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 2

Thursday 22 May 2025 Morning 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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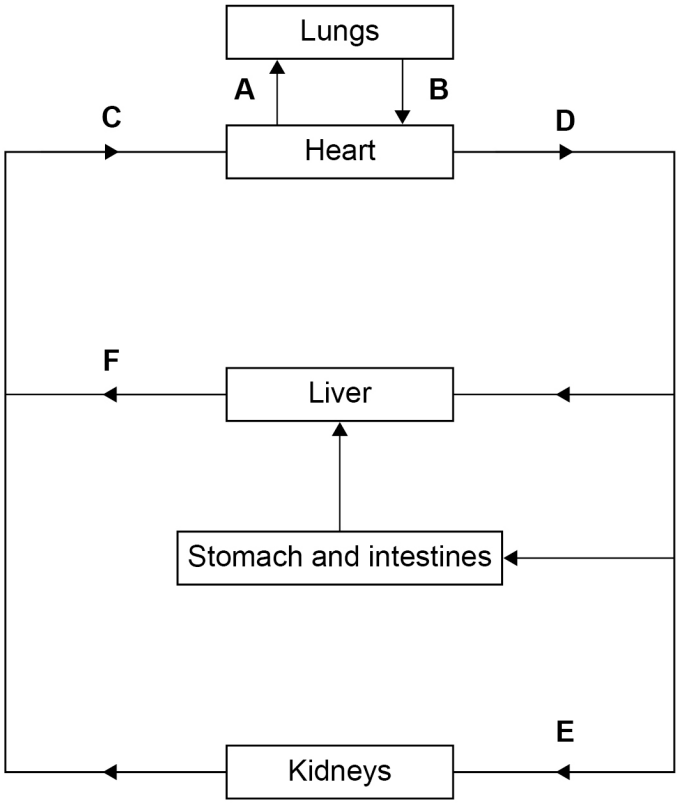
Answer **all** questions in the spaces provided.

0 1 **Figure 1** shows the arrangement of some of the blood vessels in a mammalian circulatory system.

Figure 1



0 1 . 1 Name the blood vessels labelled **B** and **E** in **Figure 1**.

[2 marks]

B _____

E _____

0 1 . 2 Give the letters of all the blood vessels shown in **Figure 1** that transport deoxygenated blood.

[1 mark]

_____

Do not write outside the box

0 1 . 3 Many animals are adapted to their environments by having different types of haemoglobin with different tertiary structures.

Using your knowledge of the structure of proteins, explain how different types of haemoglobin can have different tertiary structures.

[3 marks]

Question 1 continues on the next page

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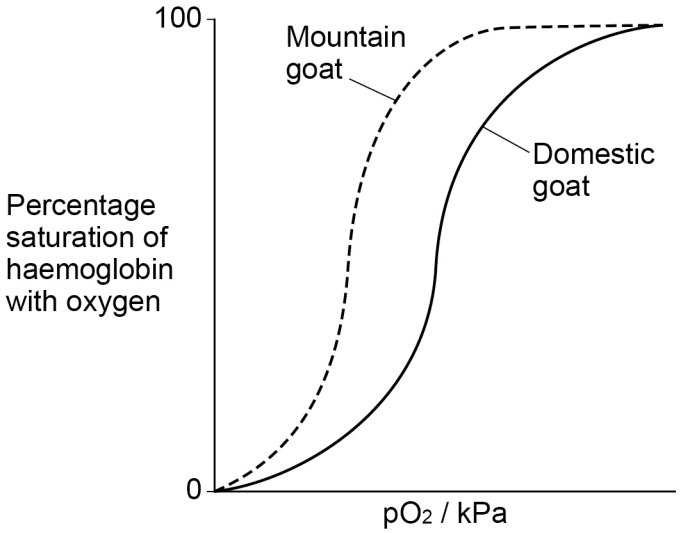
Figure 2 shows the oxyhaemoglobin dissociation curve for two species of goat.

Figure 2



0 1 . 4 The mountain goat lives at high altitudes where the pO_2 is lower than where the domestic goat lives.

