Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

# AS
# BIOLOGY

**Paper 1**

# 7401/1

**Tuesday 21 May 2019 Afternoon**

**Time allowed: 1 hour 30 minutes**

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

**At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.**

**[Turn over]**

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## INSTRUCTIONS

- **Use black ink or black ball-point pen.**
- **Answer ALL questions.**
- **You must answer the questions in the spaces provided. Do not write 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.**

**DO NOT TURN OVER UNTIL TOLD TO DO SO**

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

**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** _____

_____

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**2** _____

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**3** _____

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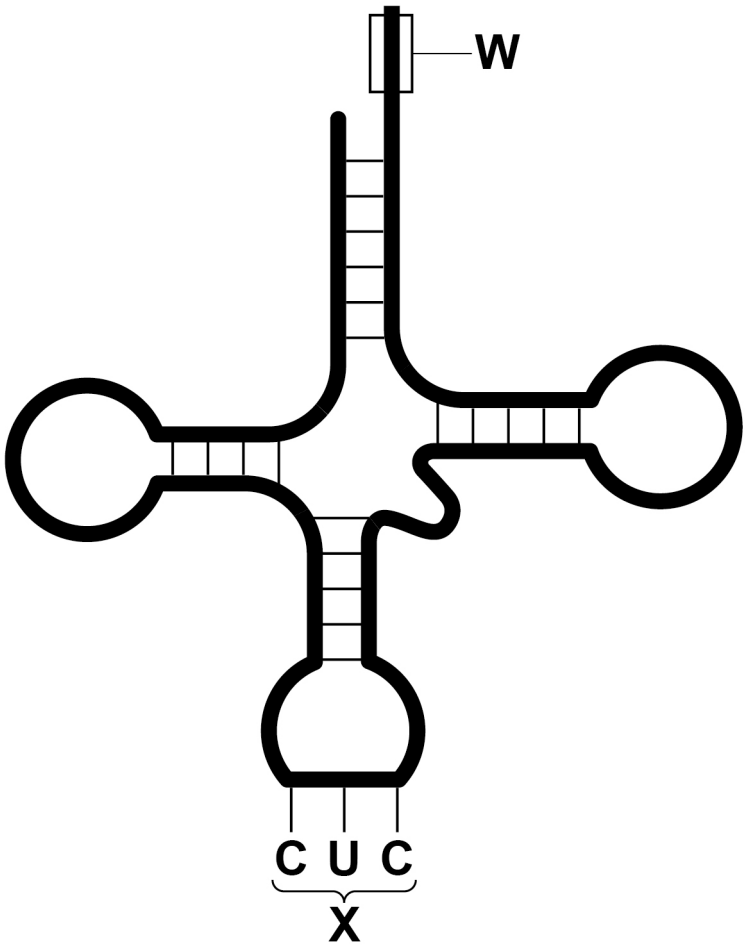
**0 1 . 2** **Some DNA nucleotides have the organic base thymine, but RNA nucleotides do not have thymine. RNA nucleotides have uracil instead of thymine.**

**Give ONE other difference between the structure of a DNA nucleotide and the structure of an RNA nucleotide. [1 mark]**

**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** _____

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**2** _____

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**7**

**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]**

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**[Turn over]**

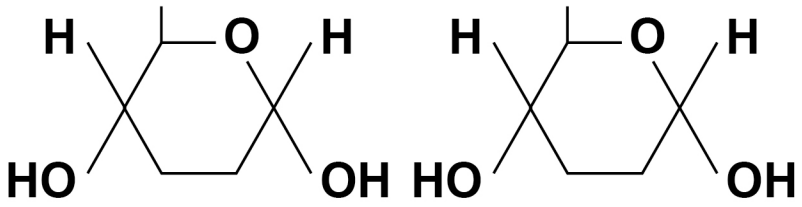
**0 2 . 3** **Describe the role of antibodies in producing a positive result in an ELISA test. [4 marks]**

6

[Turn over]

**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]**

**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**

**[Turn over]**

**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 $\pm$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**

**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. [1 mark]**

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

**Index of diversity (d) =** _____

**[Turn over]**

**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, on page 18, 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

