



Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

AS

BIOLOGY

Paper 1

7401/1

Time allowed: 1 hour 30 minutes

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

[Turn over]



For this paper you must have:

- **a ruler with millimetre measurements**
- **a scientific calculator.**

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.**
- **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.**

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

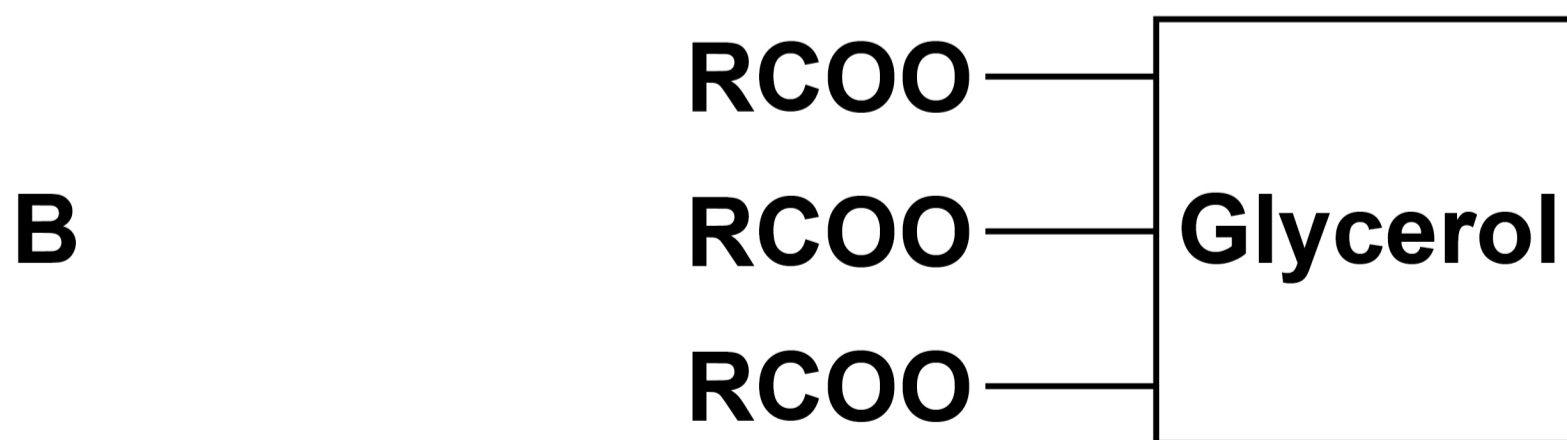
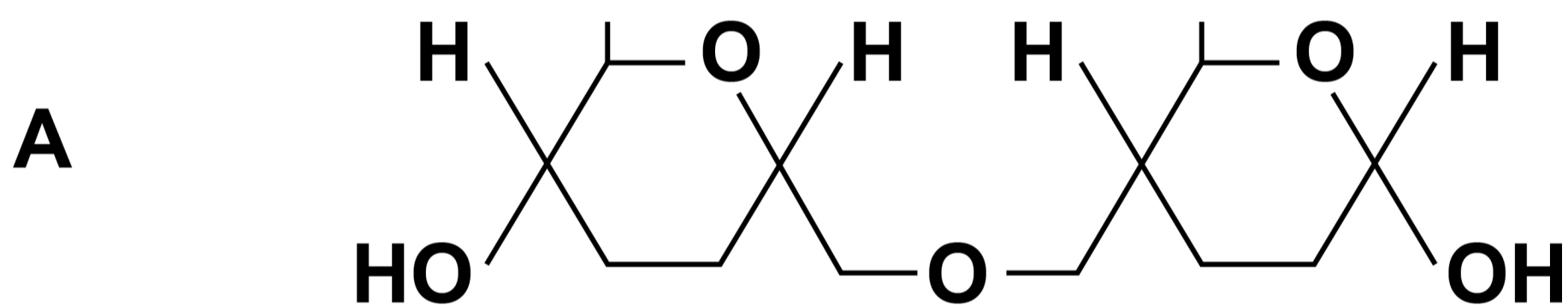


Answer ALL questions in the spaces provided.

01.1

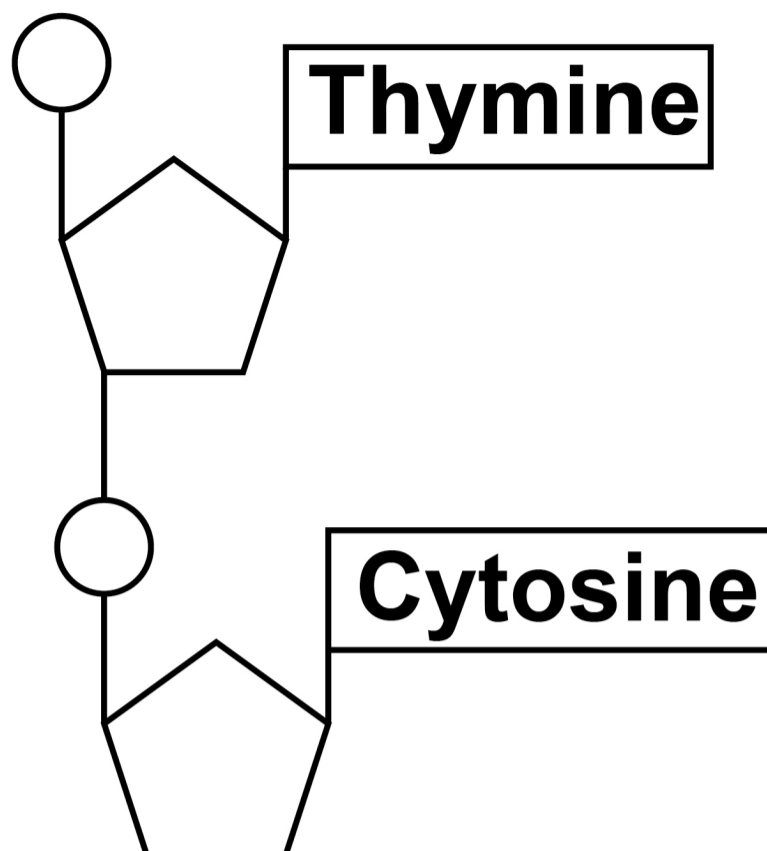
FIGURE 1 shows the structure of some biological molecules.