Use **Figure 2** to explain how the mountain goat is adapted to living at high altitudes.

[2 marks]

_____

_____

_____

_____

_____

_____

8

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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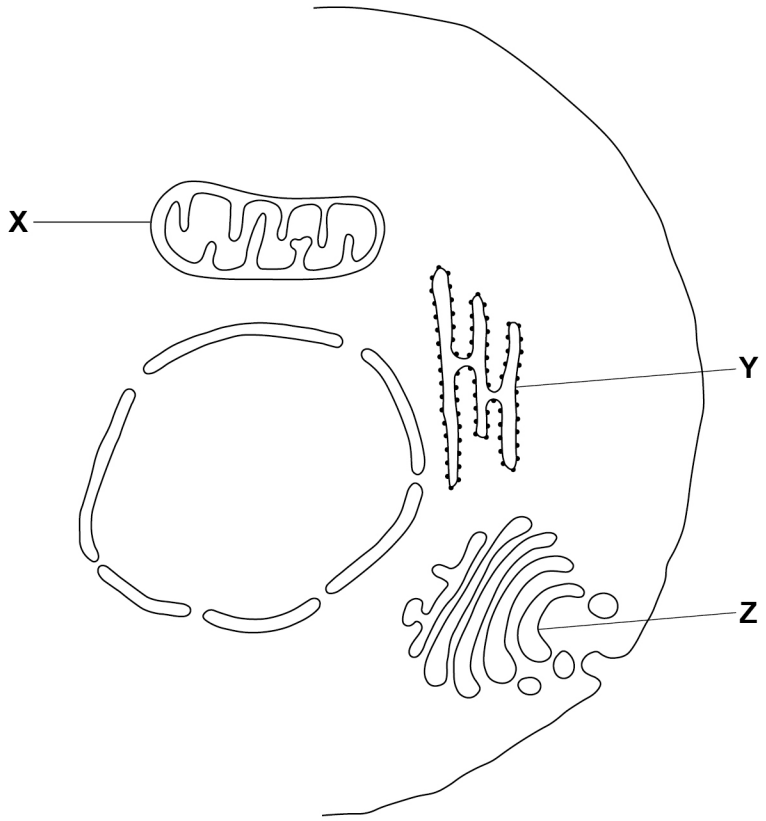
0 2 **Figure 3** shows part of a eukaryotic cell.

Figure 3



0 2 . 1 Name the organelle labelled **X** and state its function.

[2 marks]

Name _____

Function _____

_____

_____

Do not write outside the box

0 2 . 2 Pancreatic cells produce and secrete digestive enzymes.

Explain why pancreatic cells contain large numbers of organelles **Y** and **Z**.

[4 marks]