**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]**

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

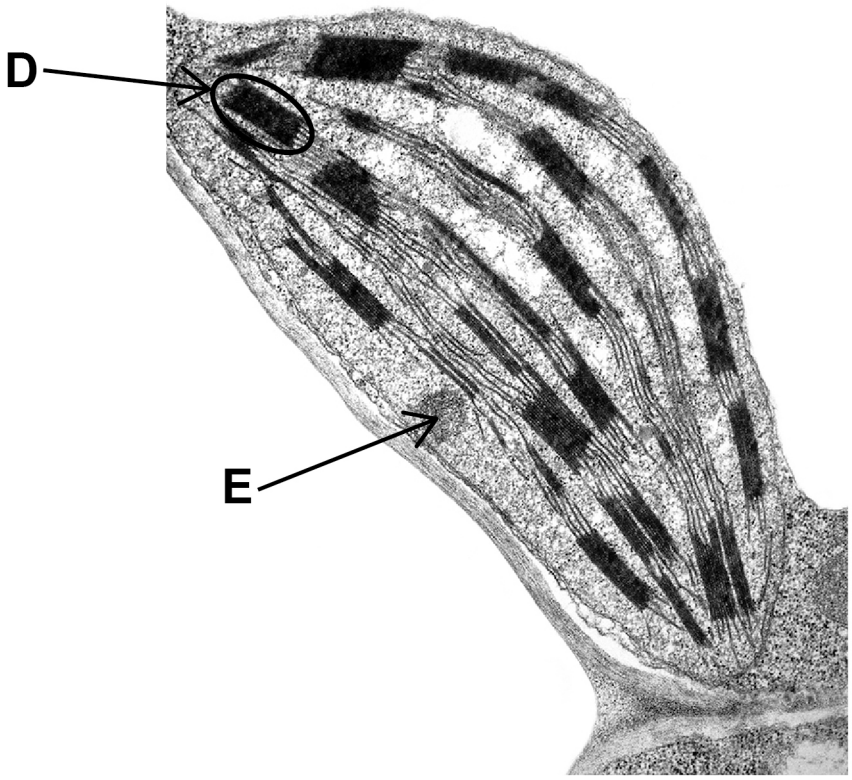
☐ $50\ \text{nm} < 0.5\ \mu\text{m} < 0.5 \times 10^{-5}\ \text{m} < 5 \times 10^{-2}\ \text{mm}$

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

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

**FIGURE 3 is an electron micrograph of a chloroplast.**

**FIGURE 3**




**0 5 . 2 Identify structures labelled D and E. [2 marks]**

**D** _____

**E** _____

**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]**

**[Turn over]**

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**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 $\mu m^3$**
- **the volume of all the mitochondria in a plant cell is 262.5 $\mu m^3$**
- **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 = _____ $\mu m^3$**

