

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	
<b>TOTAL</b>	

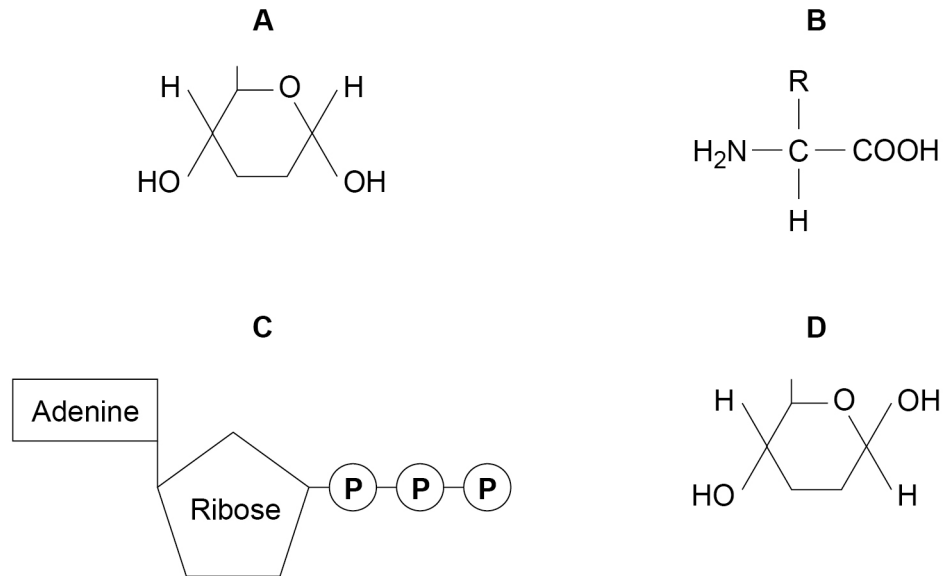


Answer **all** questions in the spaces provided.

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



**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]**

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8

Turn over ►



0 2 . 1

Explain the arrangement of phospholipids in a cell-surface membrane.

[2 marks]

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0 2 . 2

Describe how an ester bond is formed in a phospholipid molecule.

[2 marks]

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0 2 . 3

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

[2 marks]

Property \_\_\_\_\_

Explanation \_\_\_\_\_

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6



0 3 . 1

Describe how a phagocyte destroys a pathogen present in the blood.

[3 marks]

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0 3 . 2

Give **two** types of cell, other than pathogens, that can stimulate an immune response.

[2 marks]

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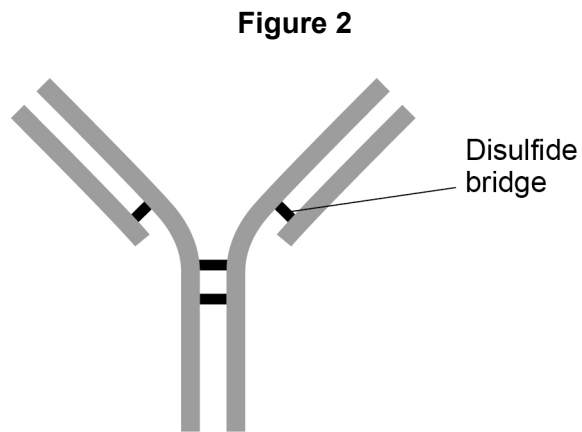
2 \_\_\_\_\_

**Question 3 continues on the next page**

**Turn over ►**



0 3 . 3 **Figure 2** shows the structure of an antibody.



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]

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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]**

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**Question 4 continues on the next page**

**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]

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**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]

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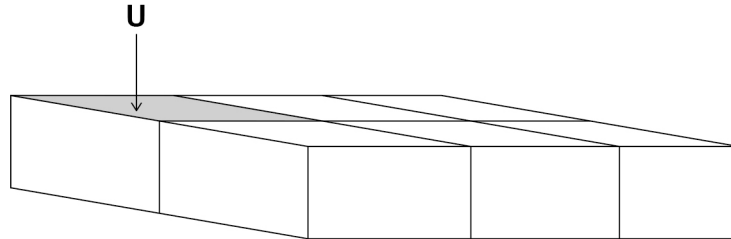
0 4 . 5

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  $150 \mu\text{m}^2$

The total area of the upper surface of the leaf is  $70.65 \text{ cm}^2$

**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

Turn over ►



0 5 . 1

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

[3 marks]

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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.**



**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]**

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**Question 5 continues on the next page**

**Turn over ►**



**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]**

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**9**



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]

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0 6 . 2

Define the term exon.

[1 mark]

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Question 6 continues on the next page

Turn over ►



**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]**

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**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]**

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**0 7 . 1**

Describe binary fission in bacteria.