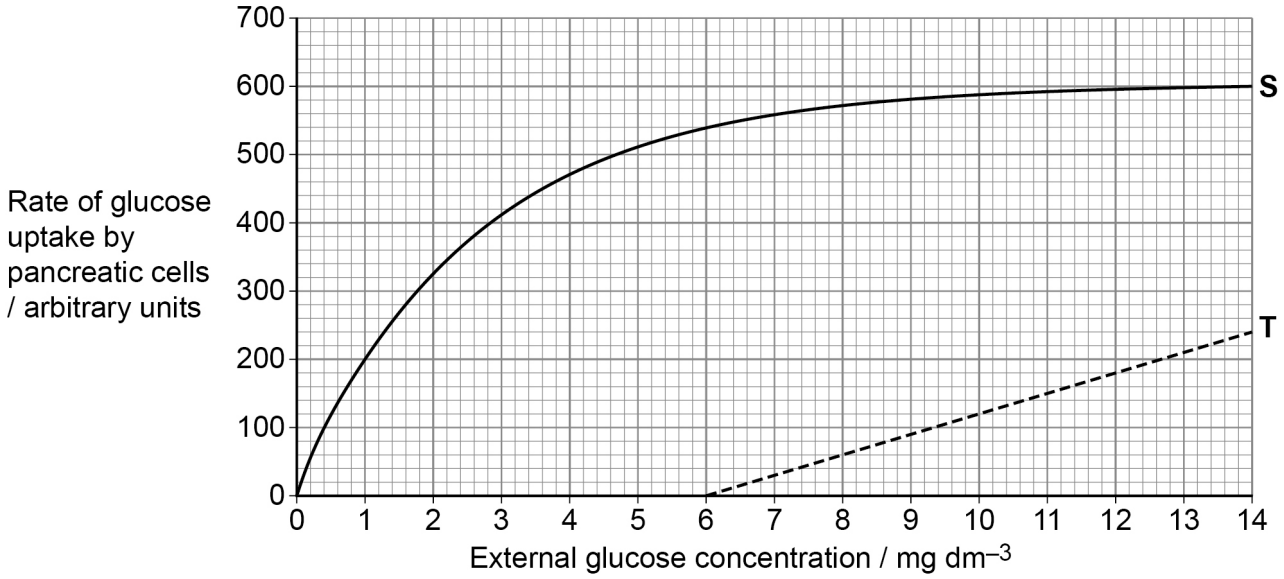
Question 2 continues on the next page

Do not write outside the box

0 2 . 3 A scientist placed pancreatic cells in solutions containing different concentrations of glucose. The scientist measured the rate of uptake of glucose by these cells.

Figure 4 shows the scientist's results.

Figure 4



Key

—— Curve **S**
Cells in solution with oxygen

- - - - Curve **T**
Cells in solution without oxygen

Using **Figure 4**, what can you conclude about the processes involved in the uptake of glucose molecules by pancreatic cells?

[3 marks]

Do not write outside the box

0 2 . 4 Use **Figure 4** to calculate the ratio

rate of glucose uptake with oxygen : rate of glucose uptake with no oxygen

at an external glucose concentration of 14 mg dm^{-3}

[1 mark]

Ratio = _____

10

Turn over for the next question

Do not write outside the box

0 3 **Table 1** shows the names of three biological molecules and different combinations of elements.

Table 1

	Cellulose	Triglyceride	Antibody	
A	C, H, O	C, H, O	C, H, O, N	
B	C, H, O	C, H, O	C, H, O, N, S	
C	C, H, O	C, H, O, N	C, H, O, N, S	
D	C, H, O, N	C, H, O	C, H, O, N, P	

0 3 . 1 Which row identifies the correct elements in each molecule?

Tick (✓) **one** box.

[1 mark]

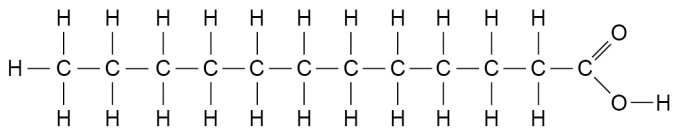
0 3 . 2 Describe the biochemical test used to confirm the presence of lipid in a sample.

[2 marks]

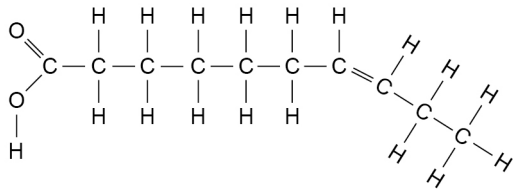
Do not write outside the box

0 3 . 3 **Figure 5** shows two types of fatty acids.

Figure 5



Fatty acid **A**



Fatty acid **B**

State which fatty acid in **Figure 5** is unsaturated **and** explain your answer.

[1 mark]

Unsaturated fatty acid _____

Explanation _____

_____

_____

Question 3 continues on the next page

Do not write outside the box

0 3 . 4 Cholesterol is a type of lipid transported in the blood. High blood cholesterol concentrations can lead to cardiovascular disease.

Scientists studied the effectiveness of the drug cholestyramine (CA) in lowering blood cholesterol concentration.