FIGURE 1

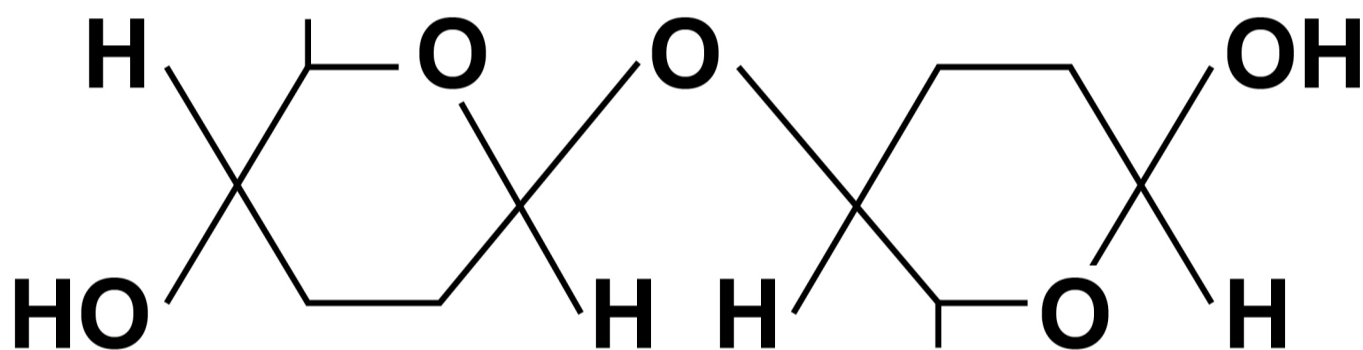


5

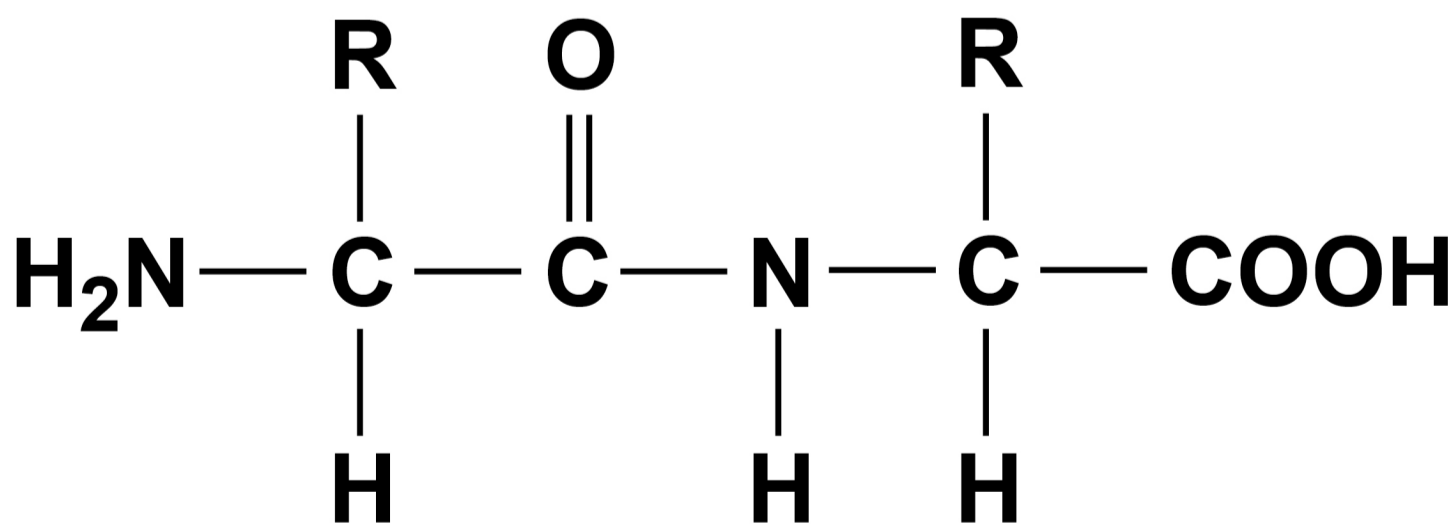
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D



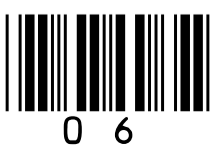
E



[Turn over]



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Complete TABLE 1 by writing the correct letter, A, B, C, D or E, 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 hydrolysed in the ileum and a product of this hydrolysis is found in micelles
	is formed by a condensation reaction between two α -glucose molecules
	is formed by the action of DNA polymerase
	gives a positive result in an emulsion test

[Turn over]



0 1 . 2

**Describe the mechanism for the absorption of amino acids in the ileum.
[4 marks]**

[illegible]

8



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[Turn over]



0	2	.	1
---	---	---	---

Give the TWO types of molecule from which a ribosome is made. [2 marks]

1 _____

2 _____



02.2

Complete TABLE 2 to give FOUR structural differences between a DNA molecule and an mRNA molecule.
[4 marks]

