AQA

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	

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

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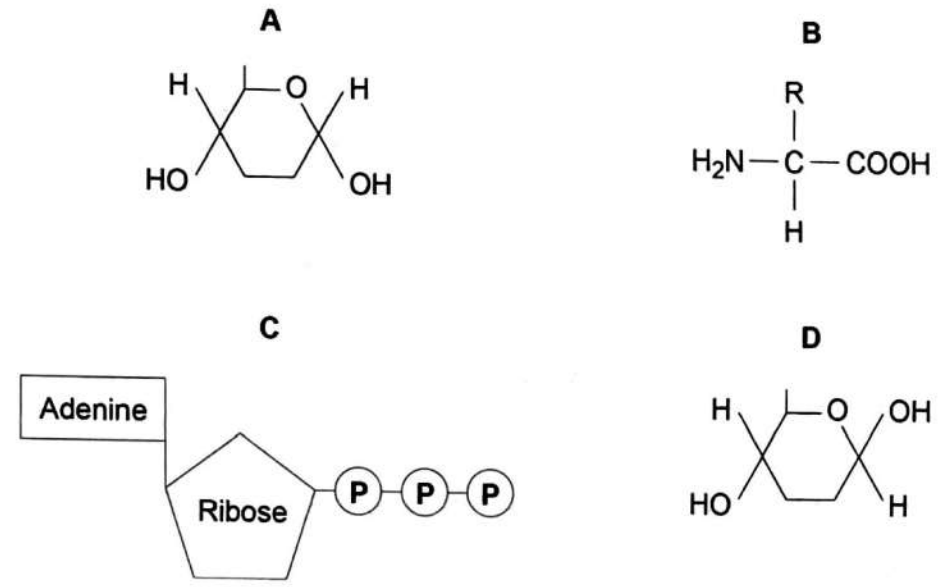
0 1 **Figure 1** shows the structure of molecules found in organisms.

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

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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 18

Number of hydrogen atoms 32

Number of oxygen atoms 16

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]

Mix sample with an acid and then neutralise with an alkali. Add Benedicts reagent and heat in a water bath. If reducing sugar is present red percipitate will form.

8

Turn over ▶

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0 2 . 1 Explain the arrangement of phospholipids in a cell-surface membrane.

[2 marks]

They are arranged into a phospholipid bilayer, with fatty acid tails pointing inwards (hydrophobic) and phosphate heads pointing outwards (hydrophilic).

0 2 . 2 Describe how an ester bond is formed in a phospholipid molecule.

[2 marks]

Formed between a molecule of glycerol and a fatty acid chain through a condensation reaction.

0 2 . 3 State and explain the property of water that helps to prevent temperature increase in a cell.

[2 marks]

Property High specific heat capacity

Explanation Needs a lot of energy to increase the temperature by just a little. This buffers changes, maintaining a more constant environment.

6

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0 3 . 1 Describe how a phagocyte destroys a pathogen present in the blood.

[3 marks]

They attach to their antigens on the surface then engulf them. This wraps the cell around the phatogen, enclosing it into a vesicle. This vesicle fuses with the lysosome that contains hydrolyse enzymes. These enzymes break down the ~~phat~~ pathogen into its components.

0 3 . 2 Give **two** types of cell, other than pathogens, that can stimulate an immune response.

[2 marks]

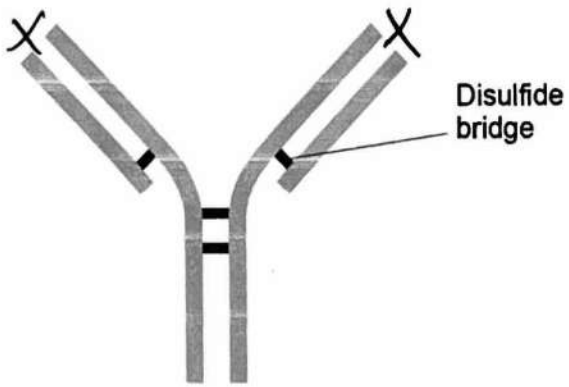
1 Transplanted cells

2 Cancer cells

Question 3 continues on the next page

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]

Forms Joins together 2 strands of polypeptide chains. Several bridges join all 4 chains together.