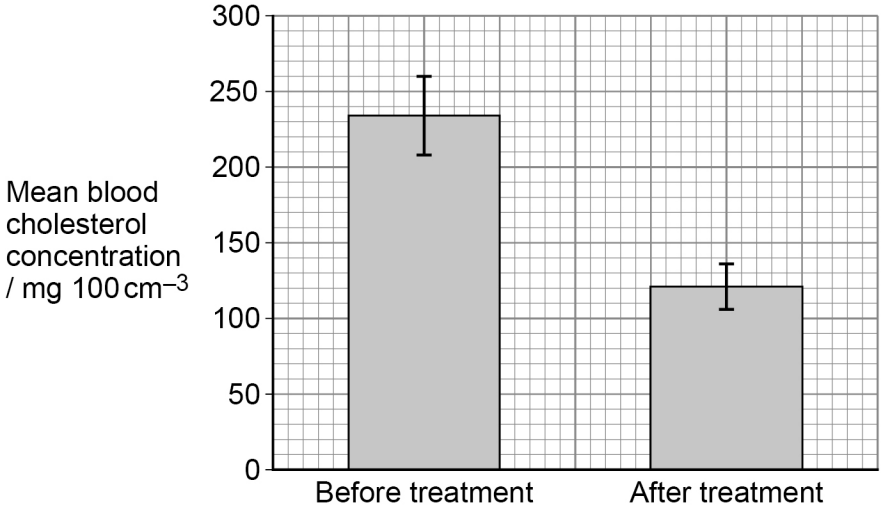
They:

- gave 10 patients CA for 1 month
- measured the blood cholesterol concentrations at the start of the study and after 1 month of treatment with CA.

Figure 6 shows the scientists' results.

The error bars represent ±2 standard deviations from the mean, which includes over 95% of the data.

Figure 6



Do not write outside the box

Use the information provided to evaluate the effectiveness of the drug CA in reducing blood cholesterol concentration.

[5 marks]

9

Turn over for the next question

Do not write outside the box

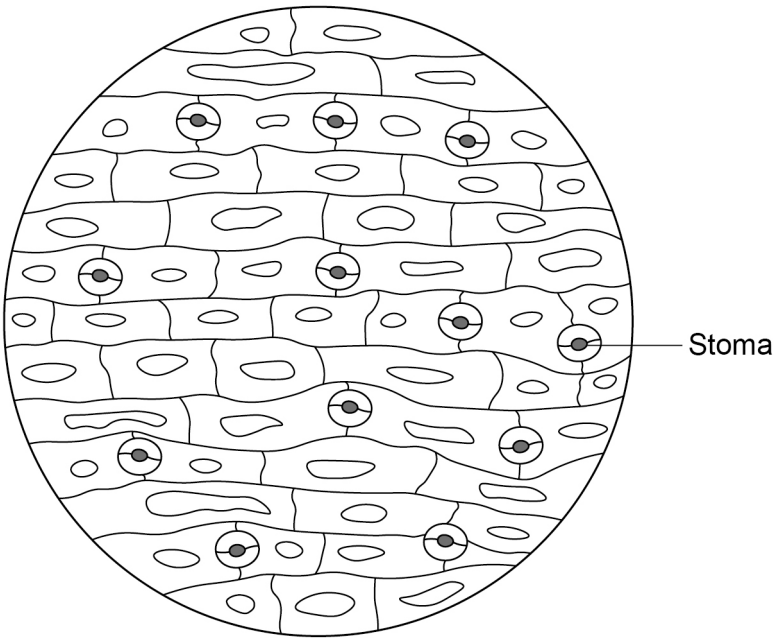
0 4 A student investigated the distribution of stomata on a leaf.

The student:

- observed one area of the lower surface of a leaf using an optical microscope
- counted all the stomata.

Figure 7 shows the area of the leaf the student observed.

Figure 7



The diameter of the field of view was 0.36 mm

0 4 . 1 Use **Figure 7** and the information provided to calculate the stomatal density of the lower leaf surface.

The area of a circle can be calculated using the formula πr^2

For π use 3.14

Give your answer to 2 significant figures.

