AQA

Please write clearly in block capitals.

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AS
BIOLOGY

Paper 1

Tuesday 21 May 2019 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.
- 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 . 1 The nucleus and a chloroplast of a plant cell both contain DNA.

Give **three** ways in which the DNA in a chloroplast is different from DNA in the nucleus.

[3 marks]

1 _____

_____

_____

2 _____

_____

_____

3 _____

_____

_____

0 1 . 2 Some DNA nucleotides have the organic base thymine, but RNA nucleotides do not have thymine. RNA nucleotides have uracil instead of thymine.

Give **one** other difference between the structure of a DNA nucleotide and the structure of an RNA nucleotide.

[1 mark]

_____

_____

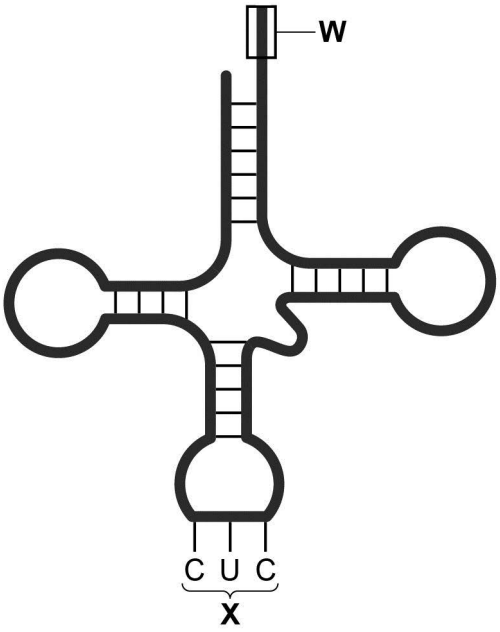
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Figure 1 shows a tRNA molecule.

Figure 1



0 1 . 3 Name the structures labelled **W** and **X** in **Figure 1**.

[1 mark]

W _____

X _____

0 1 . 4 Not all mutations in the nucleotide sequence of a gene cause a change in the structure of a polypeptide.

Give **two** reasons why.

[2 marks]

1 _____

_____

_____

_____

2 _____

_____

_____

_____

7

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0 2 . 1 What is a **monoclonal** antibody?

[1 mark]

0 2 . 2 After a disease is diagnosed, monoclonal antibodies are used in some medical treatments.

Give **one** example of using monoclonal antibodies in a medical treatment.

[1 mark]

0 2 . 3 Describe the role of antibodies in producing a positive result in an ELISA test.

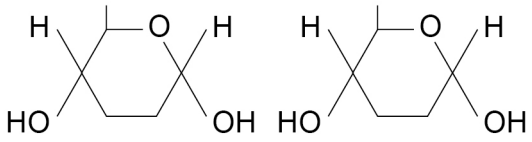
[4 marks]

6

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0 3 **Figure 2** shows the structure of two α-glucose molecules.

Figure 2



0 3 . 1 On **Figure 2**, draw a box around one chemical group in each glucose molecule used to form a glycosidic bond.

[1 mark]

0 3 . 2 A precipitate is produced in a positive result for reducing sugar in a Benedict's test.
A precipitate is solid matter suspended in solution.

A student carried out the Benedict's test. Suggest a method, other than using a colorimeter, that this student could use to measure the **quantity** of reducing sugar in a solution.

[2 marks]

[Extra space]

Question 3 continues on the next page

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In an investigation, a student wanted to identify the solutions in two beakers, **A** and **B**. She knew one beaker contained maltose solution and the other beaker contained glucose solution. Both solutions had the same concentration.

She did two separate biochemical tests on a sample from each beaker.

Test 1 – used Benedict's solution to test for reducing sugar.

Test 2 – added the enzyme maltase, heated the mixture at 30 °C for 5 minutes, and then used Benedict's solution to test for reducing sugar.

Maltose is hydrolysed by maltase.

The student's results are shown in **Table 1**.

Table 1

	Colour of solution after testing with Benedict's solution	
Beaker	**Test 1**	**Test 2**
A	red	red
B	red	dark red

0 3 . 3 Explain the results for beakers **A** and **B** in **Table 1**.

[2 marks]

Beaker A _____

_____

_____

_____

Beaker B _____

_____

_____

_____

Do not write outside the box

0 3 . 4 Use of a colorimeter in this investigation would improve the repeatability of the student's results.

Give **one** reason why.

