z

AQA

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Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

A-level
BIOLOGY
Paper 1
7402/1

Thursday 4 June 2020 Morning

Time allowed: 2 hours

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 91.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

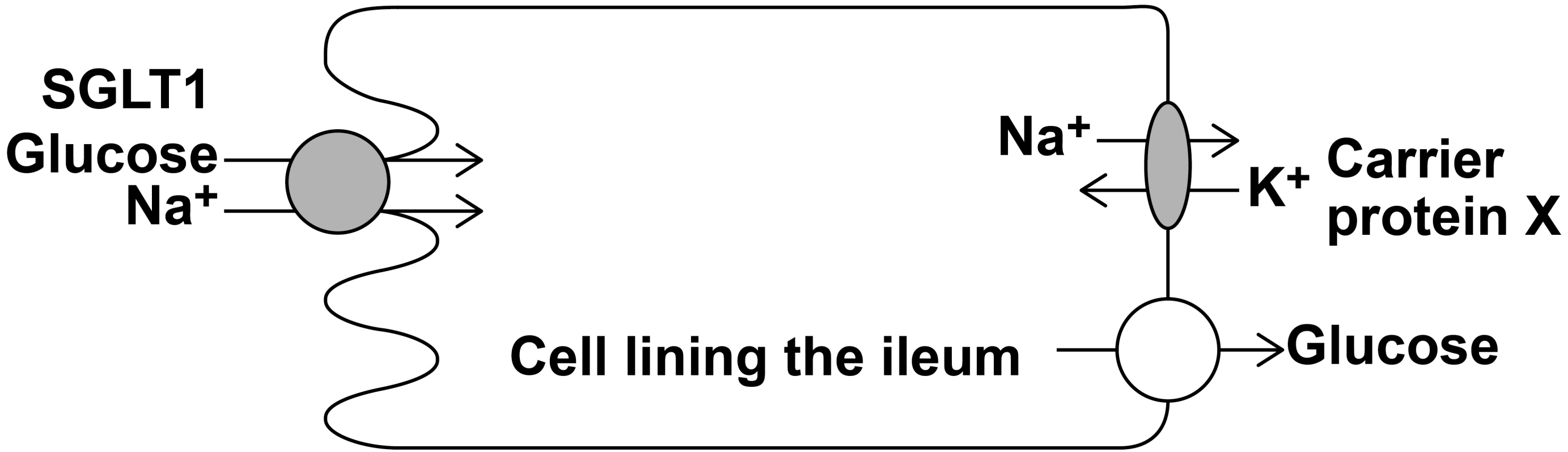
Answer ALL questions in the spaces provided.

0 1

FIGURE 1, on the opposite page, shows a cell from the lining of the ileum specialised for absorption of products of digestion.

SGLT1 is a carrier protein found in the cell-surface membrane of this cell, it transports glucose and sodium ions (Na^+) into the cell.

FIGURE 1



[Turn over]

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0 1 . 1

The action of the carrier protein X in FIGURE 1, on page 5, is linked to a membrane-bound ATP hydrolase enzyme.

Explain the function of this ATP hydrolase. [2 marks]

0 1 . 2

The movement of Na^+ OUT of the cell allows the absorption of glucose INTO the cell lining the ileum.

Explain how. [2 marks]

0 1 . 3

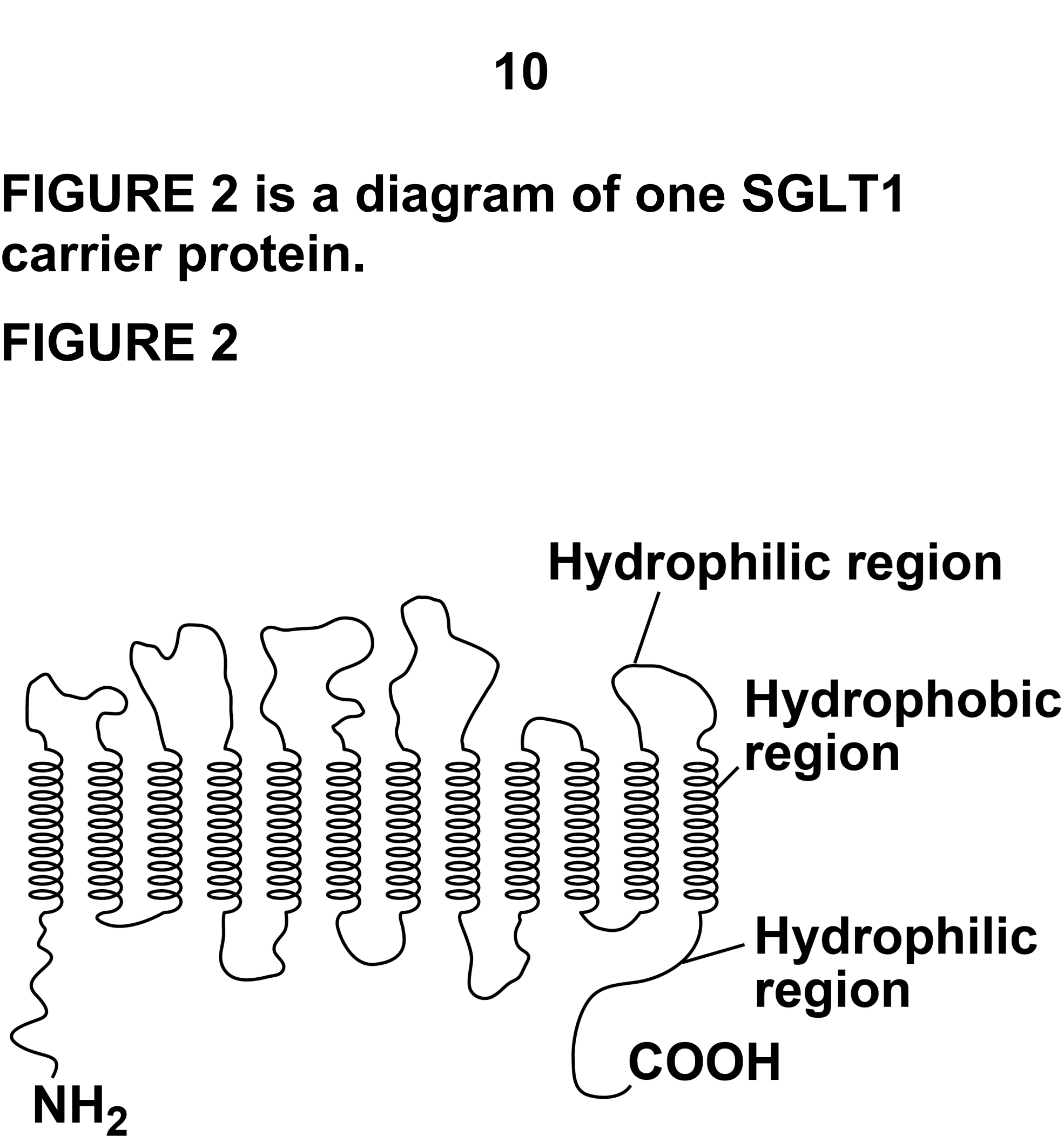
Describe and explain TWO features you would expect to find in a cell specialised for absorption. [2 marks]

1

2

FIGURE 2 is a diagram of one SGLT1 carrier protein.