TABLE 2

	DNA structure	mRNA structure
1		
2		
3		
4		

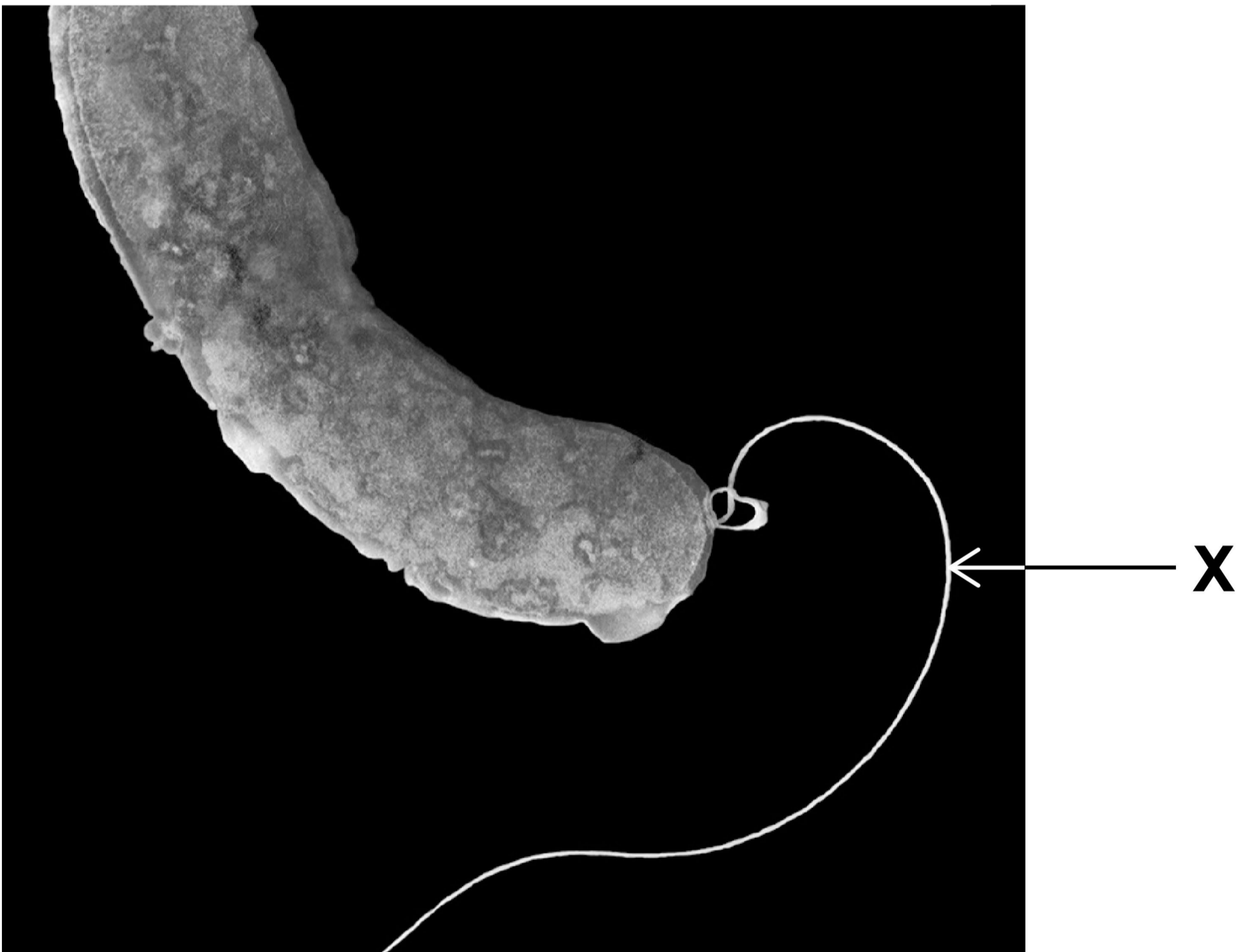
[Turn over]



0	3	.	1
---	---	---	---

FIGURE 2 is an image of a bacterium obtained using a scanning electron microscope.

FIGURE 2



Name the structure labelled X. [1 mark]

0	3	.	2
---	---	---	---

FIGURE 2, on the opposite page, is different from an image of this bacterium obtained using a transmission electron microscope.

Describe and explain ONE difference between these images. [2 marks]

Description _____

Explanation _____

[Turn over]



0	3	.	3
---	---	---	---

The resolution of an image obtained using an electron microscope is higher than the resolution of an image obtained using an optical microscope.

Explain why. [1 mark]

0	3	.	4
---	---	---	---

A student determined the size of a cell structure from a photograph obtained using a microscope.

He used a ruler and a calculator and gave the answer in μm



Describe how the student determined the size of the structure. [2 marks]

[Turn over]

0	3	.	5
---	---	---	---

Name TWO structures found in ALL bacteria that are NOT found in plant cells. [2 marks]

1 _____

2 _____



0	3	.	6
---	---	---	---

Name TWO features of HIV particles that are NOT found in bacteria.

Do NOT include attachment protein in your answer. [2 marks]

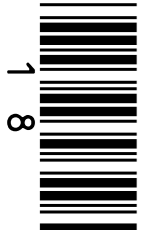
1 _____

2 _____

[Turn over]

10



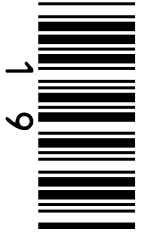


04.1

Lugworms create tubes in the sand on seashores. The tubes are filled with seawater.

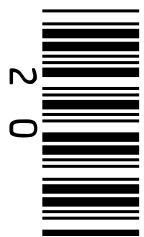
A scientist measured the partial pressure of dissolved oxygen (pO_2) in seawater at different places in a tube with a lugworm inside.

FIGURE 3, on page 20, shows her results.



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[Turn over]