[1 mark]

In **Test 1**, the student used a measuring cylinder to measure 15 cm^3 of solution from a beaker. The measuring cylinder gives a volume with an uncertainty of ± 1 cm^3. She used a graduated syringe to measure 5.0 cm^3 of Benedict's solution. The graduated syringe gives a volume with an uncertainty of $\pm$ 0.5 cm^3. She mixed these volumes of liquid to do the biochemical test.

0 3 . 5 Calculate the percentage error for the measurements used to obtain a 20 cm^3 mixture of the solution from the beaker and Benedict's solution. Show your working.

[2 marks]

Answer = _____ %

8

Turn over for the next question

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0 4 A scientist identified and counted the invertebrate species present in samples taken at two sites in a river. The scientist also measured the rate of water flow at each site.

His results are shown in **Table 2** and **Table 3**.

Table 2

Invertebrate species	**Site 1**	**Site 2**
Anglers' Curse mayfly	17	5
Flat-headed mayfly	6	8
Slate Drake mayfly	0	6
Water beetle	12	13
Midge fly	13	13
Total number caught	48	45

Table 3

	Site 1	**Site 2**
Index of diversity		4.7
Rate of water flow / cm s^{-1}	1–14	30–60

0 4 . 1 Complete **Table 3** by calculating the index of diversity (d) at **Site 1**.

$$d = \frac{N(N-1)}{\sum n(n-1)}$$

[1 mark]

Index of diversity (d) = _____

Do not write outside the box

0 4 . 2 Explain why it is more useful to calculate an index of diversity than to record species richness.

[2 marks]

0 4 . 3 Suggest how the scientist measured the rate of water flow in the river.

[1 mark]

0 4 . 4 Use information in **Table 2** and **Table 3** to suggest and explain a reason for the difference in the numbers of Slate Drake mayfly at these sites in this river.

[2 marks]

0 4 . 5 It was important that the sampling procedure was standardised when collecting the Slate Drake mayflies from the two sites.

Give **one** way in which the sampling procedure could be standardised.

[1 mark]

7

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0 5 . 1 Place a tick (✓) in the box next to the sequence that shows the correct order of magnitude of these measurements.

[1 mark]

$50\ \text{nm} < 0.5\ \mu\text{m} < 5 \times 10^{-2}\ \text{mm} < 0.5 \times 10^{-5}\ \text{m}$ ☐

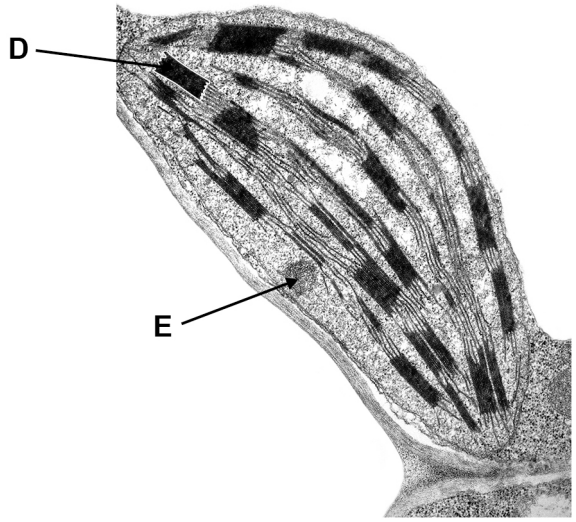
$50\ \text{nm} < 0.5\ \mu\text{m} < 0.5 \times 10^{-5}\ \text{m} < 5 \times 10^{-2}\ \text{mm}$ ☐

$0.5\ \mu\text{m} < 50\ \text{nm} < 0.5 \times 10^{-5}\ \text{m} < 5 \times 10^{-2}\ \text{mm}$ ☐

$0.5\ \mu\text{m} < 50\ \text{nm} < 5 \times 10^{-2}\ \text{mm} < 0.5 \times 10^{-5}\ \text{m}$ ☐

Figure 3 is an electron micrograph of a chloroplast.

Figure 3



0 5 . 2 Identify structures labelled **D** and **E**.

[2 marks]

D _____

E _____

Do not write outside the box

0 5 . 3 The detail shown in **Figure 3** would **not** be seen using an optical microscope.

Explain why.

[2 marks]

0 5 . 4 Name an organelle found in both a chloroplast and a prokaryotic cell.

[1 mark]

0 5 . 5 A scientist determined the volume of a plant cell and the volume of organelles it contained.

They found:

- the volume of a plant cell is 17 500 μm^3
- the volume of all the mitochondria in a plant cell is 262.5 μm^3
- the volume of all the mitochondria and all the chloroplasts in a plant cell is 44.1% of the volume of a plant cell.

Use this information to calculate the volume of all the chloroplasts in a plant cell.