FIGURE 2



0 1 . 4

Draw phospholipids on FIGURE 2, on the opposite page, to show how the carrier protein, SGLT1, would fit into the cell-surface membrane.

Do not draw more than eight phospholipids. [2 marks]

[Turn over]

0 1 . 5

FIGURE 2, on page 10, shows the SGLT1 polypeptide with NH_2 at one end and COOH at the other end.

Describe how amino acids join to form a polypeptide so there is always NH_2 at one end and COOH at the other end.

You may use a diagram in your answer. The answer space for the diagram is on the opposite page. [2 marks]

Space for diagram:

0 2

To study lipid digestion, a scientist placed a tube into the gut of a healthy 20-year-old man. The end of the tube passed through the stomach but did not reach as far as the ileum.

The scientist fed the man a meal containing triglycerides through the tube. The scientist also used the tube to remove samples from the man's gut at intervals after the meal.

The scientist measured the type of lipid found in the samples. Some of her results are shown in TABLE 1, on page 16.

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[Turn over]

TABLE 1

Sample	Time of collection after meal / min	Concentration of fatty acids / mg cm^{-3}	Concentration of triglycerides / mg cm^{-3}
A	45	2.7	0.6
B	75	3.3	0.0

0 2 . 1

Use your knowledge of lipid digestion to explain the differences in the results for samples A and B shown in TABLE 1.

You should assume that NO absorption had occurred.
[3 marks]

[Turn over]

0 2 . 2

After collecting the samples, the scientist immediately heated them to 70 °C for 10 minutes.

Explain why. [2 marks]

0 2 . 3

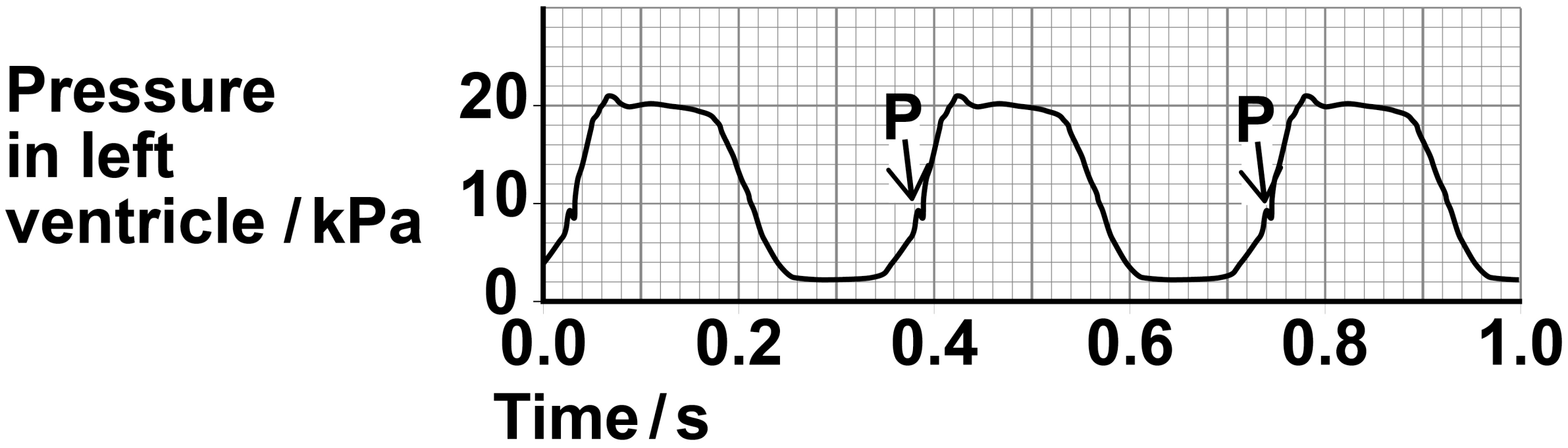
Describe the role of micelles in the absorption of fats into the cells lining the ileum. [3 marks]

8

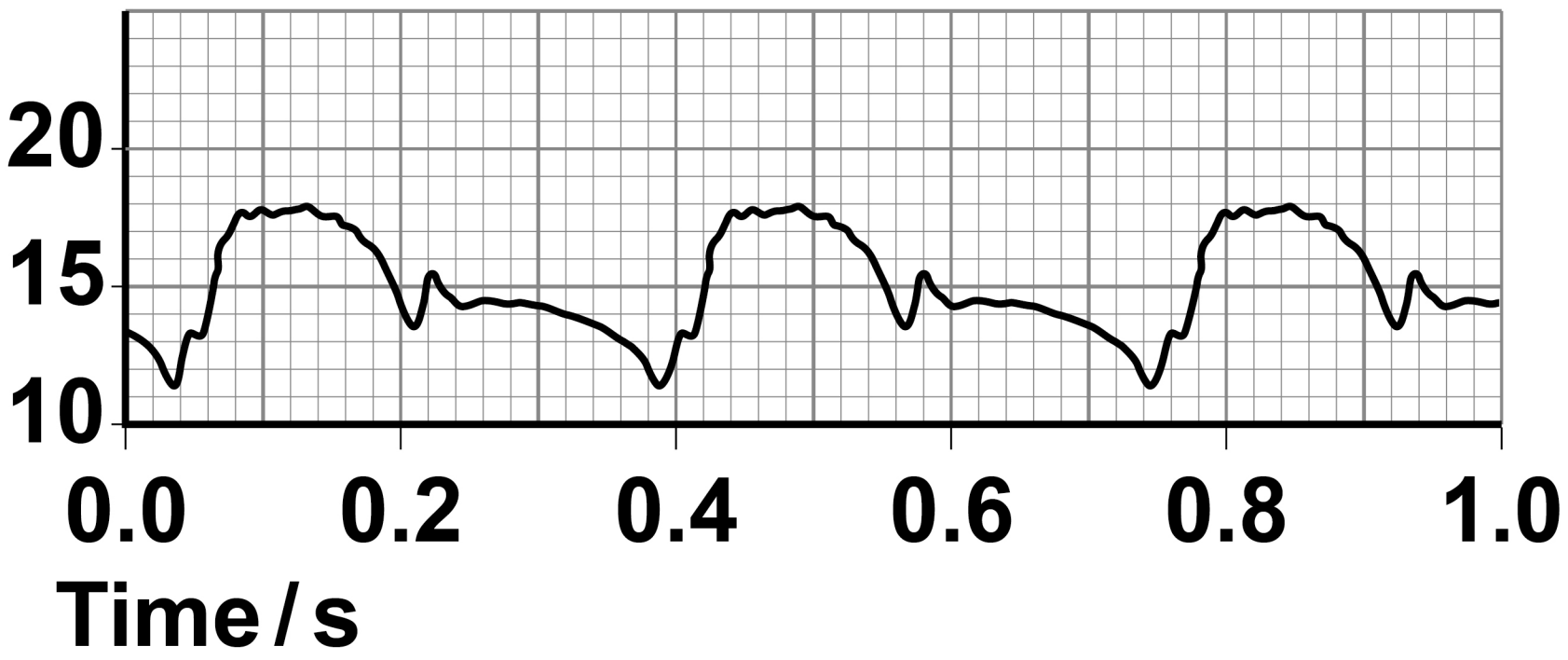
0 3

FIGURE 3, below and on the opposite page, shows pressure and blood flow during the cardiac cycle in a dog.