20

FIGURE 3

**8.3 kPa
water out**

**19.5 kPa
water in**

**Tube filled with
seawater**

Lugworm

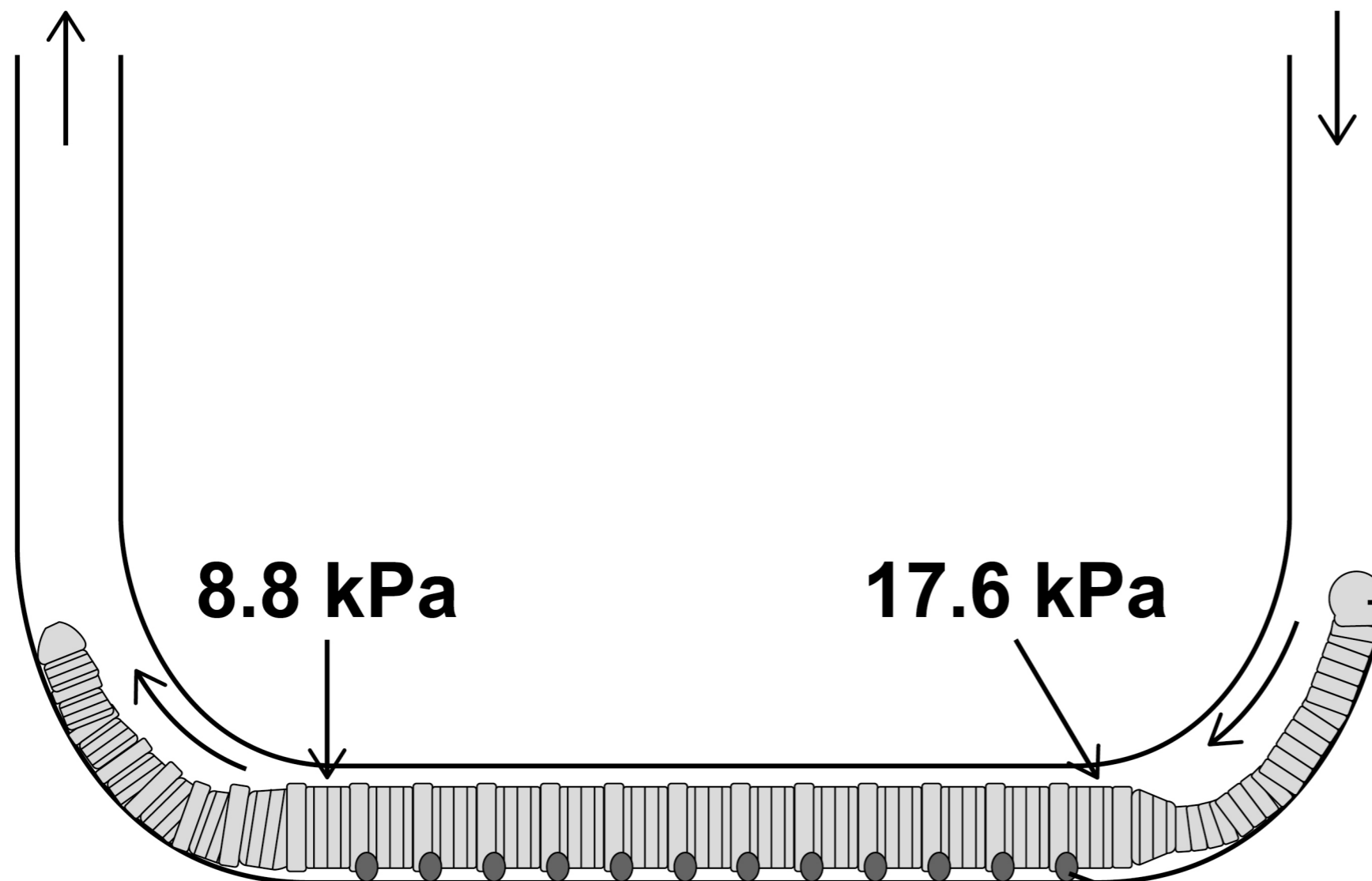
8.8 kPa

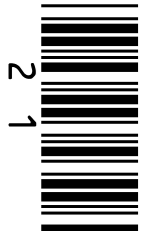
17.6 kPa

Gill

Surface with external gills

20

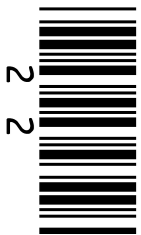


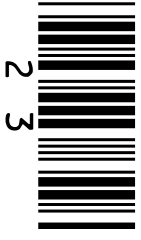


**The pO_2 of dissolved oxygen in lugworm blood is
< 2.7 kPa**

**Using the data in FIGURE 3, what can you conclude about
the uptake of oxygen over the entire body of the
lugworm? [4 marks]**

[Turn over]





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[Turn over]

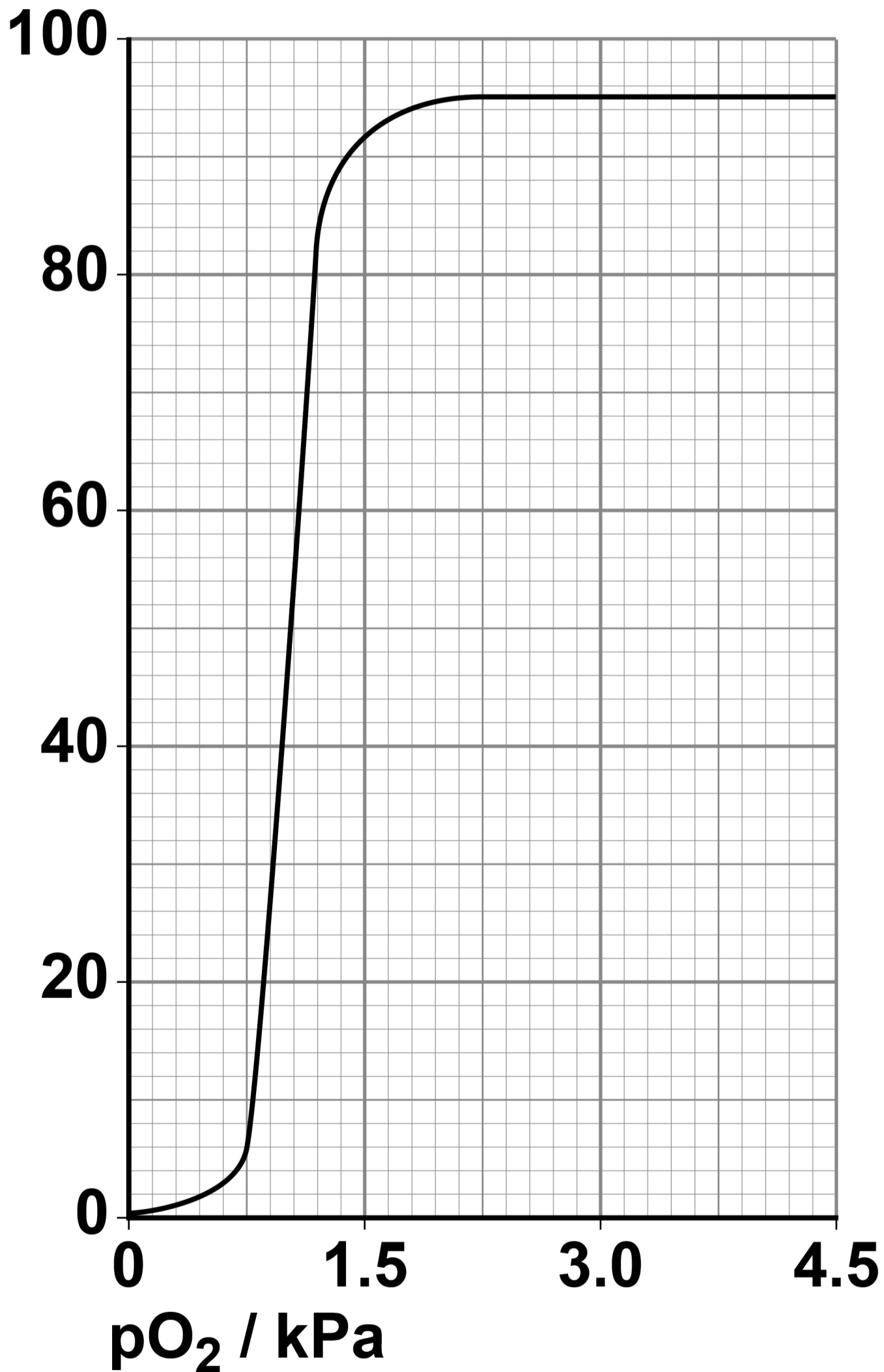
0	4	.	2
---	---	---	---

FIGURE 4, on the opposite page, shows the oxyhaemoglobin dissociation curve for a lugworm.