[2 marks]

Answer = _____ μm^3

Question 5 continues on the next page

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0 5 . 6 A biologist separated cell components to investigate organelle activity. She prepared a suspension of the organelles in a solution that prevented damage to the organelles.

Describe **three** properties of this solution and explain how each property prevented damage to the organelles.

[3 marks]

Property 1 _____

Explanation

_____

_____

_____

_____

Property 2 _____

Explanation

_____

_____

_____

_____

Property 3 _____

Explanation

_____

_____

_____

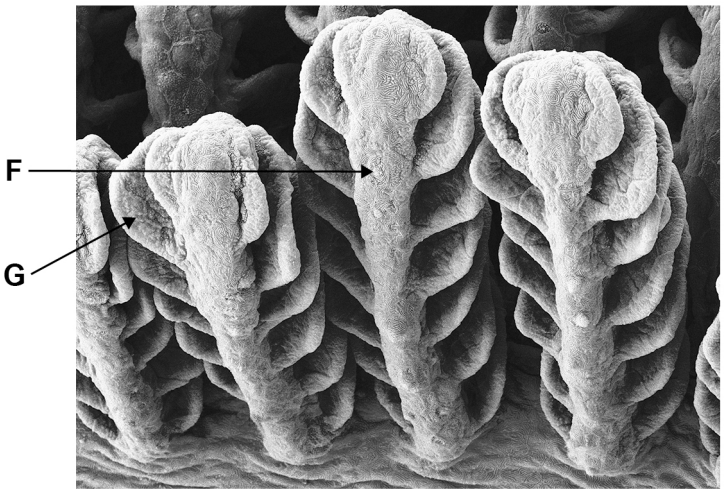
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11

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0 6 **Figure 4** is an image of a fish gill taken using a scanning electron microscope.

Figure 4



0 6 . 1 Identify structures labelled **F** and **G**.

[1 mark]

F _____

G _____

0 6 . 2 Describe and explain the advantage of the counter-current principle in gas exchange across a fish gill.

[3 marks]

_____

_____

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_____

Question 6 continues on the next page

Do not write outside the box

Scientists captured a large number of three species of fish.

The scientists measured:

- the water depth where fish were caught
- the concentration of dissolved oxygen at all water depths
- the mean gill surface area and mean body mass of each species of fish caught.

The scientists calculated the ratio of gill surface area to fish body mass.

The results are shown in **Figure 5** and **Table 4**.

Figure 5

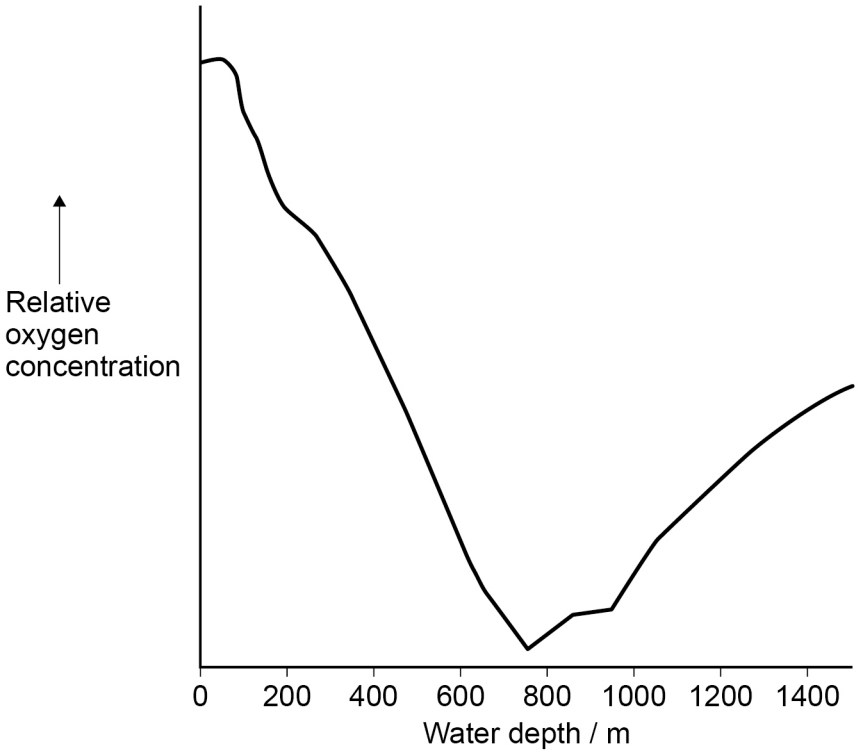


Table 4

Fish species	Water depth where fish were caught / m	Ratio of gill surface area to body mass
Anoplopoma fimbria	450–1280	148:1
Careproctus melanurus	850–1307	124:1
Embassichtys bathybius	1205–1307	20:1

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0 6 . 3 Use information in **Figure 5** and **Table 4** to describe the relationship between:

1. dissolved oxygen concentration and increasing water depth
2. dissolved oxygen concentration and the distribution of *Anoplopoma fimbria*.