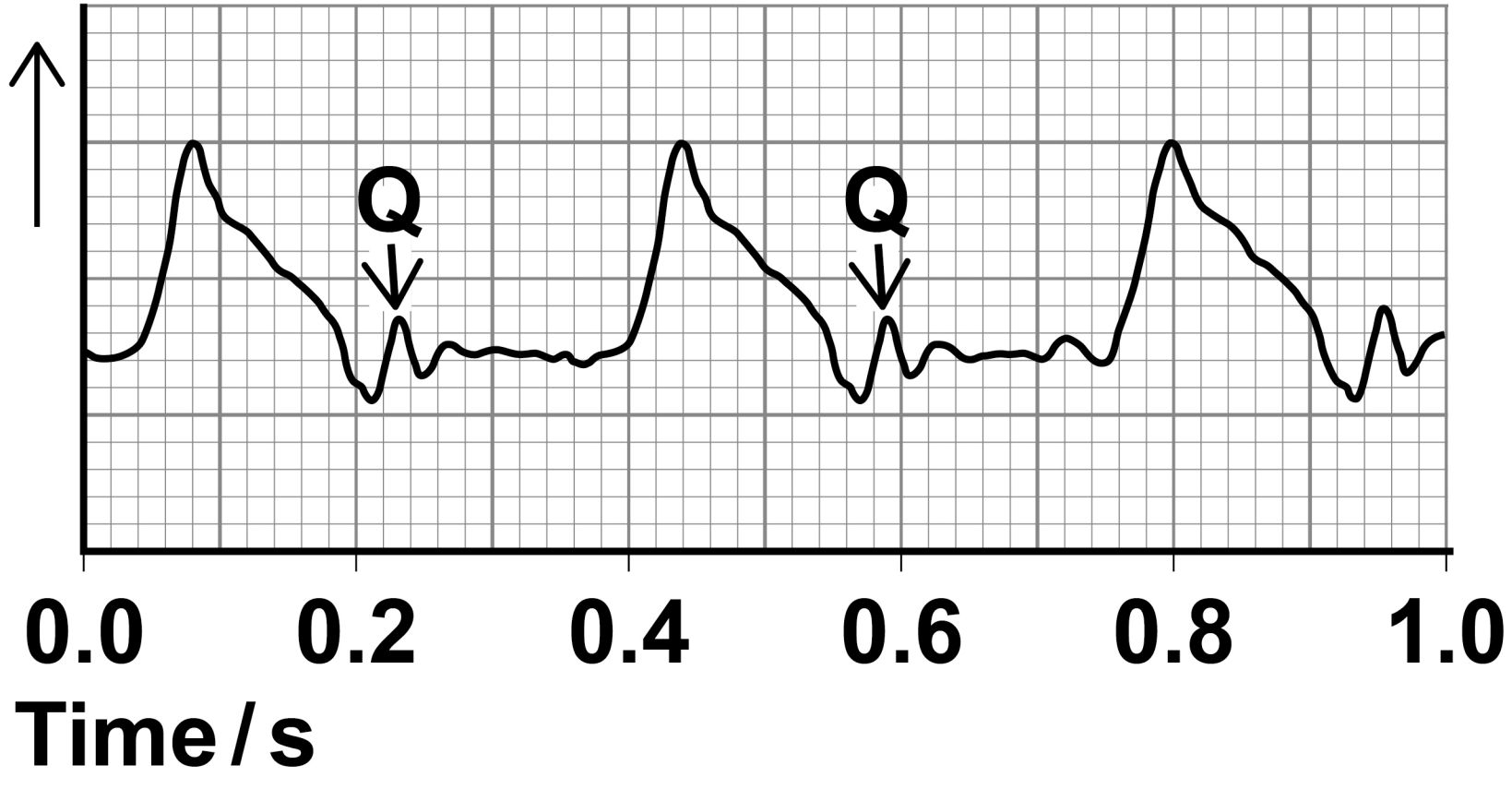
FIGURE 3



Pressure in the aorta near to the heart / kPa



Rate of blood flow in aorta near to heart



[Turn over]

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0 3 . 1

At P on FIGURE 3, on pages 20 and 21, the pressure in the left ventricle is increasing. At this time, the rate of blood flow has not yet started to increase in the aorta.

Use evidence from FIGURE 3 to explain why. [2 marks]

0 3 . 2

At Q on FIGURE 3 there is a small increase in pressure AND in rate of blood flow in the aorta.

Explain how this happens AND its importance. [2 marks]

0 3 . 3

A student correctly plotted the right ventricle pressure on the same grid as the left ventricle pressure in FIGURE 3, on pages 20 and 21.

Describe ONE way in which the student's curve would be similar to and ONE way it would be different from the curve shown in FIGURE 3. [2 marks]