[3 marks]

Answer _____ stomata mm^{-2}

Do not write outside the box

0 4 . 2 Suggest **one** improvement the student could make to obtain a more reliable value for stomatal density.

[1 mark]

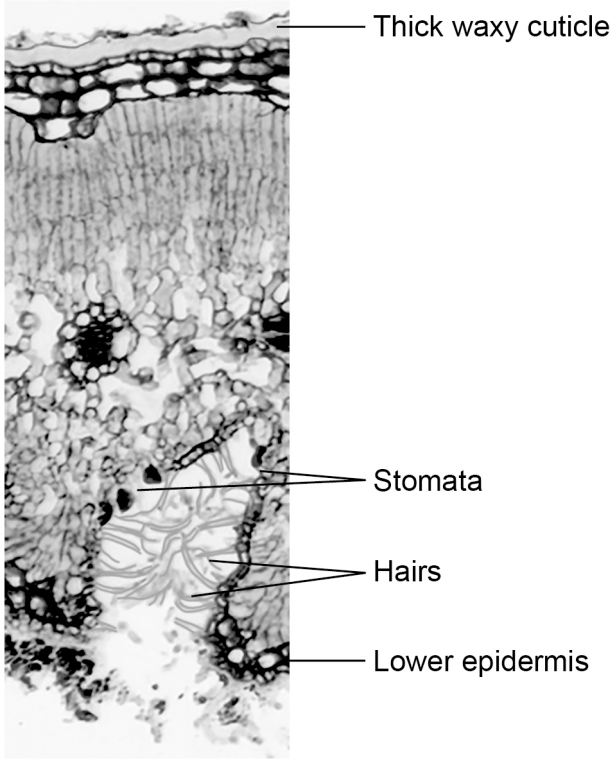
_____

_____

_____

0 4 . 3 **Figure 8** shows a transverse section of a leaf from a xerophytic plant.

Figure 8



Explain how **one** feature shown in **Figure 8** reduces water loss from the leaf.

[1 mark]

Feature _____

How it reduces water loss _____

_____

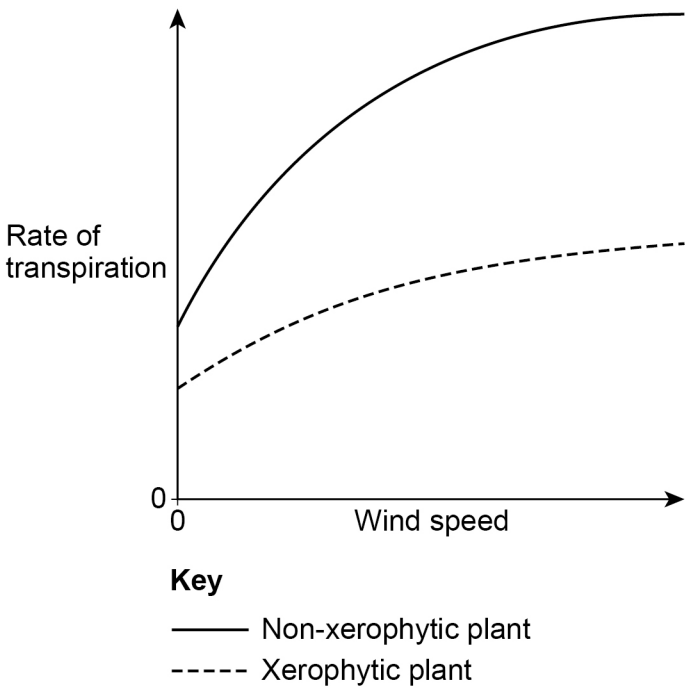
_____

Question 4 continues on the next page

Do not write outside the box

Figure 9 shows the effect of wind speed on the rate of transpiration of a xerophytic plant and a non-xerophytic plant.

Figure 9



0 4 . 4 Give **two** conclusions that can be made from **Figure 9**.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

7

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 5 . 1 Name the **two** types of molecule from which a ribosome is made.

[1 mark]

1 _____

2 _____

Table 2 shows some of the features of the phases of the eukaryotic cell cycle.