**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** _____

_____

_____

_____

_____

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_____

**Property 2** _____

**Explanation** _____

_____

**Property 3**

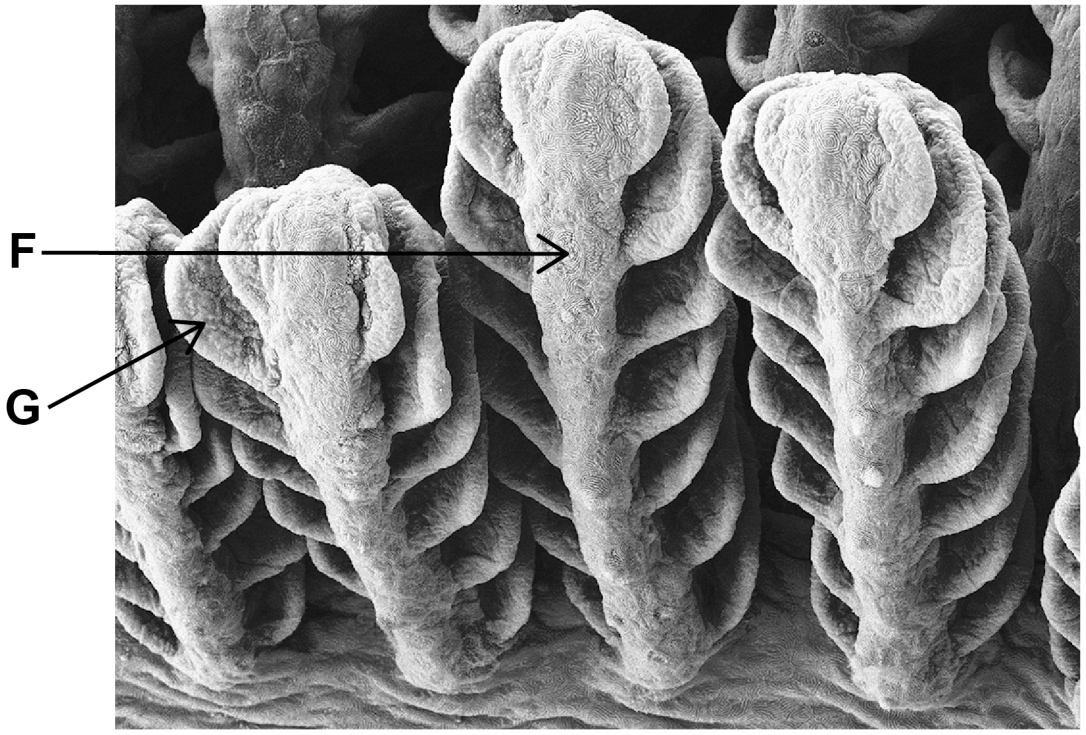
**Explanation**

**[Turn over]**

11

**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]**

**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.**

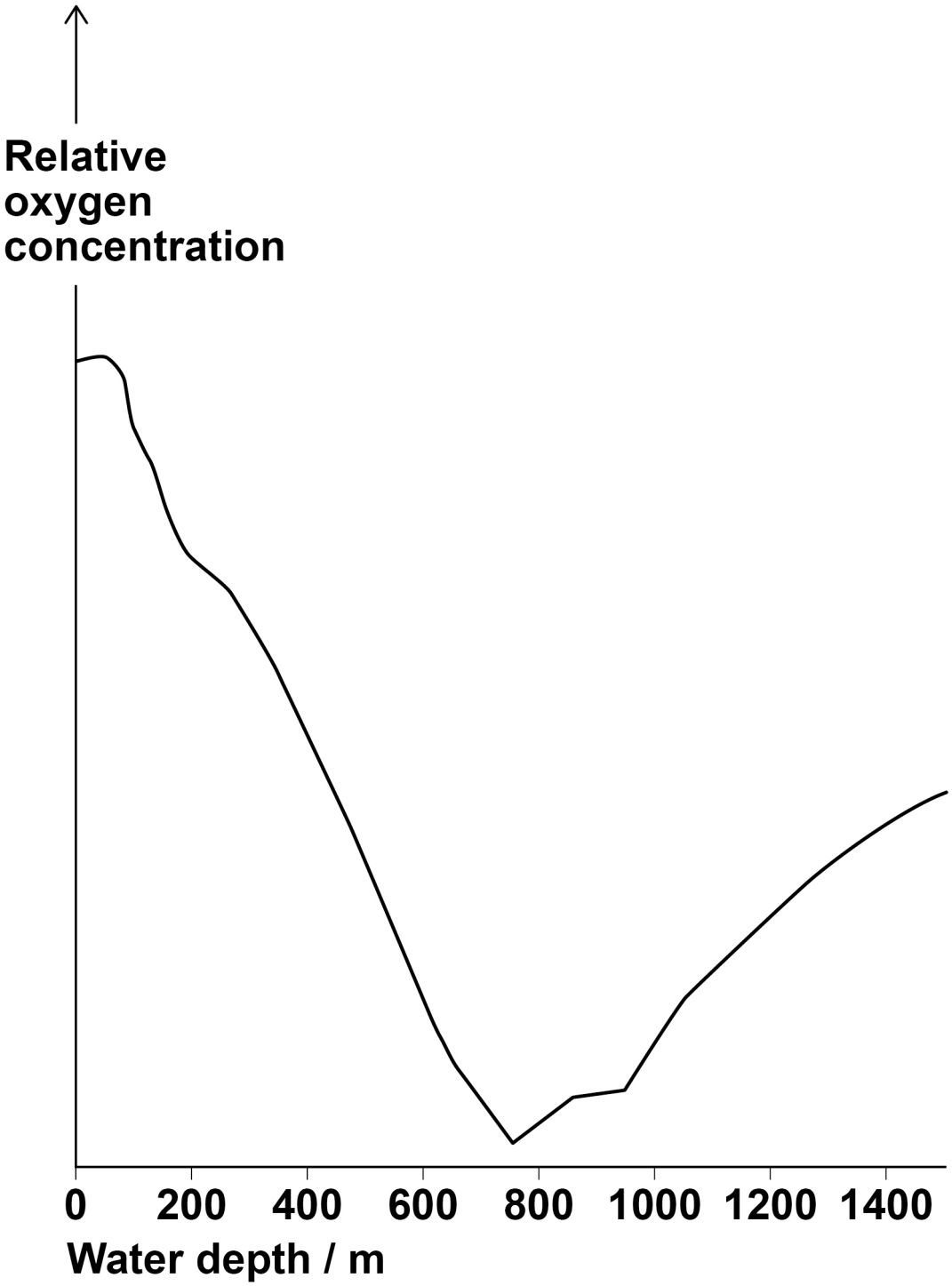
**The scientists calculated the ratio of gill surface area to fish body mass.**