Similarity _____

_____

_____

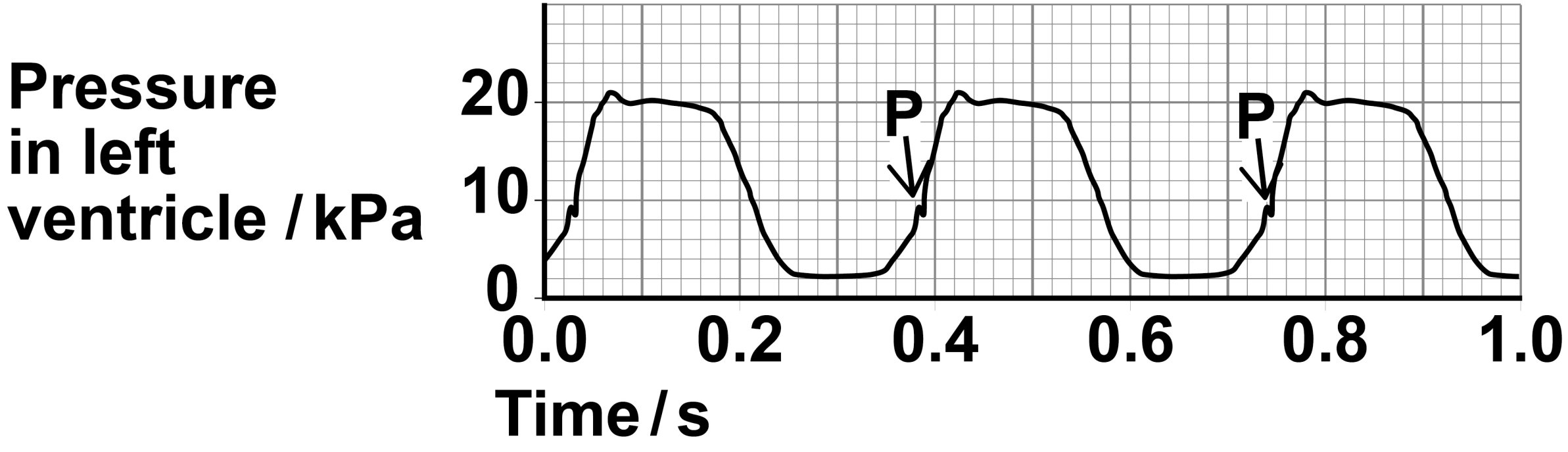
_____

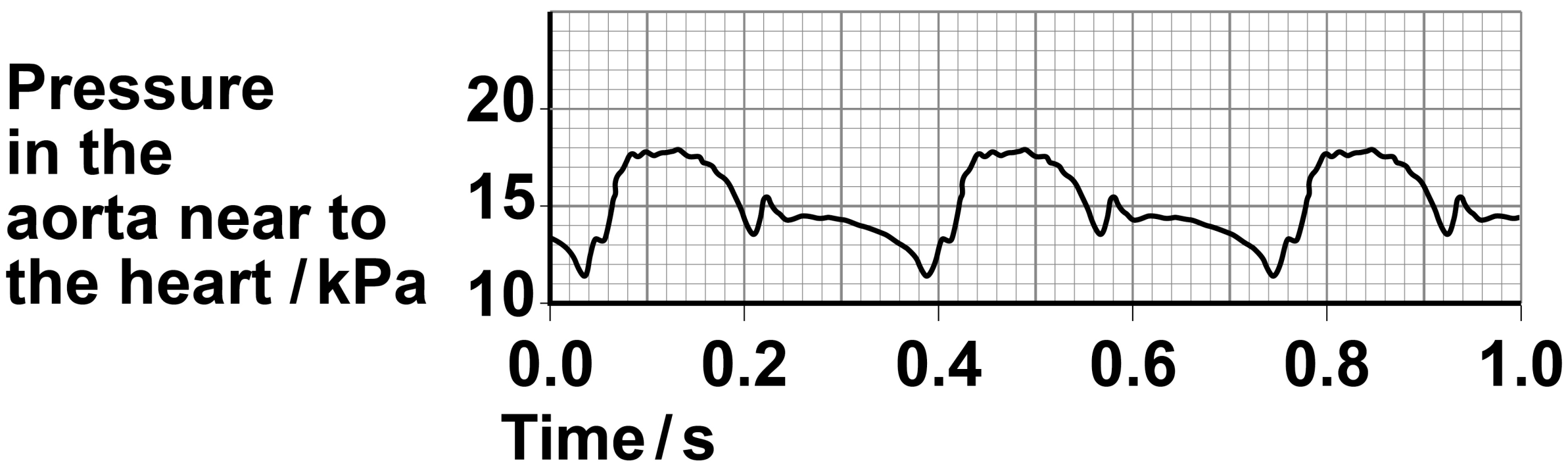
Difference _____

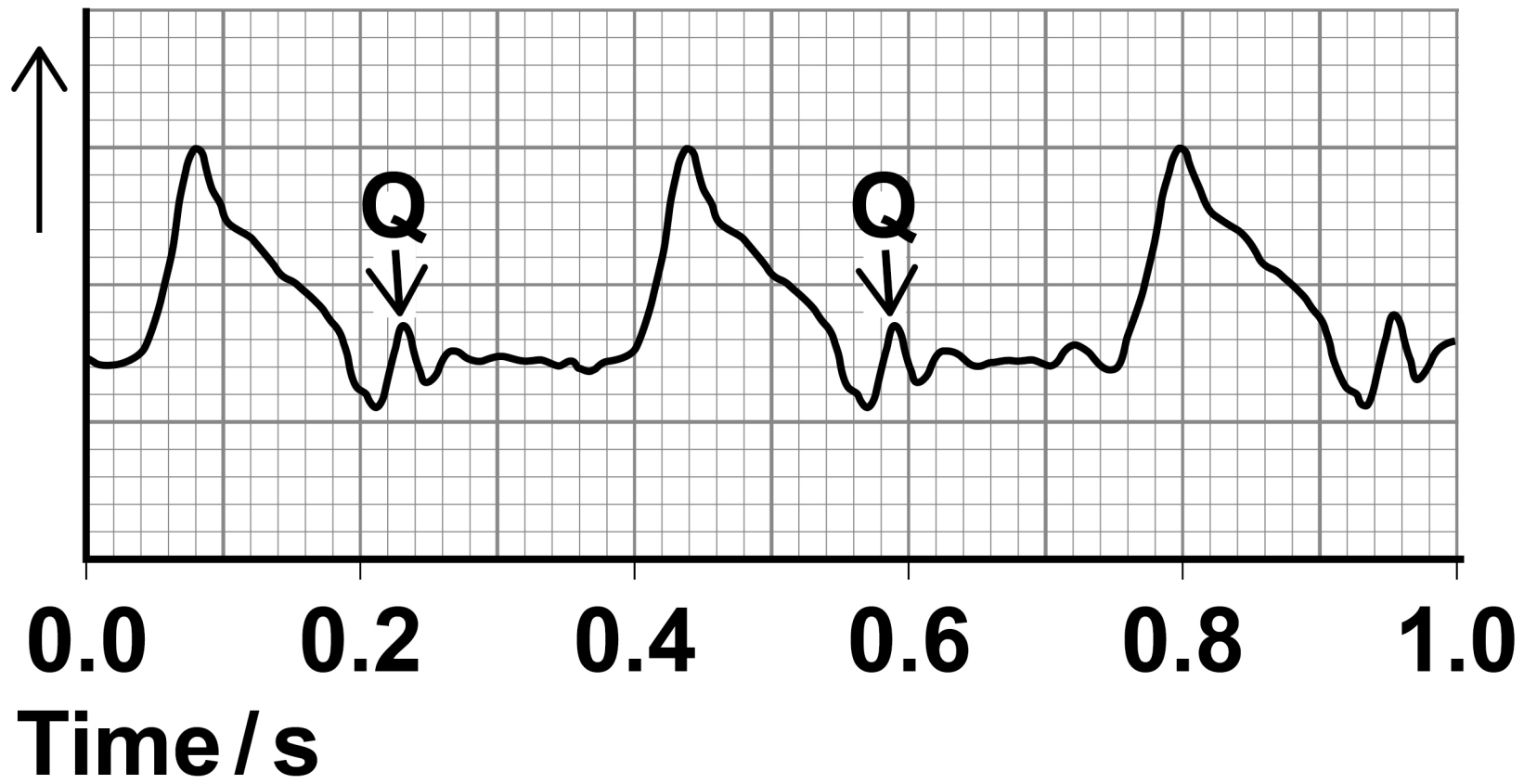
_____

_____

REPEAT OF FIGURE 3







0 3 . 4

Use information from FIGURE 3 to calculate the heart rate of this dog. [1 mark]

Heart rate _____ beats minute^{-1}

7

0 4

Anthocyanins are coloured pigments found in the cell vacuole of some plant cells. Anthocyanins cannot move across undamaged cell membranes.

A student investigated how to extract anthocyanins from blueberries.

She mixed 10 g of crushed, fresh blueberries with 100 cm^3 of extraction solvent for 1 hour.

She investigated three different extraction solvents:

- **E – Ethanol, water and acid**
- **F – Ethanol and water**
- **G – Water**

0 4 . 1

When making up extraction solvent E, the student used a volume ratio of 70:30:1 ethanol:water:acid.