Table 2

Phase	**Features**
First phase of interphase	Ribosomes synthesised Proteins synthesised
Second phase of interphase	DNA replicated Histones synthesised DNA associates with histones
Third phase of interphase	Accuracy of DNA replication is checked Membrane-bound organelles replicated
Stages of mitosis	Prophase, metaphase, anaphase, telophase
Cytokinesis	Cytoplasm divides Cell-surface membrane formed

Do not write outside the box

0 5 . 2 Use the information in **Table 2** to give **two** similarities and **two** differences between the eukaryotic cell cycle and binary fission.

[4 marks]

Similarity 1 _____

_____

_____

Similarity 2 _____

_____

_____

Difference 1 _____

_____

_____

Difference 2 _____

_____

_____

0 5 . 3 The accuracy of DNA replication is checked in the third phase of interphase.

Suggest and explain **one** advantage of checking the accuracy of DNA replication.

[2 marks]

_____

_____

_____

_____

_____

_____

7

Turn over for the next question

Do not write outside the box

0 6 The reaction catalysed by the enzyme catalase is shown below.

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

0 6 . 1 Use your knowledge of the induced-fit model to explain how catalase breaks down hydrogen peroxide.

[3 marks]

Do not write outside the box

Potato cells contain catalase.

A student investigates the effect of the surface area of potato pieces on the rate of the reaction of catalase.

0 6 . 2 Before starting the investigation, the student reads the following information.

Hydrogen peroxide:

- is a clear, colourless solution
- is harmful if swallowed
- causes serious eye damage
- may cause damage or irritation to the skin
- may cause respiratory irritation.

Use this information to suggest **two** safety precautions the student should take.

Give **one** reason for each safety precaution.

[2 marks]

Precaution 1 _____

Reason _____

_____

_____

Precaution 2 _____

Reason _____

_____

_____

Question 6 continues on the next page

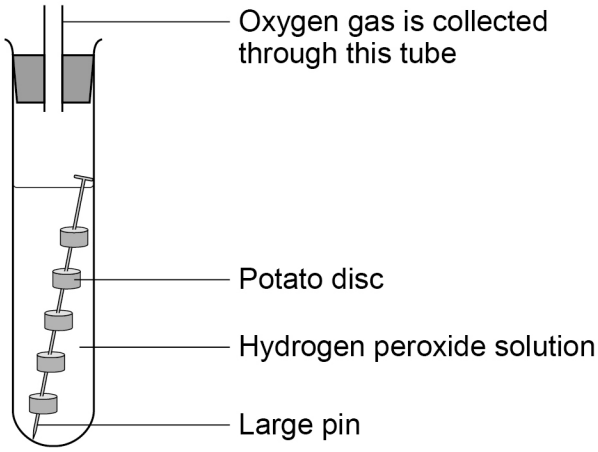
Do not write outside the box

The student uses the following method.

1. Cut a 75 mm long cylinder of potato into 5 discs of equal size.
2. Arrange the discs on a large pin in a boiling tube.
3. Add 40 cm^3 of 1.0 mol dm^{-3} hydrogen peroxide.
4. Record the volume of oxygen collected in 2 minutes.
5. Repeat steps 1 to 4 with an uncut cylinder of potato 75 mm long.

Figure 10 shows the equipment the student uses.

Figure 10



0 6 . 3 Suggest why the student arranges the potato discs on the pin as shown in **Figure 10**.
[1 mark]

Do not write outside the box

Table 3 gives measurements for one potato disc and the uncut potato cylinder used in the investigation.

Table 3

	Length (L) / mm	Diameter / mm
One potato disc	15	10
Uncut potato cylinder	75	10

0 6 . 4 Calculate how many times greater the total surface area of the five discs of potato is compared with the surface area of the uncut cylinder.

Use the information in **Table 3** and the formula below.

The formula for the surface area of a disc or cylinder = $2\pi r(r+L)$

where
r = radius
L = length
π = 3.14

[3 marks]

_____ times greater

0 6 . 5 The rate of reaction is faster with the five discs of potato than with the uncut potato cylinder.