FIGURE 4

**Percentage oxygen
saturation of blood**



[Turn over]



The oxygen saturation in the blood of a lugworm is 92%

The lugworm has 0.2 cm^3 of blood.

Calculate the volume of dissolved oxygen in the blood of this lugworm using this equation

$$pO_2 = \frac{CdO_2}{0.000\ 031}$$

CdO_2 is the concentration of dissolved oxygen in the blood, with units cm^3 oxygen per cm^3 of blood.

Show your working on the opposite page. [3 marks]



Answer _____ **cm³**

[Turn over]



04.3

The intensity of the red colour in blood is affected by the pO_2 of the blood.

The intensity of the colour in a solution is measured using a colorimeter.

The scientist used a colorimeter to measure the intensity of red colour in samples of lugworm blood with different pO_2 values. She prepared a calibration curve with this information.

Describe how the scientist will use information from the colorimeter and her calibration curve to determine the pO_2 in a sample of lugworm blood. [2 marks]



[Turn over]

9



0 5 . 1

Describe how monomers join to form the primary structure of a protein. [3 marks]

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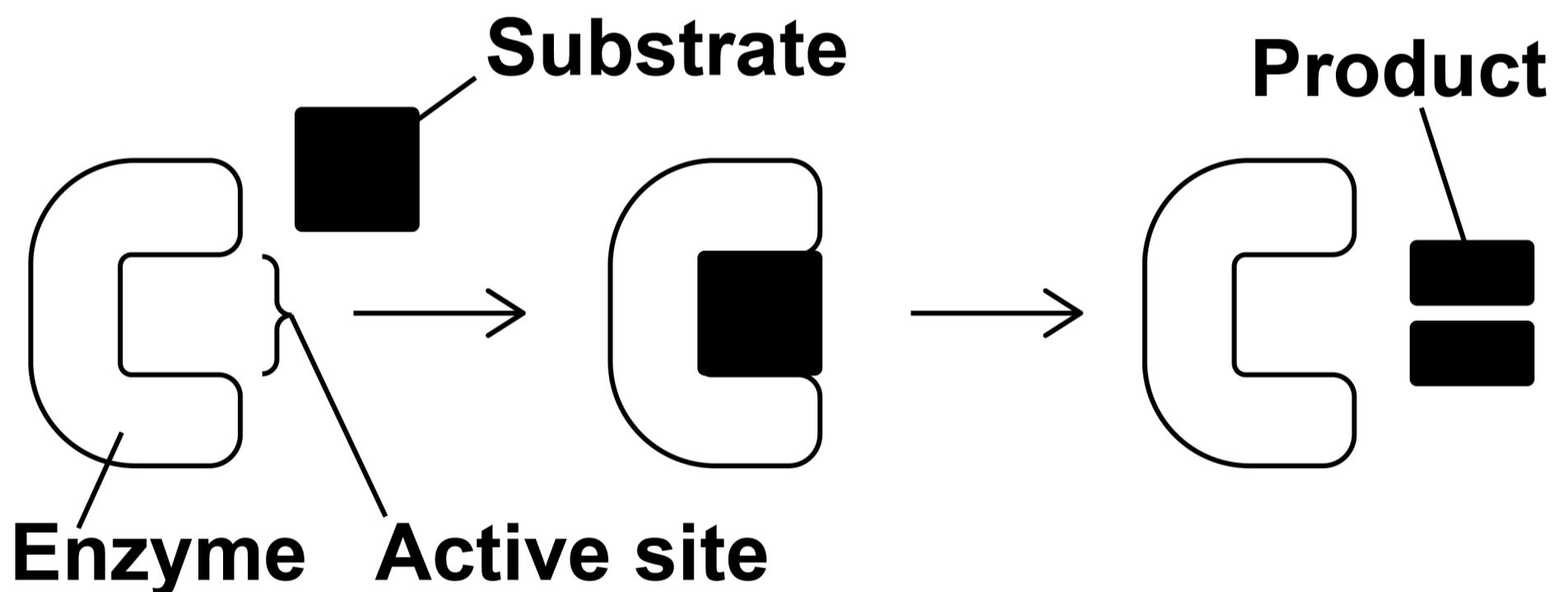
05.2

Many proteins are enzymes.

In 1894, a scientist suggested the lock and key model of enzyme action.

FIGURE 5 shows the lock and key model.

FIGURE 5



Describe ONE similarity and ONE difference between the induced-fit model of enzyme action and the lock and key model of enzyme action. [2 marks]

Similarity _____

Difference _____

[Turn over]



0	5	.	3
---	---	---	---

State how enzymes help reactions to proceed quickly at lower temperatures.

Do NOT write about active sites in your answer. [1 mark]



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[Turn over]



05.4

The enzyme maltase catalyses the hydrolysis of maltose to glucose.

A scientist investigated maltase activity in two different maltose solutions, G and H.

For each solution, he measured:

- the total number of glucose molecules produced by complete hydrolysis of the maltose**
- the time taken for the complete hydrolysis of the maltose.**

TABLE 3, on the opposite page, shows his results.

TABLE 3

Solution	Total number of glucose molecules produced	Time taken for complete hydrolysis of maltose / s
G	4×10^7	20
H	6×10^8	

Complete TABLE 3 by calculating the time taken for the complete hydrolysis of the maltose in solution H. Assume the rate of maltase activity is the same in solution G and in solution H.

Show your working. [2 marks]

[Turn over]



0	5	.	5
---	---	---	---

FIGURE 6, on the opposite page, shows the scientist's results for solution G. Curve I shows the results of a similar investigation in which he changed one independent variable.

**Tick (✓) ONE box next to the statement that describes the independent variable that the scientist changed to give the results shown by curve I in FIGURE 6.
[1 mark]**

☐

Addition of a competitive inhibitor

☐

Increased maltase concentration

☐

Increased maltose concentration

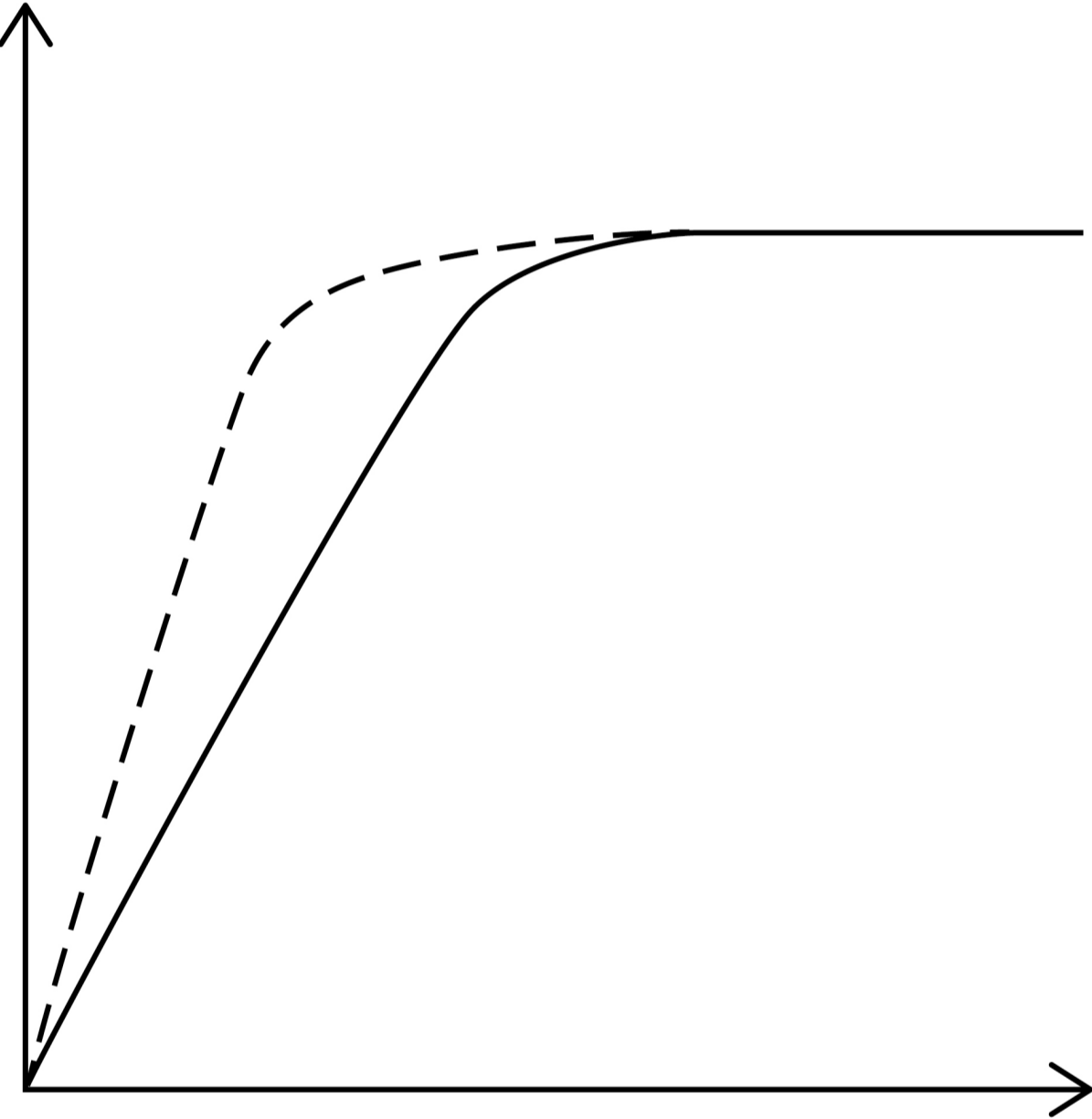
☐

Reduced temperature



FIGURE 6

Number of
glucose
molecules



Time

KEY

———— G
----- I

[Turn over]



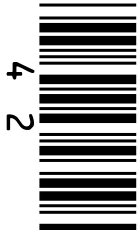
0	6	.	1
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Explain a property of iron ions that enables these ions to carry out their role in red blood cells. [2 marks]

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[Turn over]

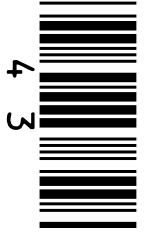




06.2

The hormone hepcidin controls the iron ion concentration in blood plasma. Hepcidin affects ferroportin, the iron ion channel protein in cell-surface membranes.

FIGURE 7, on page 44, shows how hepcidin controls the iron ion concentration in plasma.



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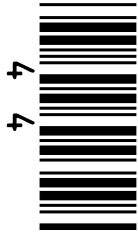
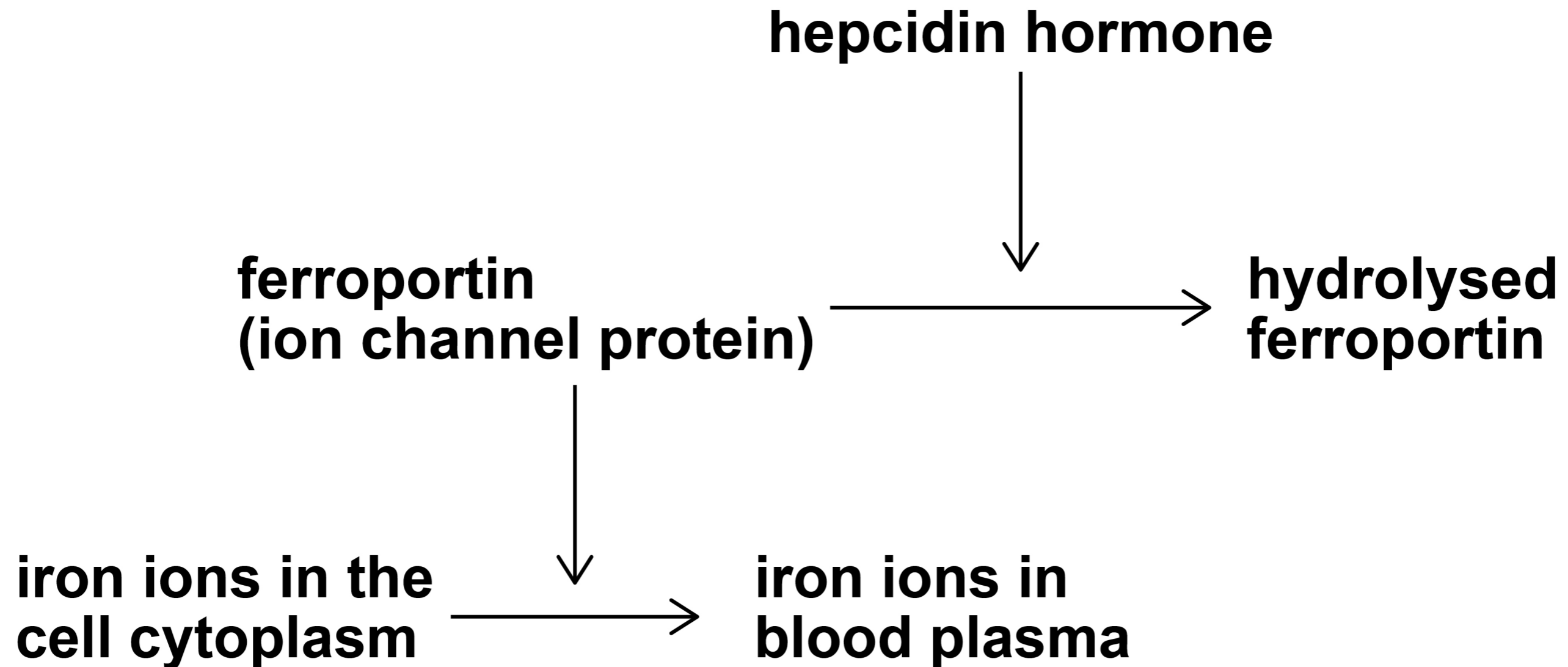
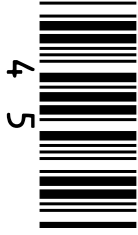


FIGURE 7



People with the disease haemochromatosis do NOT produce hepcidin.



Use information in FIGURE 7 to explain why the iron ion concentration is higher in the plasma of people with haemochromatosis. [3 marks]

45

[Turn over]

0	6	.	3
---	---	---	---

The mass of iron ions in the plasma of a person with haemochromatosis is $6104 \mu\text{g}$

The iron ion concentration in the plasma of a healthy person is $50 \mu\text{g dm}^{-3}$

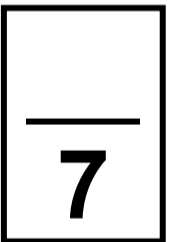
The volume of blood in each of these people is 4000 cm^3

**Calculate the ratio of the mass of iron ions in the plasma of the person with haemochromatosis to the mass of iron ions in the plasma of the healthy person.
[2 marks]**



Answer _____

[Turn over]



0	7	.	1
---	---	---	---

What is a tumour? [2 marks]

0	7	.	2
---	---	---	---

Describe how you would determine a RELIABLE mitotic index (MI) from tissue observed with an optical microscope.

Do NOT include details of how you would prepare the tissue observed with an optical microscope. [3 marks]



[Turn over]



Tumours detected under the skin can be a symptom of cancer.

Scientists investigated the link between the MI of tumours and skin cancer in dogs.

They found the MI of tumours in many dogs and recorded:

- 1. the tumour grade**
- 2. the median survival time after the tumour is detected.**

Tumour grade can be measured using this scale:

- grade 1 – low level cancer**
- grade 2 – medium level cancer**
- grade 3 – high level cancer.**

The scientists used a statistical test to calculate the probability (P) of the difference between median survival time in dogs with $MI < 5$ and dogs with $MI > 5$ being caused by chance.

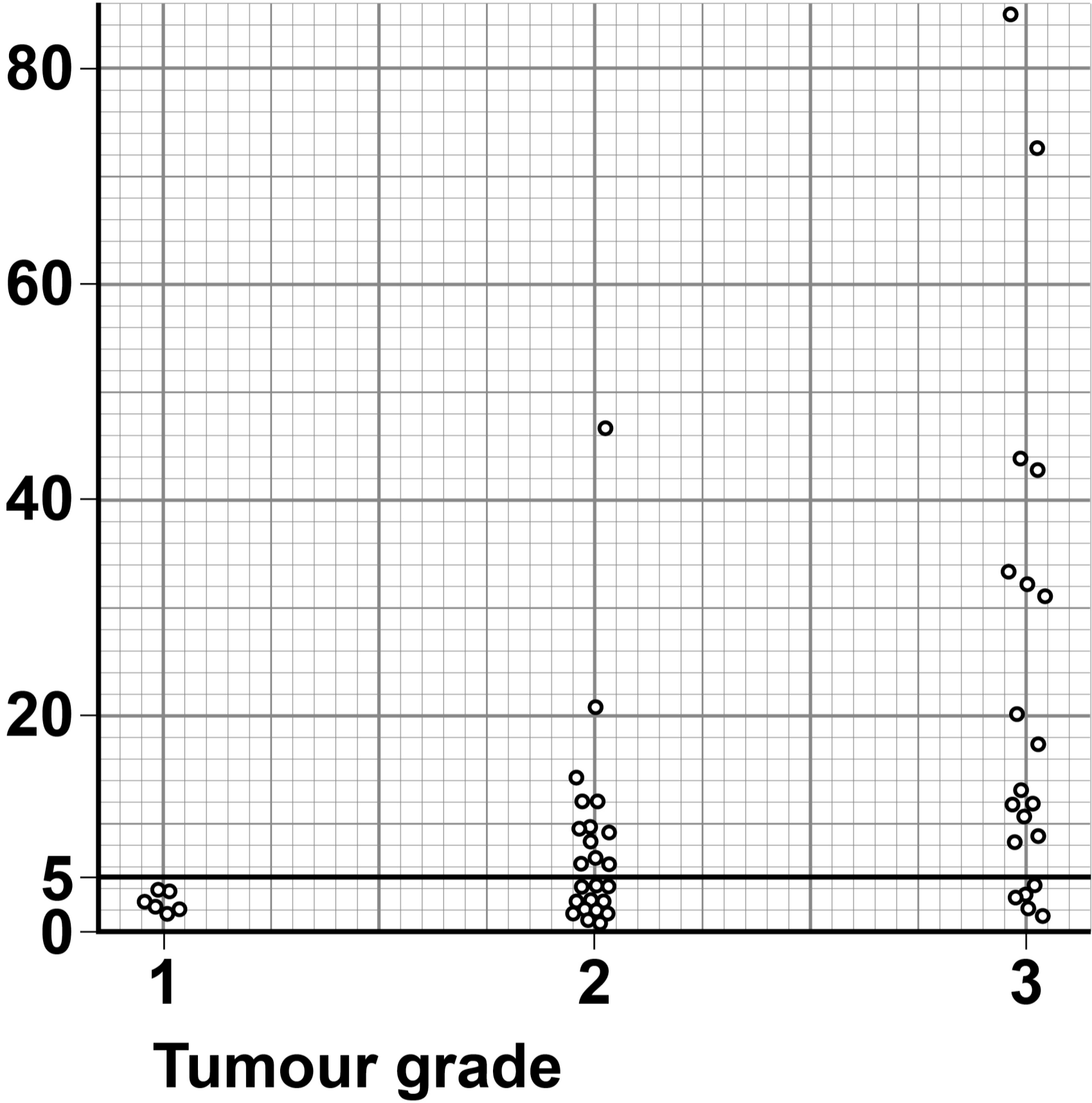
FIGURE 8 and TABLE 4, on pages 52 and 53, show the scientists' results.