Tick (✓) ONE box that shows the most appropriate volumes she would use to make up 100 cm^3 of extraction solvent E. [1 mark]

☐ **63.6 cm^3 ethanol, 27.3 cm^3 water, 9.1 cm^3 acid**

☐ **69.3 cm^3 ethanol, 29.7 cm^3 water, 1.0 cm^3 acid**

☐ **70.0 cm^3 ethanol, 30.0 cm^3 water, 1.0 cm^3 acid**

☐ **70.7 cm^3 ethanol, 30.3 cm^3 water, 1.0 cm^3 acid**

[Turn over]

0 4 . 2

The student kept constant:

- **the mass of fresh blueberries**
- **the volume of extraction solvent**
- **the time for the mixture to stand.**

Name TWO other variables the student should have kept constant during this investigation. [2 marks]

1 _____

2 _____

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[Turn over]

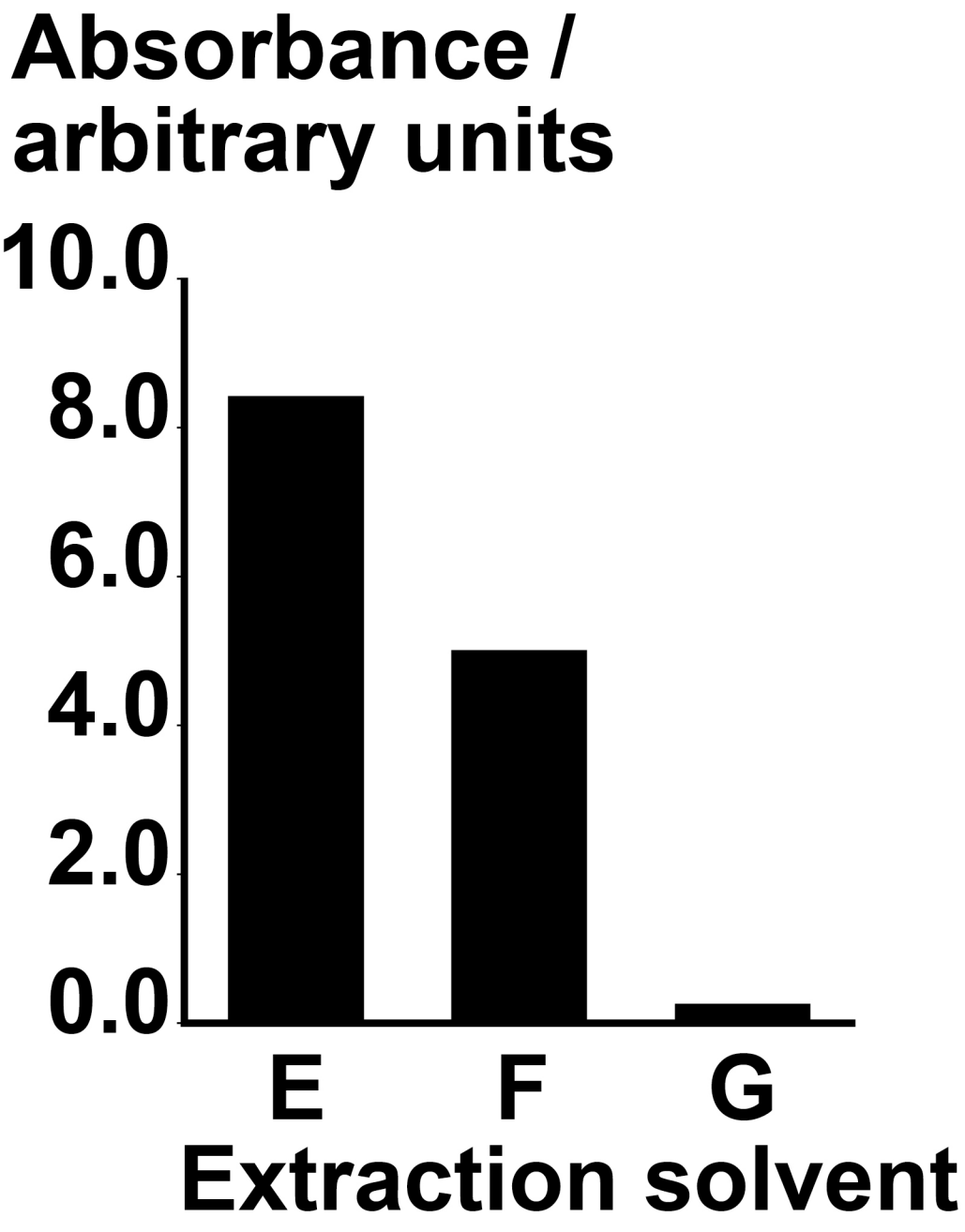
0 4 . 3

After 1 hour, the student filtered the samples.

She placed the filtrate in a colorimeter and measured the light absorbance.

Her results are shown in FIGURE 4.

FIGURE 4



Use your knowledge of membrane structure to explain the results in FIGURE 4. [4 marks]

34

0 4 . 4

A different student did this investigation. He did NOT have a colorimeter.

Describe a method this student could use to prepare colour standards and use them to give data for the total anthocyanin extracted. [3 marks]

10

0 5 . 1

Describe the role of DNA polymerase in the semi-conservative replication of DNA. [2 marks]

FIGURE 5, on the opposite page, shows the percentage of rat cells undergoing DNA replication. Some cells contained a protein called cyclin D and some cells did not contain cyclin D. All cells were in early interphase at time 0

0 5 . 2

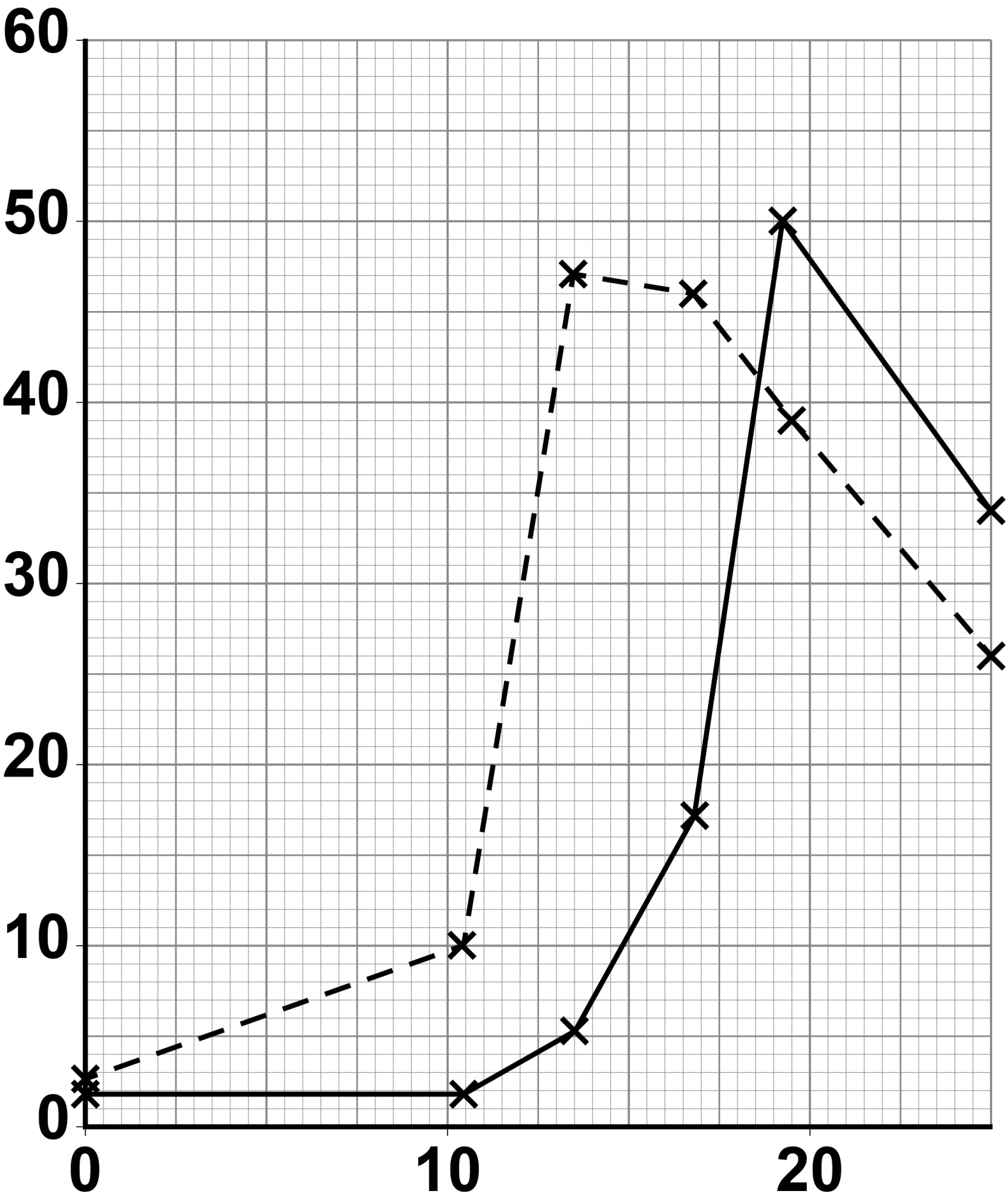
It took less time for 25% of cells with cyclin D to be undergoing DNA replication than for 25% of cells without cyclin D.