**[3 marks]**

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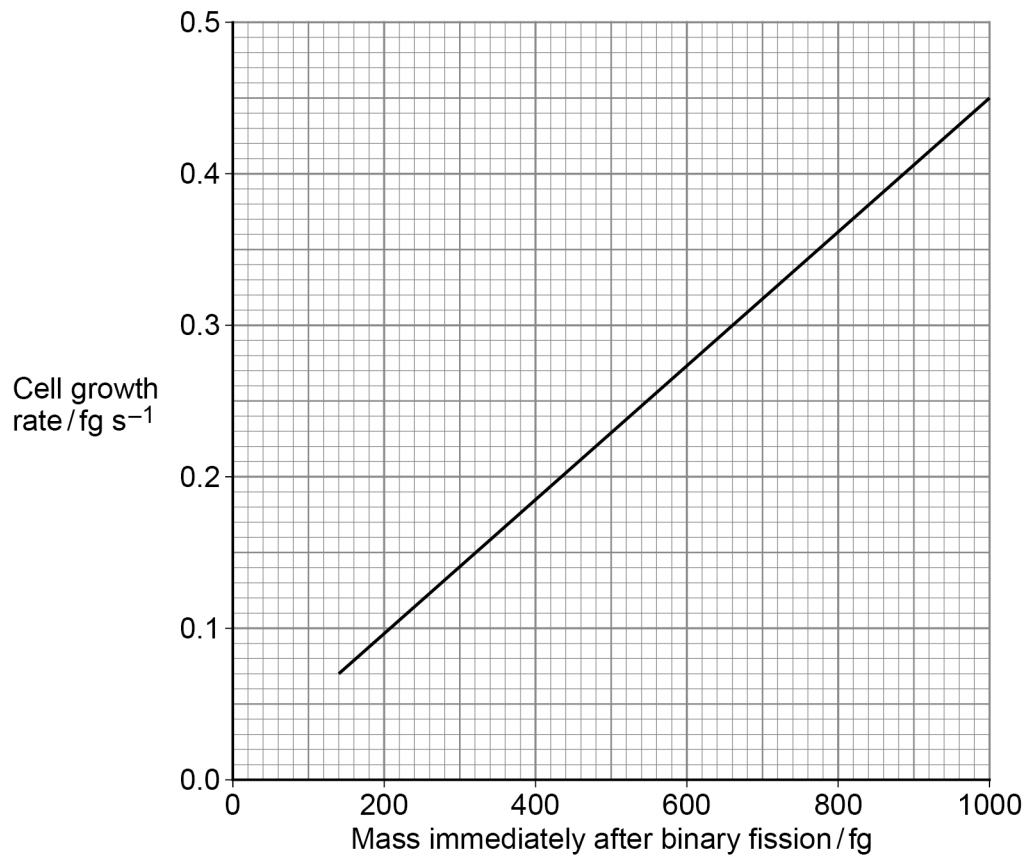
**Turn over ►**



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) =  $1 \times 10^{-15}$  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

$6.8 \times 10^{-13}$  g

$6.8 \times 10^{-15}$  g

$6.8 \times 10^{-17}$  g





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 ►



**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
$0.0 < b \leq 2.0$	2.0	5 000
$2.0 < b \leq 2.5$	0.5	20 000
$2.5 < b \leq 3.0$	0.5	90 000
$3.0 < b \leq 3.5$	0.5	260 000
$3.5 < b \leq 4.5$	1.0	200 000
$4.5 < b \leq 5.5$	1.0	20 000