**The results are shown in FIGURE 5 and TABLE 4.**

**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 |

**FIGURE 5**




**[Turn over]**

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**0 6 . 3** **Use information in FIGURE 5 and TABLE 4, on pages 32 and 33, 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, on pages 32 and 33, what can you conclude about the adaptation of the gas exchange surfaces of these species of fish? [2 marks]**

[Turn over]

8

**0 7 . 1 Explain how the active site of an enzyme causes a high rate of reaction. [3 marks]**

[Turn over]

**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, on the opposite page.**

**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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**[Turn over]**

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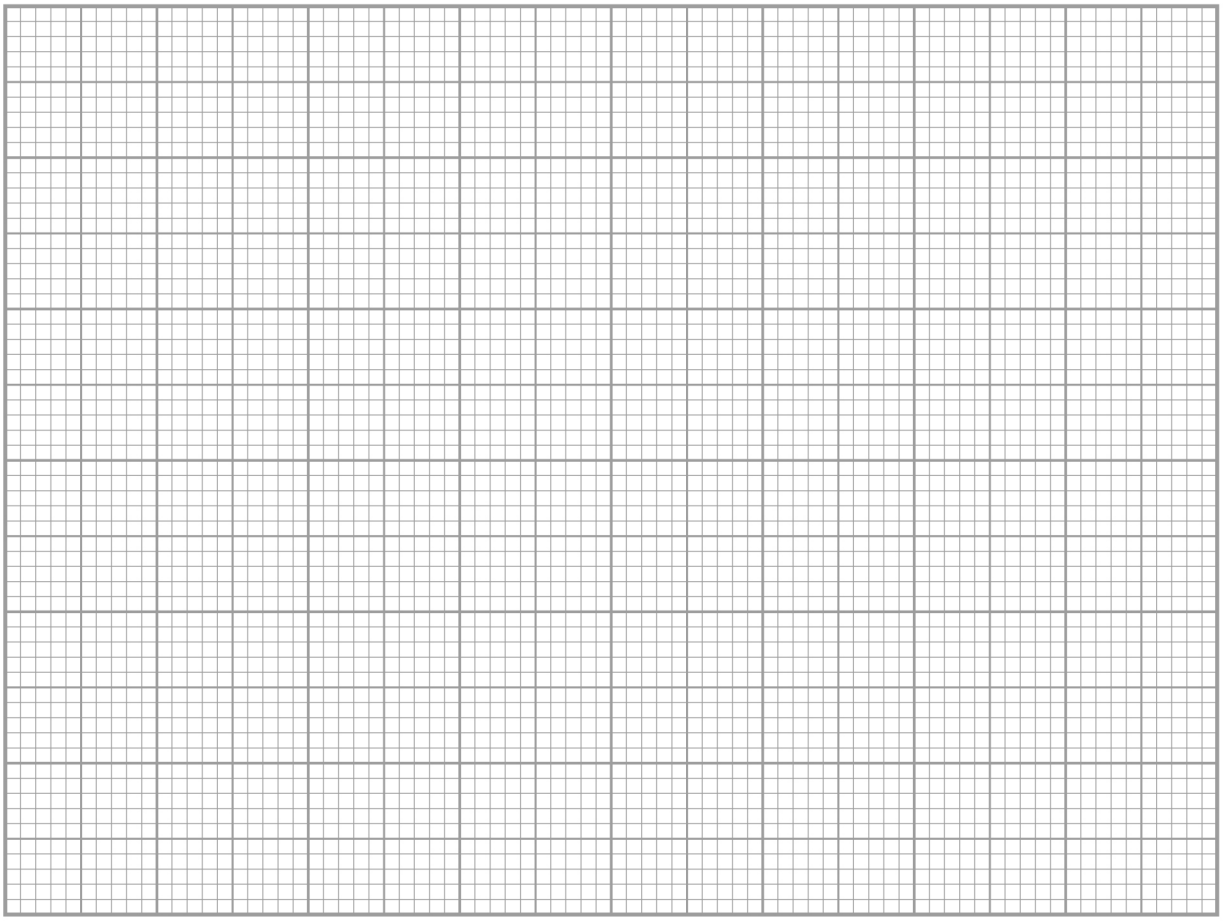
**0 7 . 3** **The student gave the maximum rate of reaction a value of 1.0 arbitrary units.**