Use FIGURE 5 to calculate this time difference as a percentage decrease.

Show your working. [2 marks]

Answer _____ %

FIGURE 5



[Turn over]

0 5 . 3

Cyclin D stimulates the phosphorylation of DNA polymerase, which activates the DNA polymerase.

Describe how an enzyme can be phosphorylated. [2 marks]

0 5 . 4

Some tumour cells contain higher than normal concentrations of cyclin D.

Use FIGURE 5, on page 39, to suggest why higher than normal concentrations of cyclin D could result in a tumour.

[2 marks]

0 6 . 1

Particulate matter is solid particles and liquid particles suspended in air. Polluted air contains more particulate matter than clean air.

A high concentration of particulate matter results in the death of some alveolar epithelium cells. If alveolar epithelium cells die inside the human body they are replaced by non-specialised, thickened tissue.

Explain why death of alveolar epithelium cells reduces gas exchange in human lungs. [3 marks]

[Turn over]

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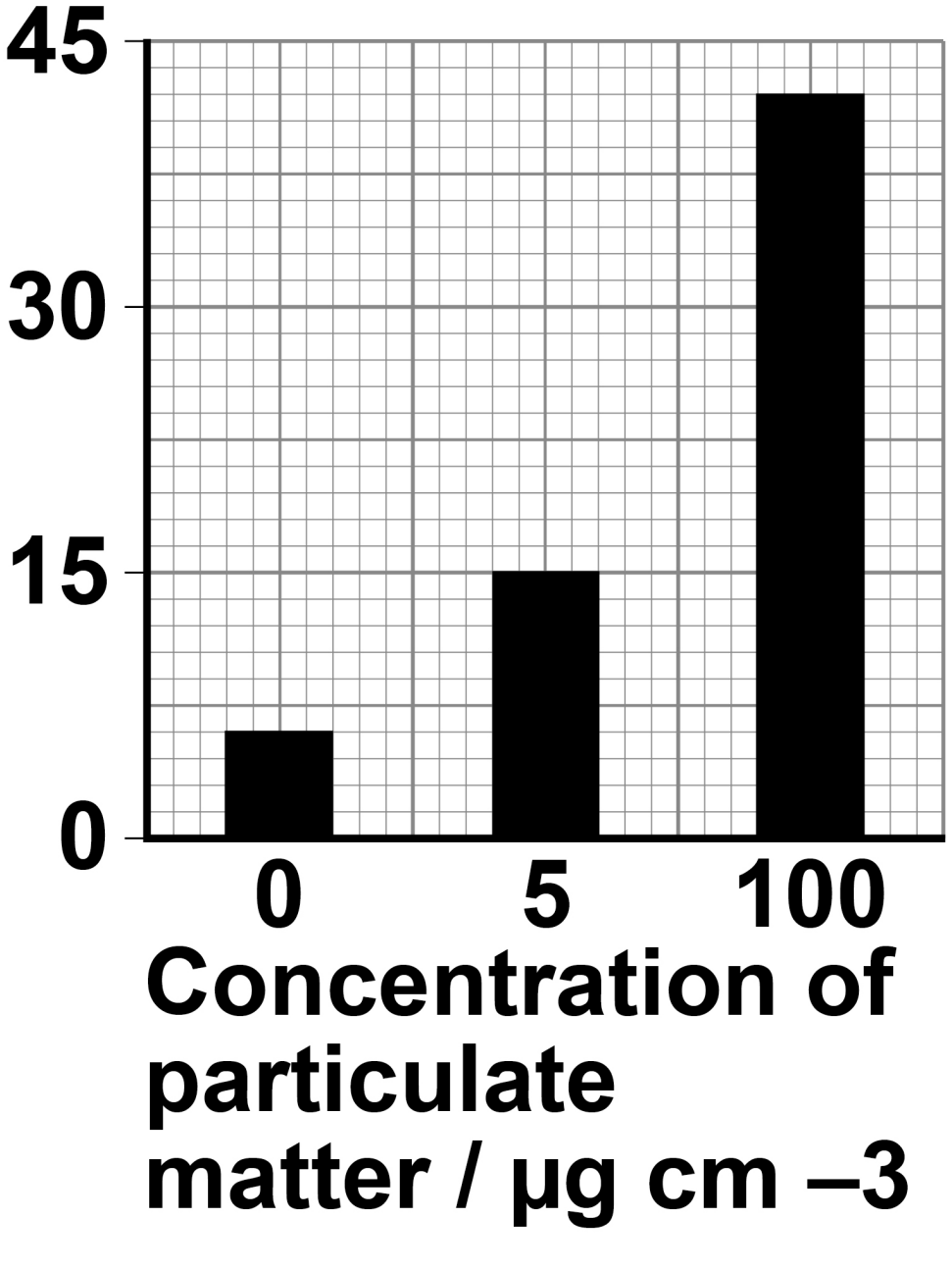
Scientists grew alveolar epithelium cells and exposed the epithelium cells to different concentrations of particulate matter. They calculated the percentage of these alveolar epithelium cells that died after 24 hours of exposure to particulate matter. Their results are shown in FIGURE 6, on page 46.

[Turn over]

FIGURE 6



0 6 . 2

Do the data in FIGURE 6 show a linear relationship between concentration of particulate matter and percentage of dead cells?

Use suitable calculations to justify your answer. [2 marks]

Space for your calculations:

0 7 . 1

Alpha-gal is a disaccharide found in red meat.

Alpha-gal is made of two galactose molecules. Galactose has the chemical formula $C_6H_{12}O_6$

Give the chemical formula for the disaccharide, alpha-gal, and describe how it is formed from two galactose molecules. [2 marks]

Formula _____

Description _____

_____

0 7 . 2

Some people eat red meat for many years without having any reaction, then have an allergic reaction to the alpha-gal in red meat.

An allergic reaction is caused by an immune response.

Draw a labelled diagram of an antibody AND identify the specific alpha-gal binding site. [3 marks]

0 7 . 3

A tick is a small animal that bites humans and feeds on their blood. This results in proteins from the tick saliva entering the human body.

