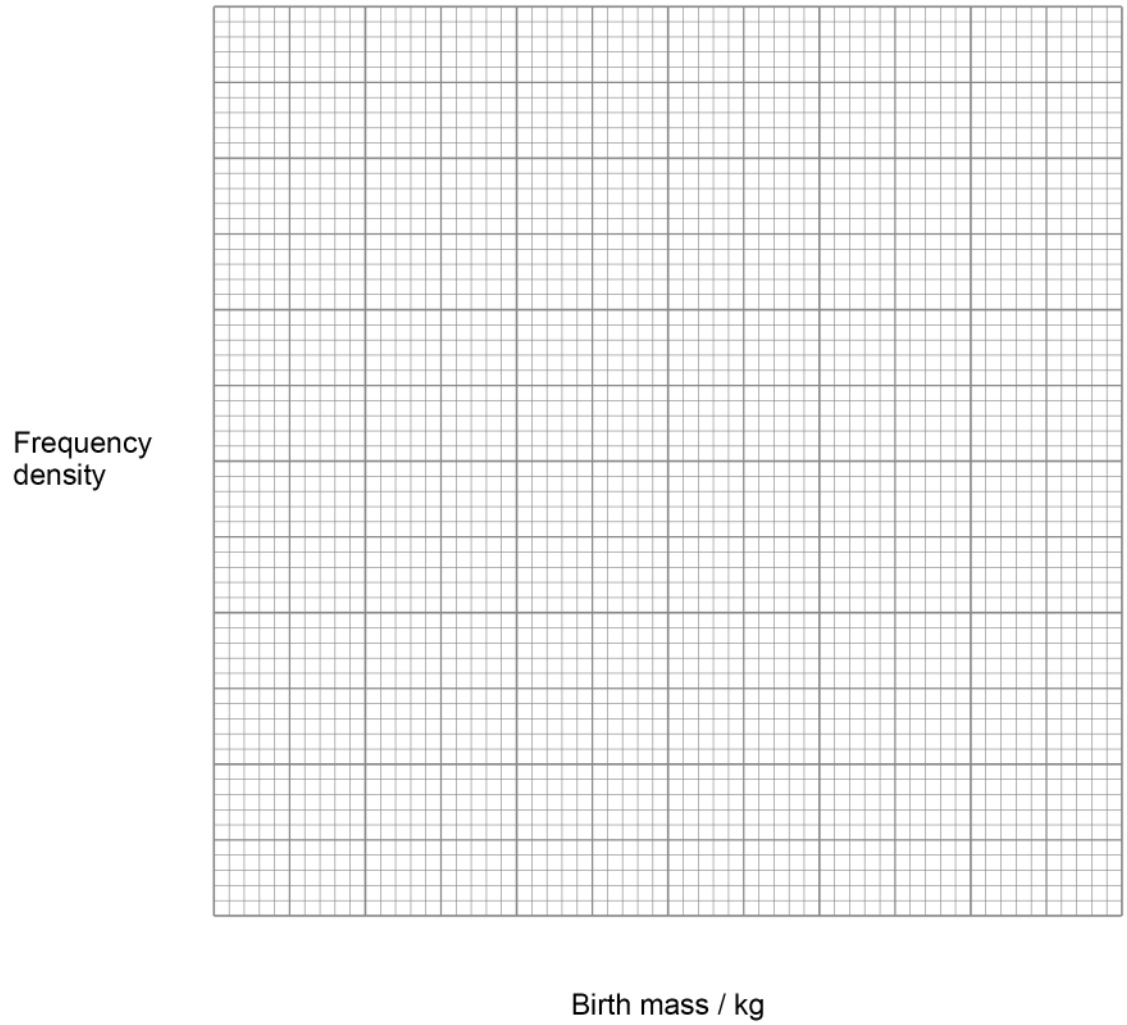
$$\text{Frequency density} = \frac{\text{number of babies}}{\text{range of mass}}$$

Do not write outside the box

0 8 . 1 Draw, on **Figure 8**, a **suitable** chart to show the distribution of birth mass for this population of babies.