7

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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]

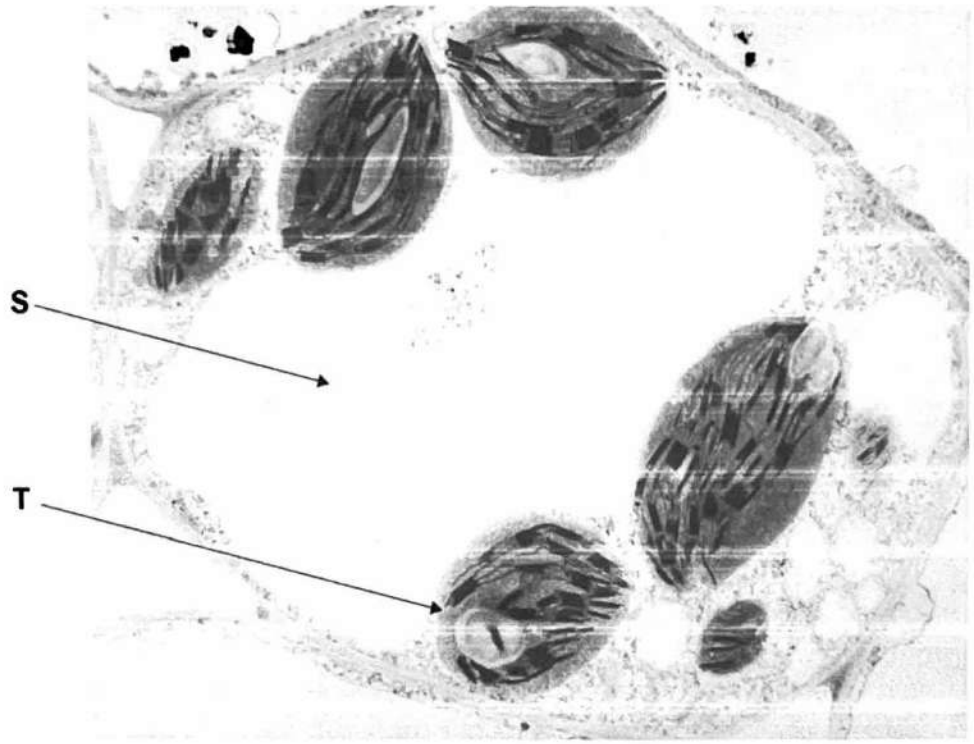
DNA codes for proteins and stored in the nucleus. Ribosomes translate this base sequence code into a polypeptide chain. Some ribosomes are found on the surface of the rough endoplasmic reticulum, involved in protein synthesis.

Golgi apparatus is involved in modifying proteins, by adding carbohydrates to their structures. They then get packaged into vesicles, which transport proteins. These vesicles eventually fuse with the cell membrane releasing the proteins.

Question 4 continues on the next page

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]

Nucleus has not been stained so doesnt show up clearly in different ~~color~~ colour.

0 4 . 3 Name the organelles labelled **S** and **T** in **Figure 3**.

[1 mark]

Organelle **S** vacuole

Organelle **T** chloroplast

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]

We are able to view internal structures of the cell, not only the surface.

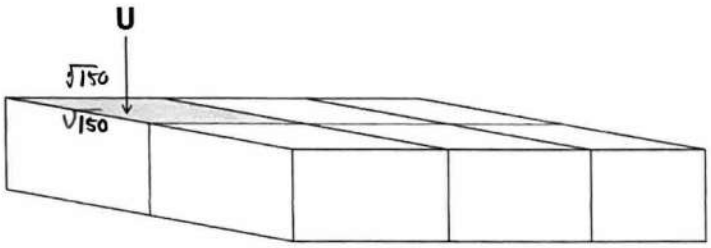
Do not write outside the box

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 μm²

The total area of the upper surface of the leaf is 70.65 cm²

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.

$1\,cm = 10\,m = 10\,000\,\mu m$

[2 marks]

~~$70.65\,cm^2 = 70\,650\,000\,\mu m^2$~~ $1\,cm^2 = 100\,mm^2 = 1 \times 10^8$

$70.65\,cm^2 \Rightarrow 7.065 \times 10^9$

$\frac{7.065 \times 10^9}{150} = 4.71 \times 10^7$

Number of cells 4.71×10^7

9

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

[3 marks]

The intercostal muscles on the external side contract, as well as the diaphragm contracts and flattens. This's pushes the chest upwards and out. Increases the volume of the cavity decreasing the pressure. Air moves in from outside, where air pressure is higher.

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 Broncide

L Artery

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]

lung tissue should not contain any starch as its from an animal. Makes the nucleus visible that contains the DNA.

Question 5 continues on the next page

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]

Burned wood indoors is greater than 0.05 So not significantly.

Obesity is highly significant, strongly suggesting its link to asthma

having with a dog or a cat is significant as there is a less than 5% chance the results are due to chance.

9

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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]

Free nucleotides pair with the template strand exposed base pairs, as they are complementary to each.

RNA polymerase forms phosphodiester bonds between these free nucleotides, joining them up.

0 6 . 2 Define the term exon.

[1 mark]

nucleotide sequence coding for the primary structure of a protein in triplet codons.

Question 6 continues on the next page

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]

Serine, Alanine, Glycine, Proline.

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]

CGT converted to CCT so G mutated to C.

This is a substitution.

7

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0 7 . 1 Describe binary fission in bacteria.

[3 marks]

Bacteria replicate by binary fission. First they replicate the genetic information, by replicating the single circular DNA then the plasmids. Lastly the cytoplasm is divided to form 2 identical daughter cells.

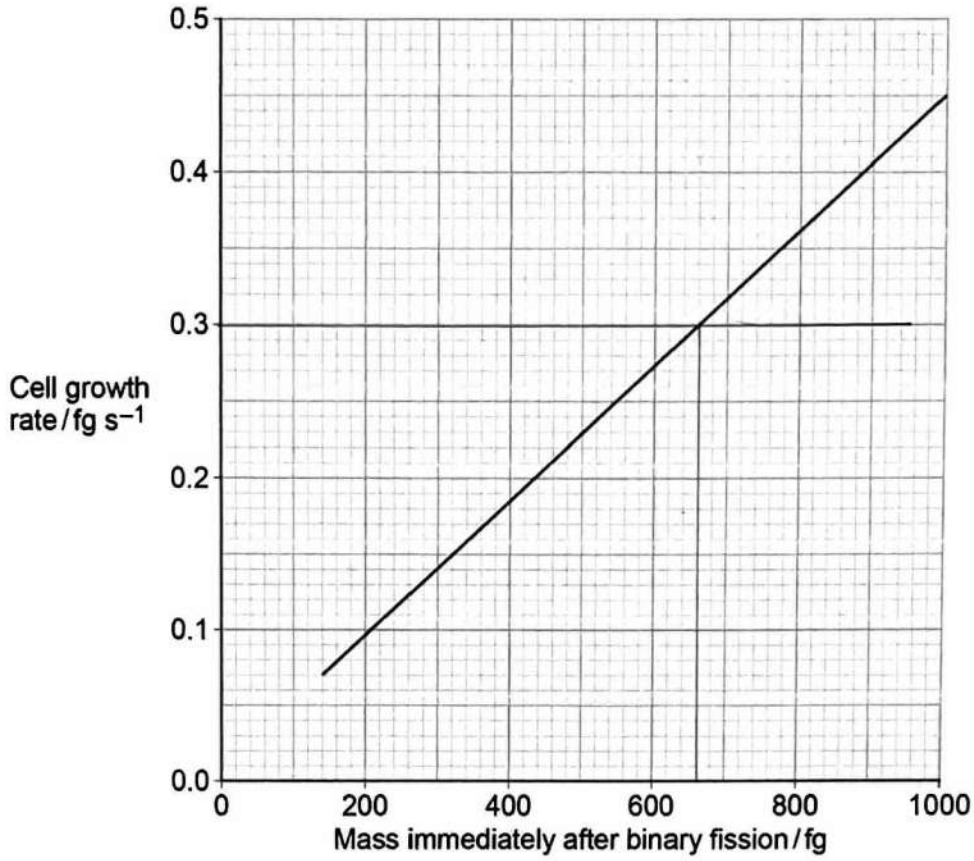
Question 7 continues on the next page

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 ☐

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]

5 min = 300 s

$\frac{90 \text{ fg}}{300 \text{ s}} = 0.3 \text{ fg s}^{-1}$

Drawn on graph

Answer 660 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 Increased temperature

Explanation Leads to higher rate of enzyme activity as particles have more energy, so more enzyme - substrate complexes form.

Suggestion 2 Increased concentration of glucose.

Explanation More available for respiration, so more energy can be released and used in processes

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

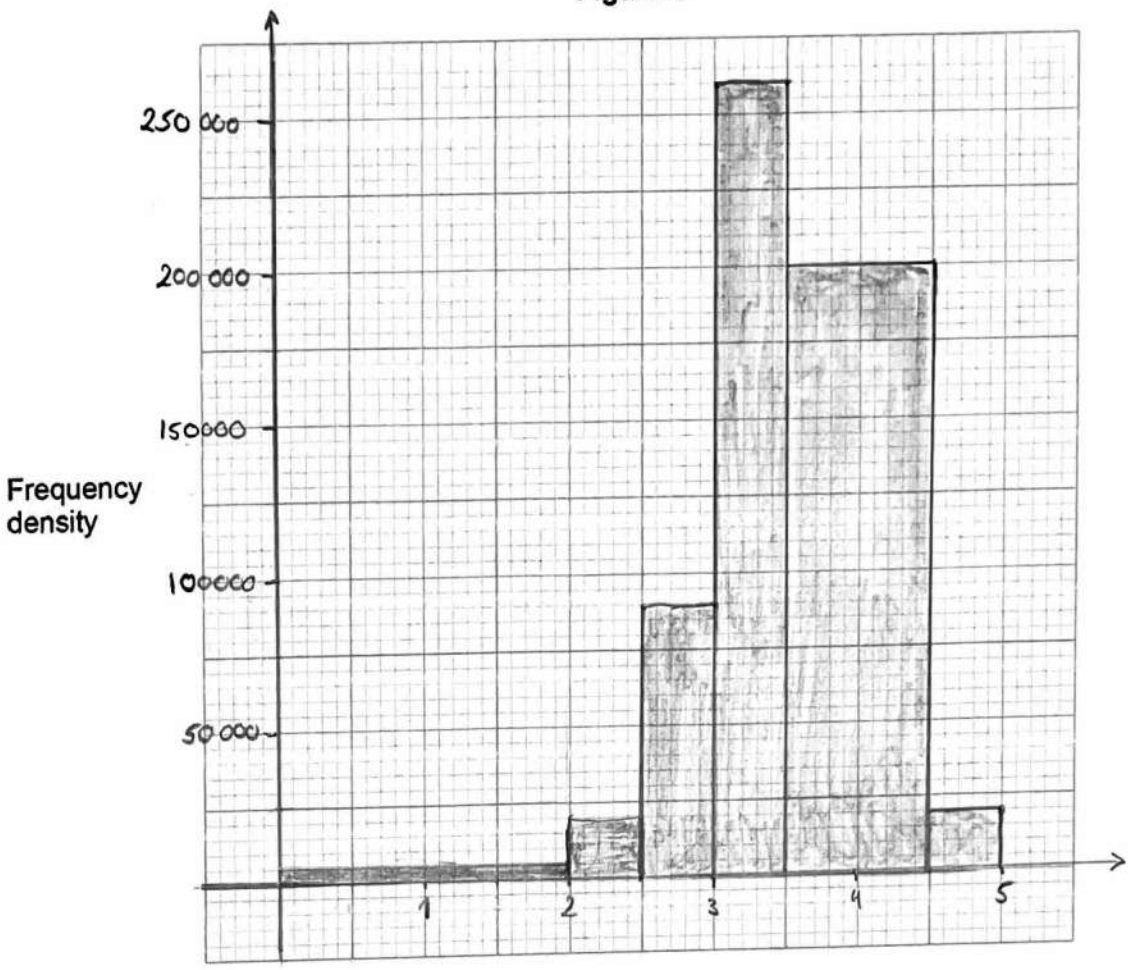
Frequency density is calculated using this equation

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

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]

number of babies = freq. density × range of mass

$= (5000 \times 2) + (20000 \times 0.5) = 10000 + 10000$

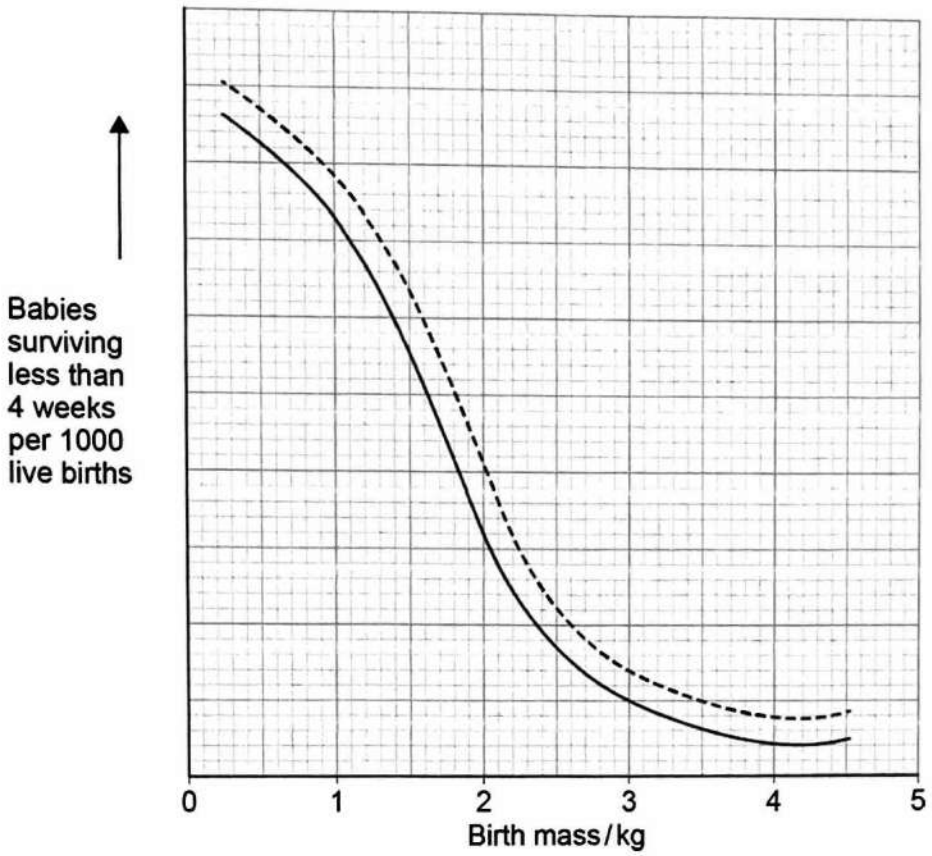
$= 20\,000$

Answer 20 000

Question 8 continues on the next page

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 Survival increases as birth mass increases for both groups

2 Survival decreases if mother smoked.

3 The effect of smoking on survival is the same at all birth masses. Reduces survival by the same amount at any mass.

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.

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]

It has all the same protein produced, but has one extra protein as gene inserted from another species is ~~also~~ also expressed. Proteome has 1 more protein.

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]

The expressed gene will lead to the increased production of aquaporins. This increases the permibility of ~~channel proteins~~ the membrane of cells to let water in.

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 More stomata allows more efficient gas uptake of CO_2 used in photosynthesis. So faster photosynthesis produces more sugars, so plants can grow faster.

Disadvantage Water is lost through the stomata in transpiration, Water is needed in photosynthesis so large amount of waterloss slows down and limits the rate of photosynthesis. So less growth will take place.

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]

Vacuole membrane

$\div 6 \left(\begin{matrix} 6 - 150 \\ 1 - 25 \end{matrix} \right) \div 6$

cell surface membrane

$\div 3 \left(\begin{matrix} 3 - 1500 \\ 1 - 500 \end{matrix} \right) \div 3$

$\frac{500}{25} = 20 \Rightarrow \times 20$

Answer $\times 20$

10

END OF QUESTIONS