Scientists have suggested one hypothesis for the allergic reaction to alpha-gal in red meat. They think that an earlier immune response to a tick bite can cause a person to have an allergic reaction to alpha-gal in red meat.

Suggest how ONE antibody can be specific to tick protein and to alpha-gal.
[2 marks]

[Turn over]

FIGURE 7

This figure has been removed due to third-party copyright restrictions.

0 7 . 4

Scientists took blood samples from one man over several weeks and measured the concentration of antibody in the man's blood. During this time, the man had two tick bites and had an allergic reaction to alpha-gal in red meat.

The scientists' results are shown in FIGURE 7 .

The scientists' hypothesis was that an earlier immune response to tick protein causes the allergic reaction.

Consider whether FIGURE 7 supports this hypothesis. [3 marks]

10

BLANK PAGE

[Turn over]

0 8 . 1

Complete TABLE 2 to show THREE differences between DNA in the nucleus of a plant cell and DNA in a prokaryotic cell. [3 marks]

TABLE 2

DNA in the nucleus of a plant cell	DNA in a prokaryotic cell
1	
2	
3	

0 8 . 2

Scientists investigated the genetic diversity between several species of sweet potato. They studied non-coding multiple repeats of base sequences.

Define 'non-coding base sequences' and describe where the non-coding multiple repeats are positioned in the genome. [2 marks]

The percentage similarities in the non-coding multiple repeats of base sequences of four species of sweet potato are shown in TABLE 3.

TABLE 3

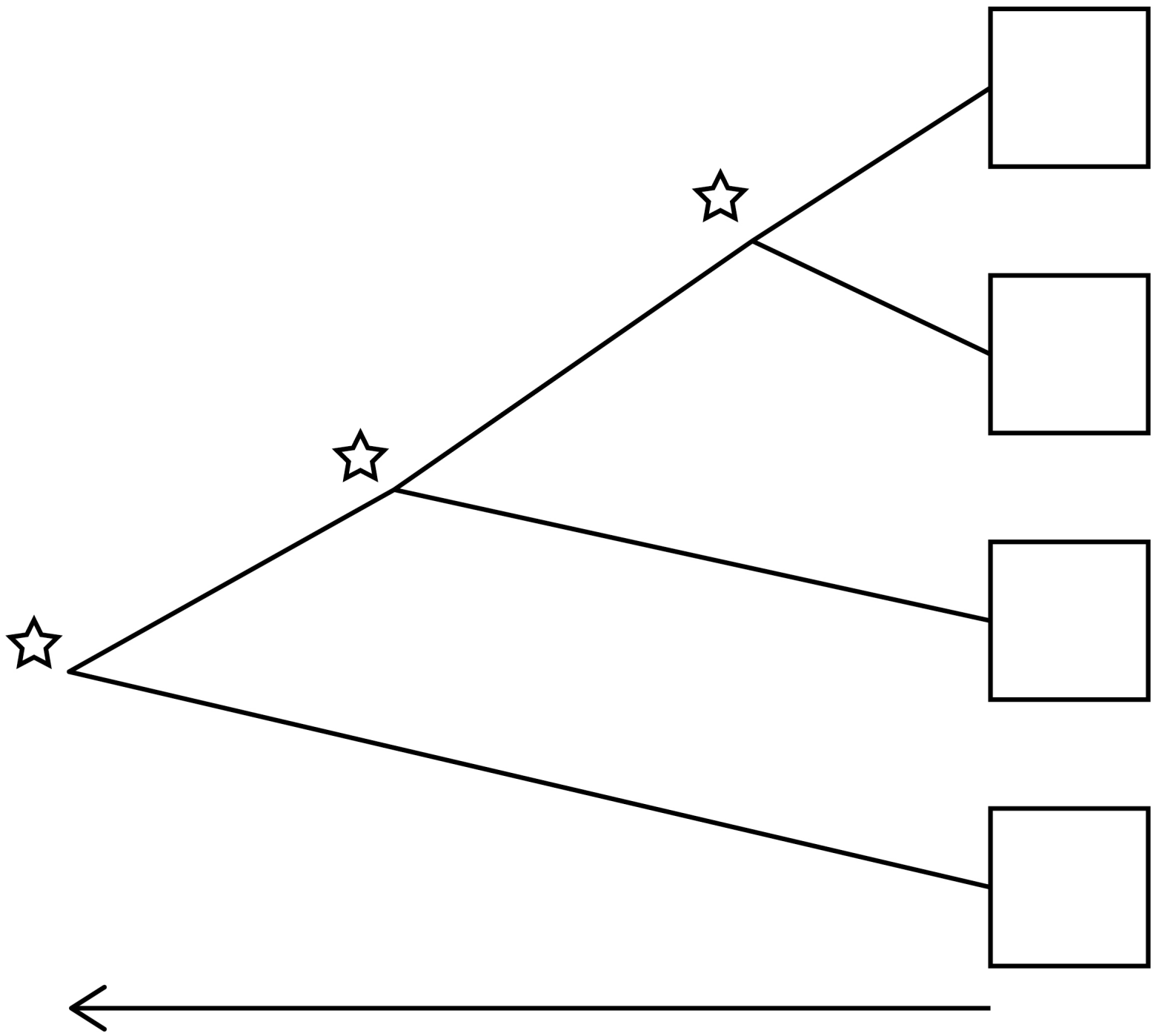
Species of sweet potato	Percentage similarity between non-coding multiple repeat base sequences			
	C	L	R	T
C		53.5	25.7	59.7
L	53.5		33.4	53.7
R	25.7	33.4		36.6
T	59.7	53.7	36.6	

0 8 . 3

Use the information in TABLE 3 to complete the phylogenetic tree shown in FIGURE 8 on the opposite page.

Write the letter that represents the correct species into each box. [1 mark]

FIGURE 8



KEY

☆ **Common ancestor of the species to the right**

[Turn over]

REPEAT OF TABLE 3

Species of sweet potato	Percentage similarity between non-coding multiple repeat base sequences			
	C	L	R	T
C		53.5	25.7	59.7
L	53.5		33.4	53.7
R	25.7	33.4		36.6
T	59.7	53.7	36.6	

0 8 . 4

The scientists studied five individuals from each species. Within the five individuals of SPECIES T they found a percentage similarity of 66%.