**Complete TABLE 5, on page 41, 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, on page 41. [3 marks]**



**[Turn over]**

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**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]**

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**[Turn over]**

10

**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** _____

_____

_____

_____

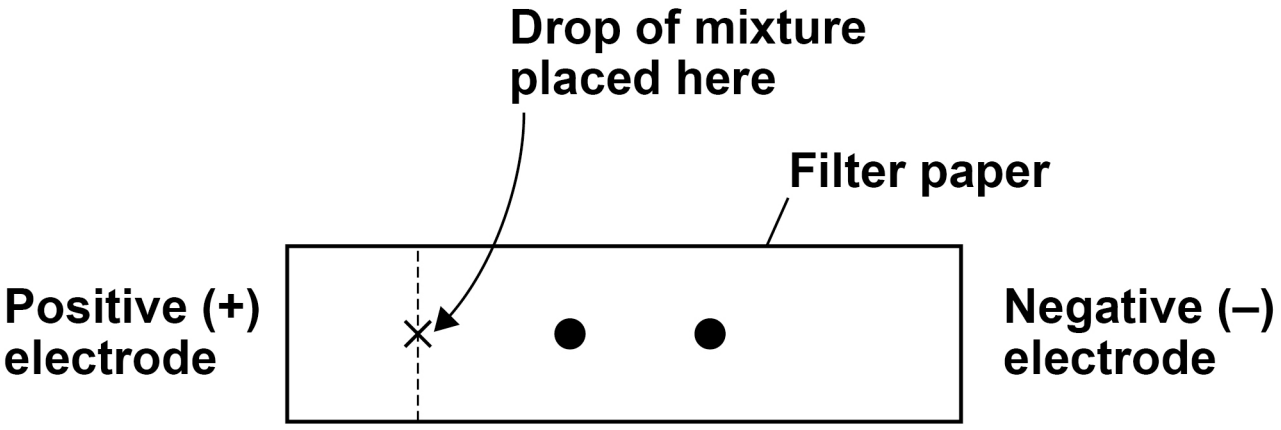
**[Turn over]**

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

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**[Turn over]**

**0 8 . 3** **Explain what the positions of the spots in FIGURE 6, on page 48, show about these amino acids. [3 marks]**

[Turn over]

8

**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 (line 4) 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 5–6).**
**[1 mark]**

**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 10–12), and Bcl-2 and Bax (lines 17–23). [4 marks]**

[Turn over]

**0 9 . 4** **Evaluate the scientists' suggestion that ABZ could be used for the successful treatment of stomach cancer. [3 marks]**

**END OF QUESTIONS**

10

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