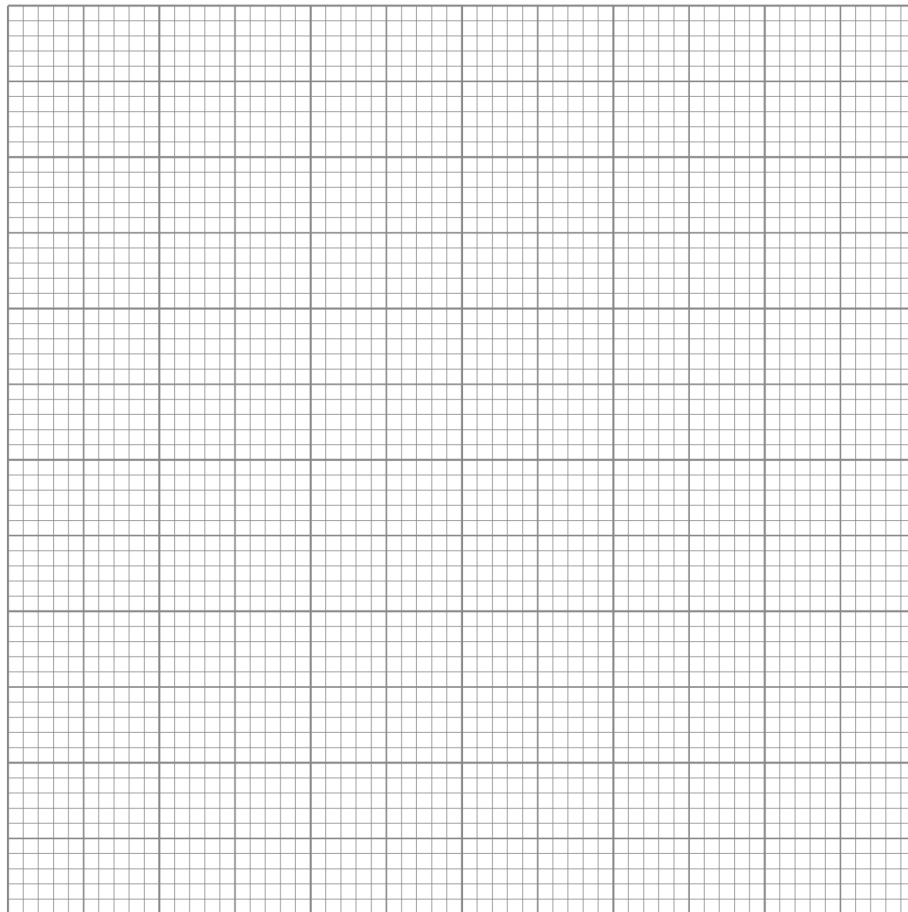
Frequency density is calculated using this equation

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



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**Frequency  
density

Birth mass / kg

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.

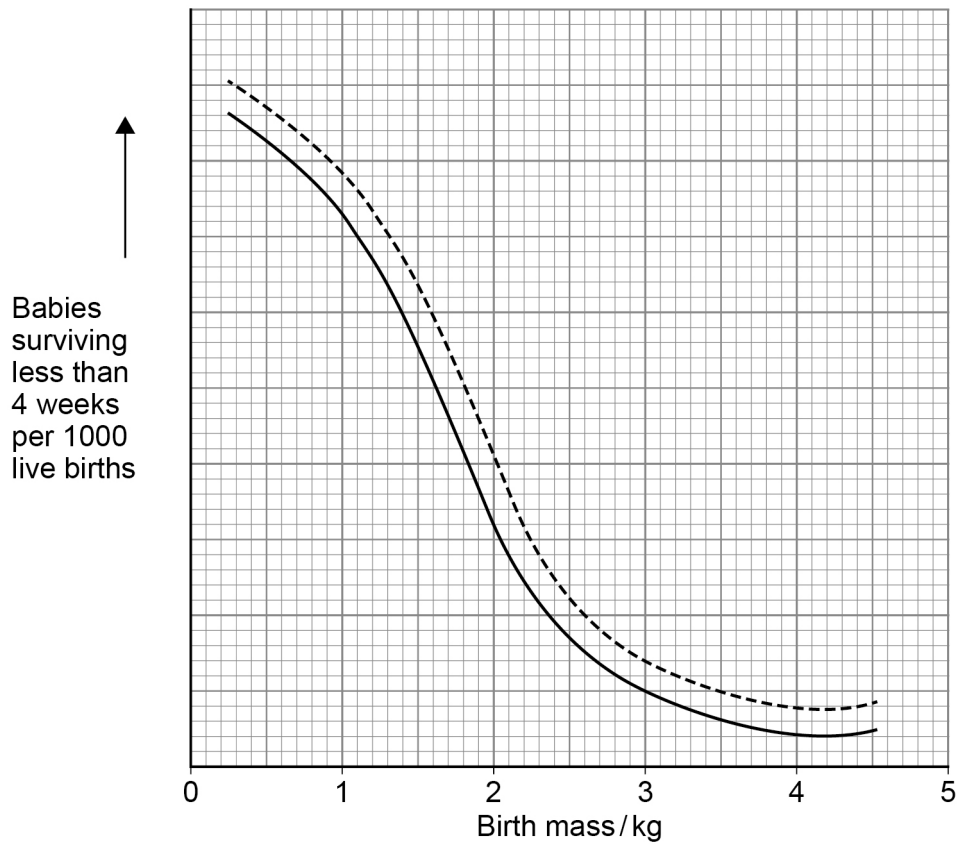
**[2 marks]**

Answer \_\_\_\_\_

**Question 8 continues on the next page****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

**0 8 . 3**

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

**[3 marks]**

1 \_\_\_\_\_

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2 \_\_\_\_\_

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3 \_\_\_\_\_

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**9**



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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. 5

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. 10

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]**


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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]**


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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 \_\_\_\_\_

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Disadvantage \_\_\_\_\_

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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**



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2 8



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