[Turn over]



FIGURE 8

Mitotic index (%)



KEY

○ represents one dog

TABLE 4

Mitotic index (%)	Median survival time / months	Probability (P value)
< 5	70	< 0.001
> 5	2	

07.3

The scientists concluded that MI > 5 is a reliable indicator of how serious the cancer is in a dog.

Use information from FIGURE 8 and TABLE 4 to evaluate this conclusion.
[4 marks]

[Turn over]



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9



0	8
---	---

A student investigated the effect of two antimicrobial substances, J and K, on the growth of 'E. coli' bacteria.

She transferred 'E. coli' cells using a sterilised pipette to make three identical cultures, 1, 2, and 3. She then added:

- no antimicrobial substance to culture 1**
- antimicrobial substance J to culture 2**
- antimicrobial substance K to culture 3.**

She incubated the cultures for 24 hours, after which she determined the number of cells per mm^3 in each culture.

0	8	.	1
---	---	---	---

The student used a sterilised pipette to transfer ‘E. coli’ into each culture.

Suggest why the number of ‘E. coli’ cells per mm³ in each culture after 24 hours might have been lower if the student had NOT used a sterilised pipette. Explain your answer. [2 marks]

[Turn over]



08.2

The student diluted 3 cm^3 of culture 1 with 12 cm^3 of water. She observed a sample of this diluted mixture using an optical microscope and counted 24 cells in 0.00025 mm^3 of the diluted mixture.

Use this information to calculate the number of cells per mm^3 in **UNDILUTED** culture 1. [2 marks]



Number of cells = _____ per mm³

[Turn over]



0	8	.	3
---	---	---	---

After 24 hours, the student compared the number of cells per mm^3 in cultures 1, 2 and 3. She found:

- substance J killed 80% of the cells**
- substance J killed twice as many cells as substance K.**

Using the axes shown in FIGURE 9, on the opposite page, SKETCH a bar chart showing the results the student obtained from cultures 1, 2 and 3.

Do NOT draw a grid on the chart.

Do NOT include figures for the number of cells per mm^3 [3 marks]



FIGURE 9

Number
of cells
per mm³



[Turn over]



0	9
---	---

Read the following passage.

The placenta is a specialised exchange surface.

In the placenta, substances are exchanged between the blood of a fetus and the blood of its mother. 5
Gas exchange for the fetus occurs in the placenta.

There is also transfer of IgG antibodies in the placenta between the mother's blood and fetal blood. 10
These IgG antibodies protect the fetus against the pathogens that infect its mother during pregnancy. The IgG antibodies can circulate at high concentration in the mother's blood for months or years. A fetus does not produce IgG antibodies. 15



The UK immunisation programme vaccinates as many babies as possible to protect the UK population 20 against pathogens such as measles viruses and tetanus bacteria.

Measles viruses spread quickly from infected people. Despite the efforts of the NHS, there has been a recent 25 increase in the number of children catching measles.

Tetanus bacteria enter the body through skin wounds. Tetanus bacteria do not spread from infected 30 people. In order to develop good immunity against tetanus, children are given three tetanus vaccinations at regular intervals before they reach their first birthday. 35

[Turn over]



Use the information in the passage, on pages 62 and 63, and your own knowledge to answer the following questions.

09.1

Gas exchange for the fetus occurs in the placenta (lines 6–7).

Describe how the composition of blood in the pulmonary artery of a fetus is different from the composition of blood in the pulmonary artery of its mother.

**Give ONE reason for this difference.
[2 marks]**



[Turn over]



0	9	.	2
---	---	---	---

Explain how a fetus is protected against the pathogens that infect its mother during pregnancy (lines 11–13).

Do NOT give details of an active immune response in the mother. [3 marks]

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0	9	.	3
---	---	---	---

Suggest how vaccinating as many babies as possible protects the UK POPULATION against pathogens such as measles viruses and tetanus bacteria (lines 18–22). [2 marks]

Protection against measles _____

Protection against tetanus _____

[Turn over]



0	9	.	4
---	---	---	---

Suggest why there has been a recent increase in the number of children catching measles (lines 24–27). [1 mark]

0	9	.	5
---	---	---	---

Explain why giving children more than one tetanus vaccination develops good immunity against tetanus (lines 31–35). [2 marks]



END OF QUESTIONS

10



Additional page, if required.
Write the question numbers in the left-hand margin.

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**Additional page, if required.
Write the question numbers in the
left-hand margin.**

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Question	Mark
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7 2



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