Explain why.

[1 mark]

_____

_____

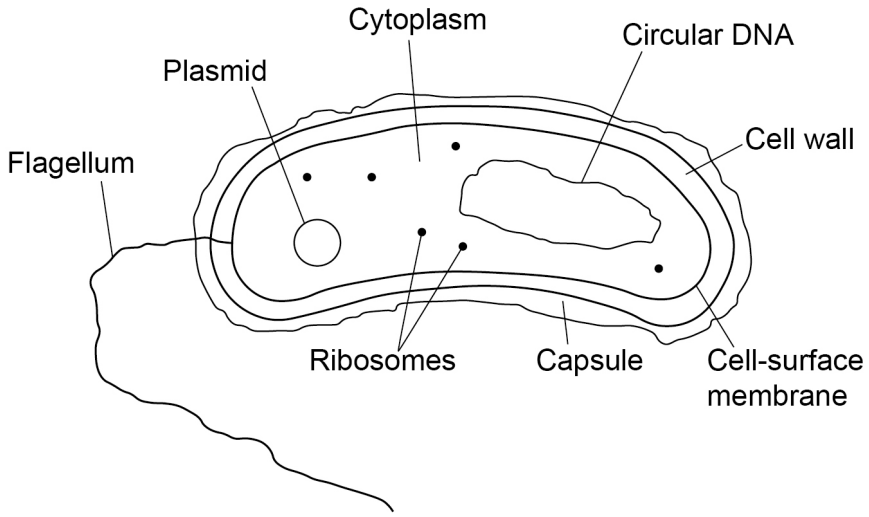
_____

10

Do not write outside the box

0 7 . 1 **Figure 11** shows the structure of the bacterium *Vibrio cholerae*.

Figure 11



Name **three** structures shown in **Figure 11** that are **not** found in all bacteria.

[2 marks]

1 _____

2 _____

3 _____

0 7 . 2 *V. cholerae* produces a toxin that only binds to the cell-surface membrane of epithelial cells lining the ileum. The toxin is a protein.

Explain why the toxin can only bind to the cell-surface membrane of epithelial cells in the ileum.

[2 marks]

_____

_____

_____

_____

_____

_____

Do not write outside the box

0 7 . 3 The toxin causes chloride ion channels in the cell-surface membrane to open. Chloride ions diffuse into the ileum. This causes diarrhoea (watery faeces).

Use your knowledge of water potential to explain how an increase of chloride ions in the ileum results in diarrhoea.

[2 marks]