[4 marks]

Figure 8



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]

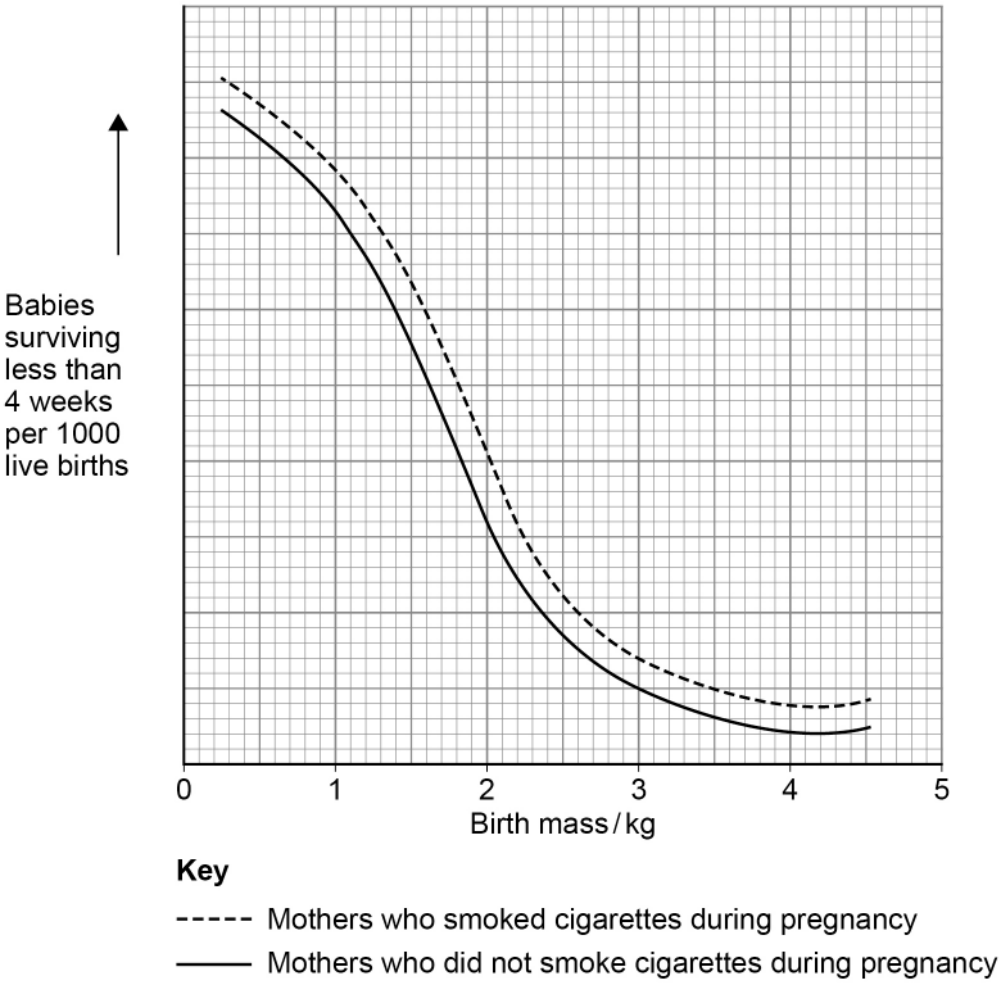
Answer _____

Question 8 continues on the next page

Do not write outside the box

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



0 8 . 3 State **three** conclusions that can be drawn from the data in **Figure 9**.

[3 marks]

1 _____

_____

_____

2 _____

_____

_____

3 _____

_____

_____

9

Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

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.

0 9 . 1 Explain how the proteome of a cell from a genetically modified tobacco plant (lines 5–7) 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 6–7) will affect the permeability of tobacco plant cell membranes to water.

[2 marks]

Do not write outside the box

0 9 . 3 Suggest and explain **one** advantage and **one** disadvantage of increased stomatal density on the growth of tobacco plant leaves (lines 8–9).

[4 marks]

Advantage _____

Disadvantage _____

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 10–14)? Show your working.

[2 marks]

Answer _____

10

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

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED