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	

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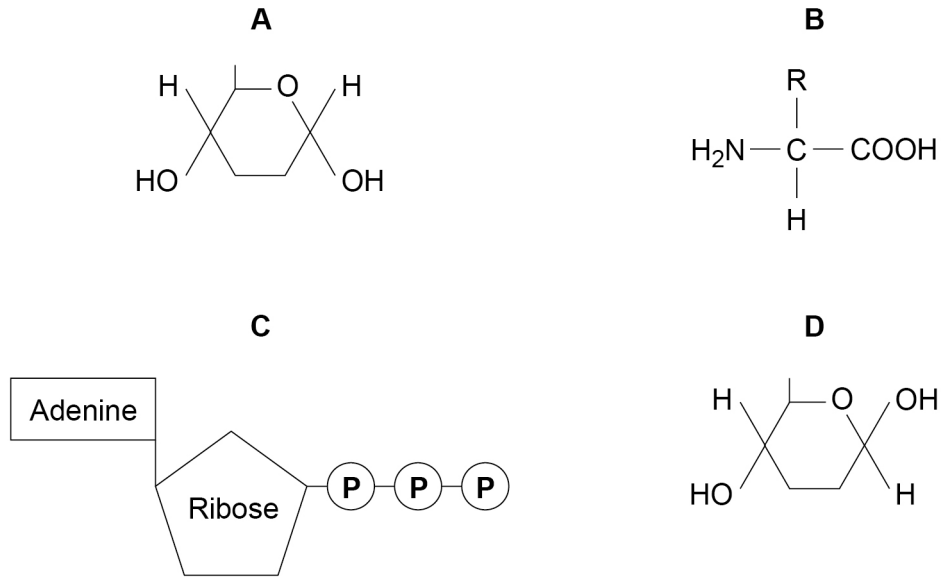
Answer **all** questions in the spaces provided.

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

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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 _____

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

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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

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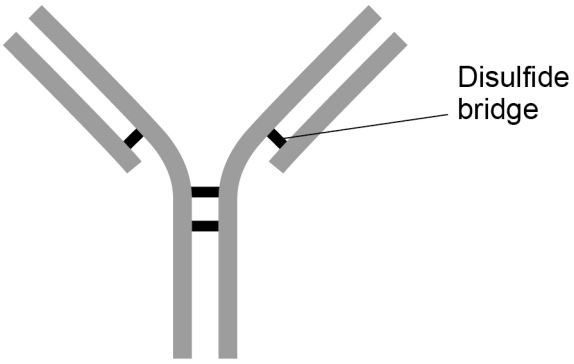
0 3 . 3 **Figure 2** shows the structure of an antibody.

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

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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]

Question 4 continues on the next page

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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]

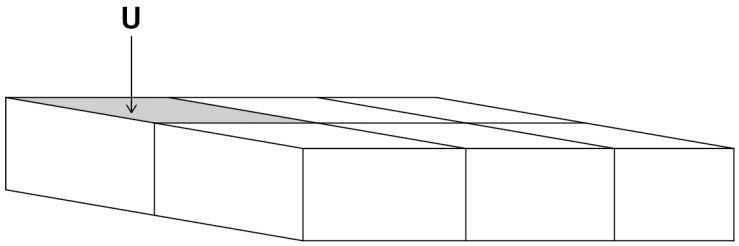
Do not write outside the box

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

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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]

_____

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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

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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

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0 7 . 1 Describe binary fission in bacteria.

[3 marks]