Question 7 continues on the next page

Do not write outside the box

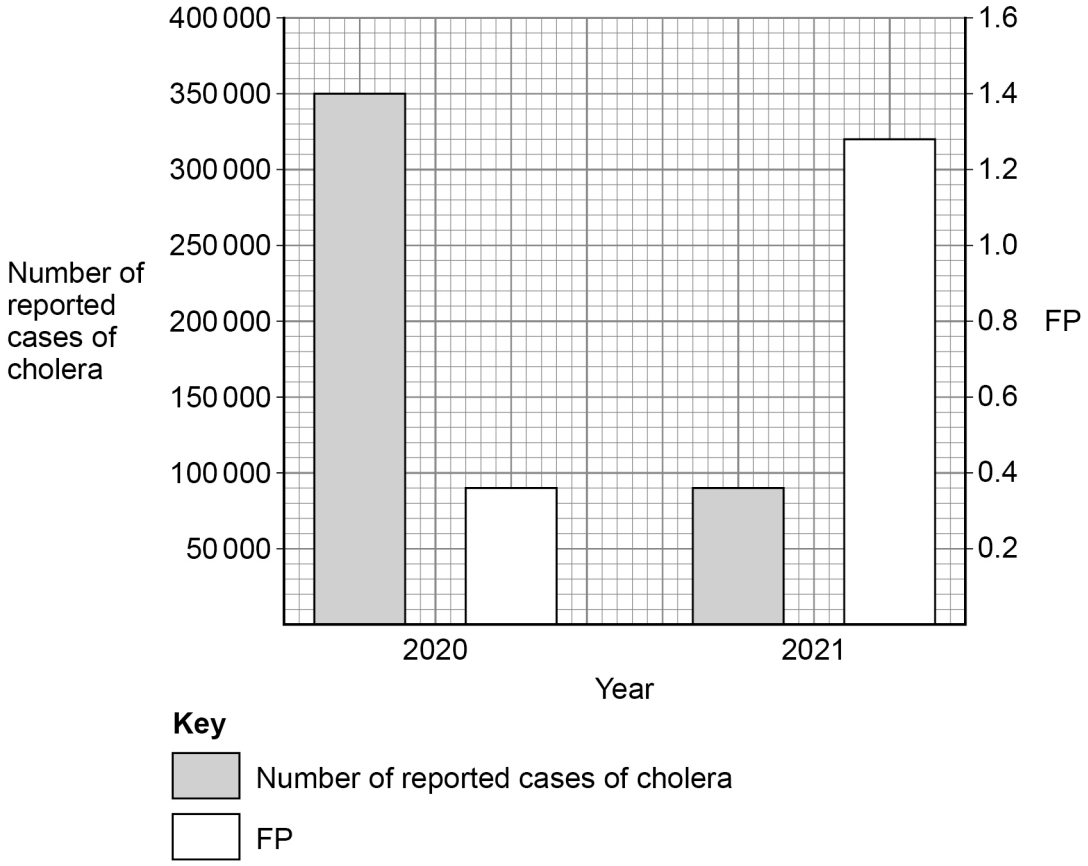
V. cholerae causes the disease cholera.

The Fatality Percentage (FP) is the percentage of people diagnosed with cholera who die from it.

Figure 12 shows:

- the number of reported cases of cholera in a population for the years 2020 and 2021
- the FP for cholera for the years 2020 and 2021.

Figure 12



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0 7 . 4 Using **Figure 12** and the information provided, calculate the difference in the number of deaths from cholera in 2020 and 2021.

[2 marks]

Difference in the number of deaths _____

0 7 . 5 The calculated numbers of deaths from cholera, in 2020 and 2021, are lower than the true number of deaths.

Using the information suggest **one** reason why.

[1 mark]

_____

_____

_____

9

Turn over for the next question

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0 8 **Table 4** shows the changes in the number of HIV RNA particles and helper T cells (T_H cells) in a person infected with HIV who was not receiving any treatment.

Table 4

Time after infection / years	HIV RNA particles per cm^3 of blood	T_H cell count / cells per mm^3 of blood
0	0	1000
1	80 000	305
2	20 000	854
6	22 000	812
10	70 000	597
11	120 000	150
12	135 000	5

0 8 . 1 A scientist concluded that other infections are more likely to develop in this person after 11 years.

Use the data in **Table 4** and your own knowledge of the immune response to explain the scientist's conclusion.

[3 marks]

Do not write outside the box

One type of infection is pneumonia, caused by the bacterium *Streptococcus pneumoniae*.

A trainee microbiologist cultured *S. pneumoniae* on an agar plate.

The trainee microbiologist:

- disinfected the laboratory bench
- used a sterile pipette to transfer *S. pneumoniae* from a broth bottle to an agar plate
- took a glass spreader and spread the *S. pneumoniae* across the agar plate
- sealed the lid with four strips of tape.

0 8 . 2 Suggest **one** other action the trainee microbiologist took during this method to ensure the technique was aseptic.

Justify why this action was needed.

Do **not** refer to gloves, masks or safety glasses in your answer.

[2 marks]

Action _____

_____

_____

Justification _____

_____

_____

5

Turn over for the next question

Do not write outside the box

0 9 . 1 Describe how meiosis results in haploid cells and how it increases genetic variation.

[5 marks]

Do not write outside the box

0 9 . 2 Describe **and** explain how tissue fluid is formed and how it is returned to the circulatory system.

[5 marks]

10

END OF QUESTIONS

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