[2 marks]

1. dissolved oxygen concentration and increasing water depth

2. dissolved oxygen concentration and the distribution of *Anoplopoma fimbria*

0 6 . 4 Using information from **Figure 5** and **Table 4**, what can you conclude about the adaptation of the gas exchange surfaces of these species of fish?

[2 marks]

8

Turn over for the next question

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0 7 . 1 Explain how the active site of an enzyme causes a high rate of reaction.

[3 marks]

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Question 7 continues on the next page

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ANSWER IN THE SPACES PROVIDED

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The action of the enzyme catalase is shown below.

$$\text{hydrogen peroxide} \xrightarrow{\text{catalase}} \text{water} + \text{oxygen}$$

A student investigated the effect of hydrogen peroxide concentration on the rate of this reaction. He used catalase from potato tissue.

The student:

- put five potato chips in a flask
- added 20 cm^3 of 0.5 mol dm^{-3} hydrogen peroxide solution to the flask
- measured the time in seconds for production of 10 cm^3 of oxygen gas
- repeated this procedure with four different concentrations of hydrogen peroxide solution.

His results are shown in **Table 5**.

Table 5

Hydrogen peroxide concentration / mol dm^{-3}	**Time for production of 10 cm^3 of oxygen gas / seconds**	**Rate of reaction / arbitrary units**
0.5	18	
1.0	10	
1.5	7	
2.0	6	
2.5	6	

0 7 . 2 Other than those stated, give **one** factor the student would have controlled in his investigation.

[1 mark]

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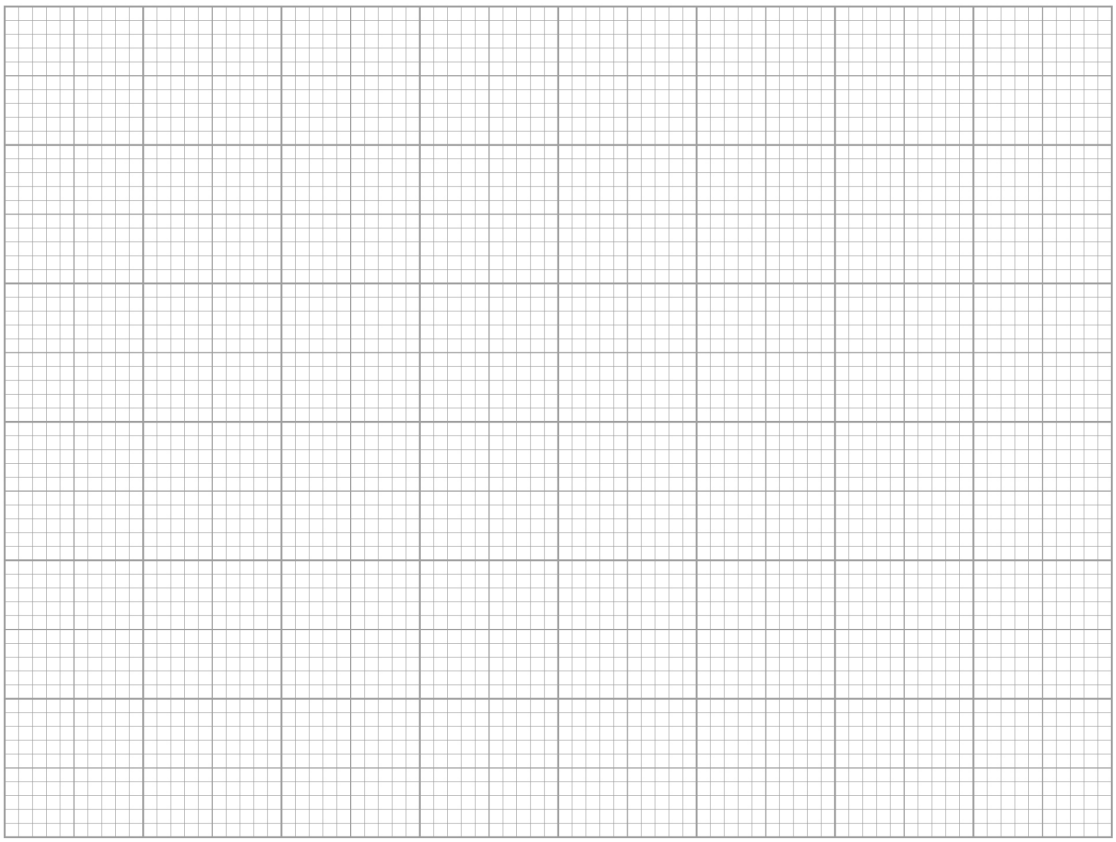
0 7 . 3 The student gave the maximum rate of reaction a value of 1.0 arbitrary units.