Question 7 continues on the next page

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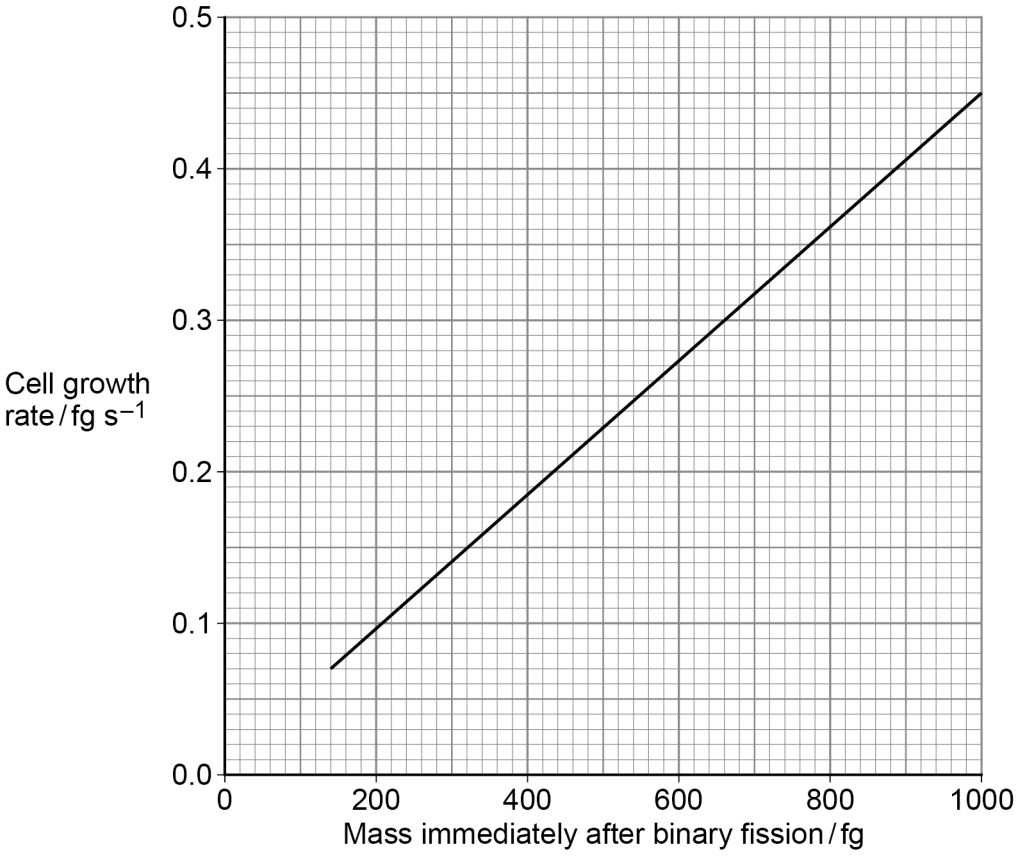
The cell growth rate of the bacterium *Bacillus subtilis* is proportional to its mass immediately after binary fission.

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 ►

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

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

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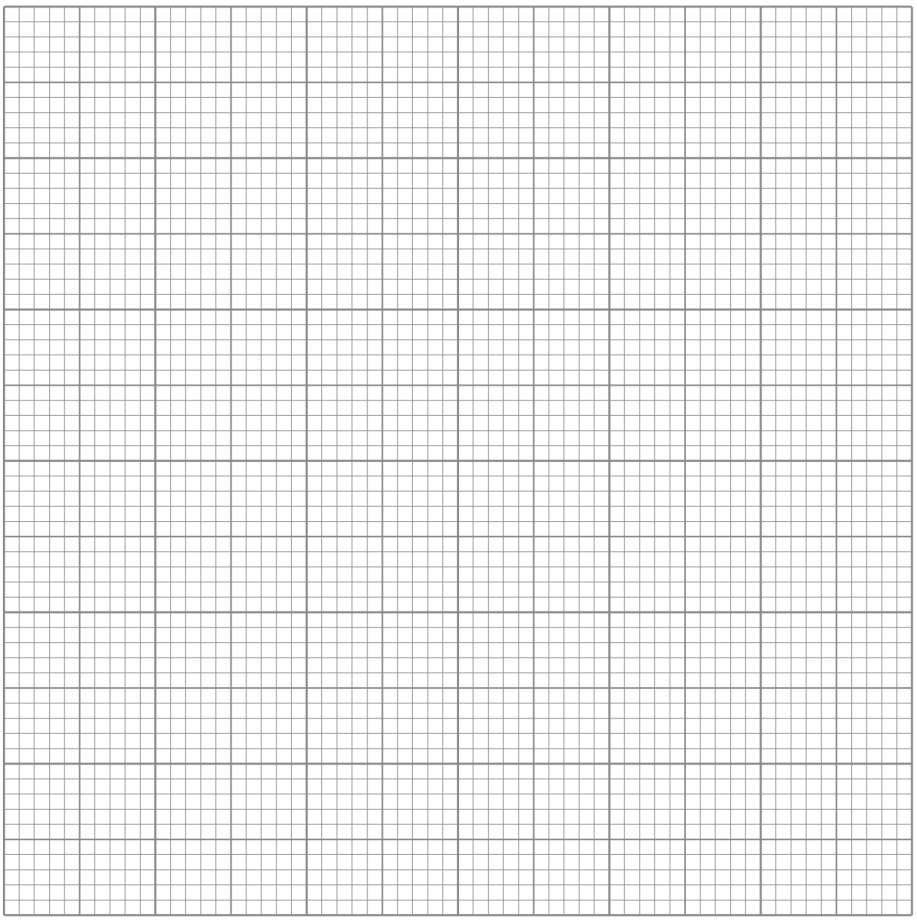
0 8 . 1 Draw, on **Figure 8**, a **suitable** chart to show the distribution of birth mass for this population of babies.