Complete **Table 5** by calculating the rate of reaction in arbitrary units at each hydrogen peroxide concentration. Record the rates using an appropriate number of significant figures.

[2 marks]

0 7 . 4 Plot a suitable graph of your processed data shown in **Table 5**.

[3 marks]



0 7 . 5 Suggest a change the student could make to his procedure so that 10 cm^3 of oxygen would be produced in less than 6 seconds.

[1 mark]

10

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0 8 . 1 Describe a biochemical test to confirm the presence of protein in a solution.

[2 marks]

0 8 . 2 A dipeptide consists of two amino acids joined by a peptide bond. Dipeptides may differ in the type of amino acids they contain.

Describe **two other** ways in which all dipeptides are similar and **one** way in which they might differ.

[3 marks]

Similarities

1

2

Difference

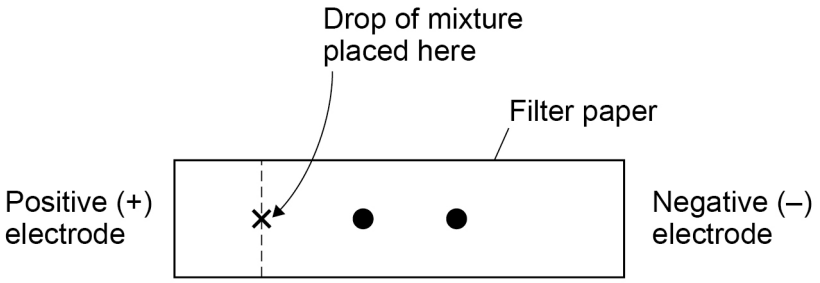
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A solution contained a mixture of **three** different amino acids. A scientist passed an electric current through the solution to separate the amino acids.

She placed a drop of the mixture at one end of a piece of filter paper, attached an electrode to each end of the paper and switched on the current. She switched off the current after 20 minutes and stained the paper to show spots of the amino acids at new positions.

Her results are shown in **Figure 6**.

Figure 6



Key

● Spot showing the location of amino acids after 20 minutes

0 8 . 3 Explain what the positions of the spots in **Figure 6** show about these amino acids.

[3 marks]

8

Turn over ►

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0 9 Read the following passage.

In laboratory tests, scientists investigated the effects of a new drug called ABZ on stomach tumour cells. They found ABZ stopped mitosis by preventing the formation of spindle fibres. They also found that ABZ affected some healthy cells.

Mitosis is a controlled process. Cyclin B is a protein found in a cell's nucleus. It regulates the timing of mitosis during the cell cycle. Mitosis starts when the concentration of Cyclin B in the nucleus rises sharply and ends when it falls. The scientists found that ABZ increased, and maintained, a high concentration of Cyclin B in stomach tumour cells.

Programmed cell death is called apoptosis. Two nuclear proteins, Bcl-2 and Bax, are involved in controlling apoptosis. Apoptosis is prevented when the ratio of Bcl-2 to Bax is high and is promoted when this ratio is low. The scientists found that ABZ decreased the concentration of Bcl-2 and increased the concentration of Bax in stomach tumour cells.

From their results the scientists claimed that ABZ could be used for the successful treatment of stomach cancer.

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

0 9 . 1 Suggest why preventing the formation of spindle fibres (lines 2–3) stopped the cell cycle.

[2 marks]

0 9 . 2 Suggest and explain why ABZ could be used as a treatment for cancer even though it affects some healthy cells (lines 3–4).

[1 mark]

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0 9 . 3 What can you conclude about the effect of ABZ on tumour cells?

Use information about changes in the concentrations of Cyclin B (lines 6–7), and Bcl-2 and Bax (lines 10–14).

[4 marks]

[Extra space]

Question 9 continues on the next page

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0 9 . 4 Evaluate the scientists' suggestion that ABZ could be used for the successful treatment of stomach cancer.

[3 marks]

[Extra space]

10

END OF QUESTIONS

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