[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

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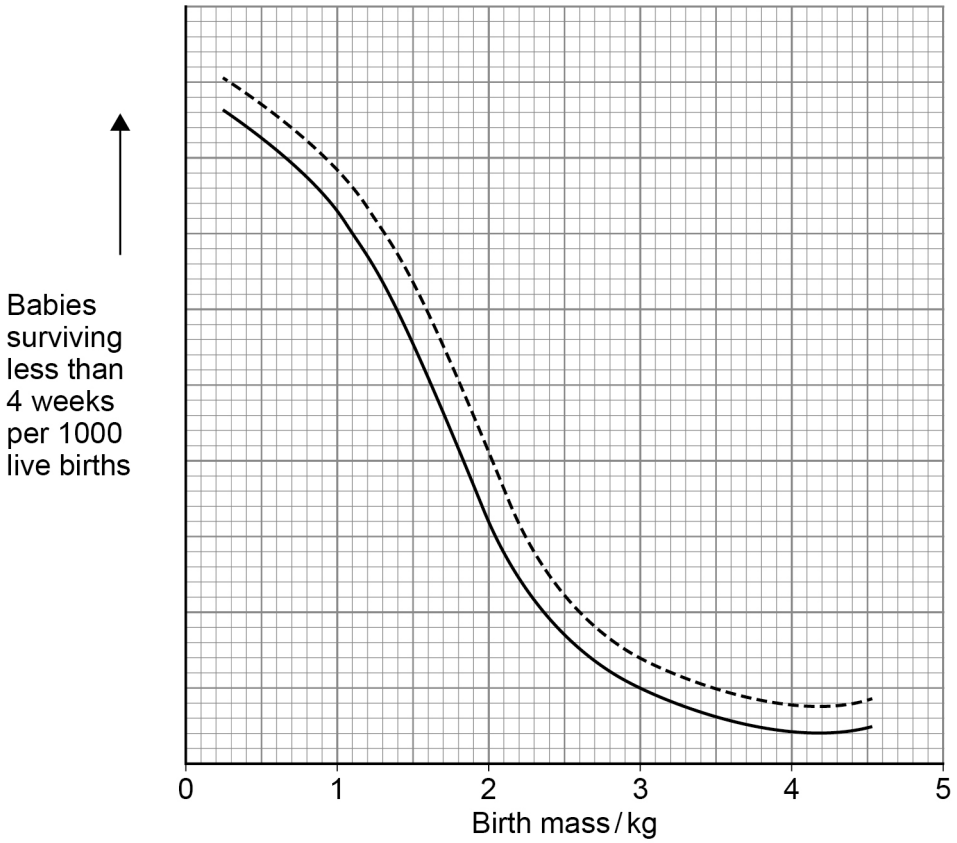
The scientist also measured the relationship between birth mass and babies surviving less than 4 weeks. She determined if the mothers of these babies smoked cigarettes during pregnancy. Her results are shown in **Figure 9**.

Figure 9



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

[3 marks]

1 _____

_____

_____

2 _____

_____

_____

3 _____

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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.

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]

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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 _____

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

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