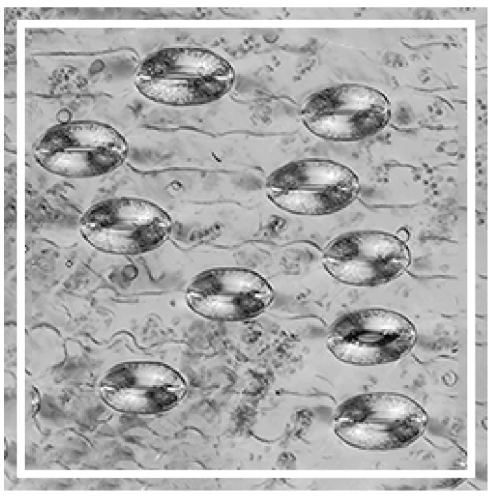
Use TABLE 3 to evaluate how this information affects the validity of the phylogenetic tree. [2 marks]

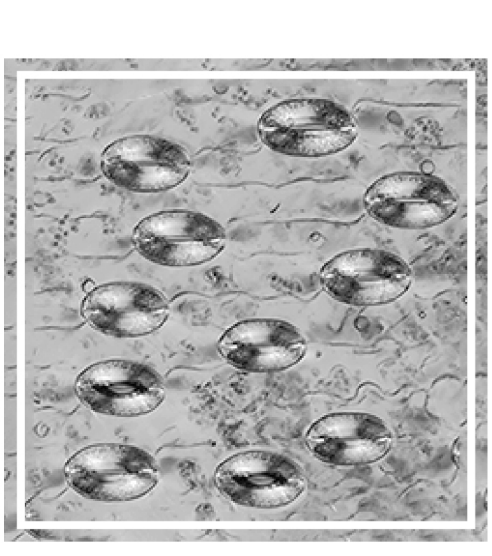
0 9

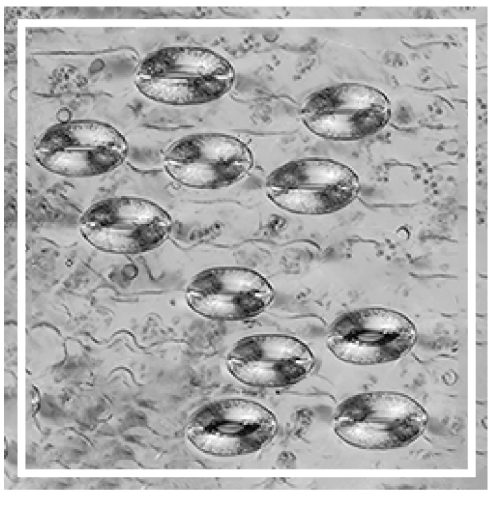
Scientists investigated stomatal density on leaves of one species of tree.

FIGURE 9, on page 63, shows three examples of the square fields of view the scientists used to calculate a mean stomatal density.

FIGURE 9







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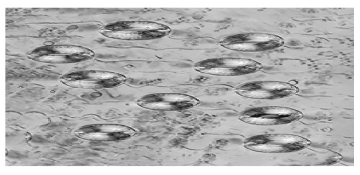
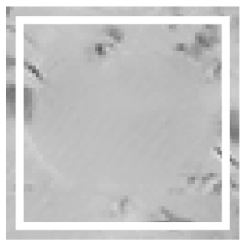


Stomata



White lines show the counting field for stomata (each edge of white square = 250 µm)

[Turn over]

BLANK PAGE

0 9 . 1

Calculate the mean stomatal density in the three fields of view in FIGURE 9, on page 63.

Give your answer as number of stomata per mm^2

Show your working. [2 marks]

Stomatal density _____ per mm^2

The scientists used leaves from individual trees that had grown in different areas of the world in different years. Each tree had grown in an area and year with known carbon dioxide concentration.

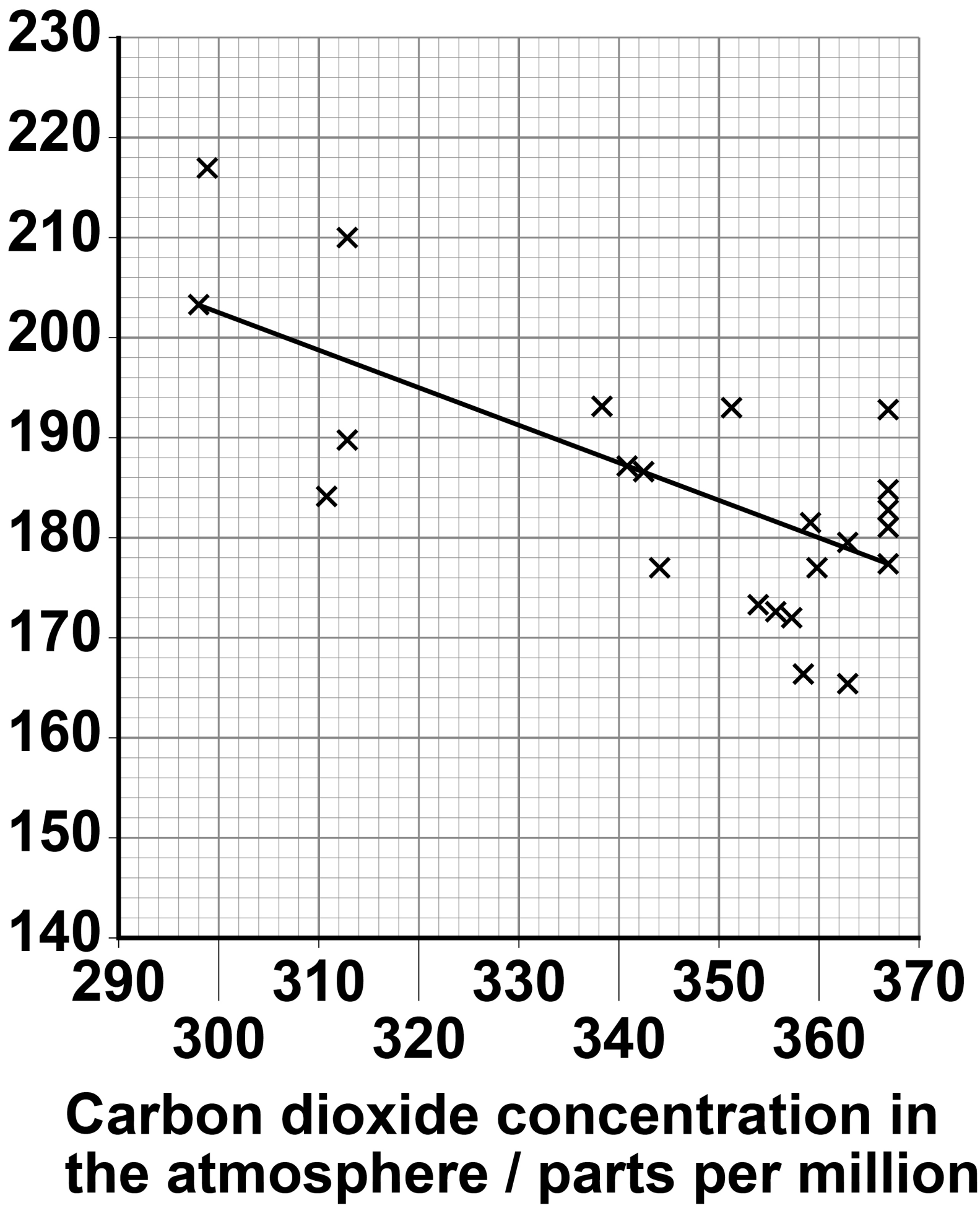
Their results are shown in FIGURE 10, on page 67.

KEY

Each plotted point represents mean stomatal density from 10 leaves from one tree

Line shows line of best fit, which shows a statistically significant change.

FIGURE 10



[Turn over]

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0 9 . 2

Give a null hypothesis for this investigation AND name a statistical test that would be appropriate to test your null hypothesis. [2 marks]

Null hypothesis _____

_____

_____

_____

_____

Statistical test _____

_____

[Turn over]

BLANK PAGE

0 9 . 3

From 1910 to 2000, the carbon dioxide concentration in the atmosphere increased from 300 parts per million to 365 parts per million.

Use FIGURE 10, on page 67, to calculate the mean rate of change in stomatal density from 1910 to 2000.

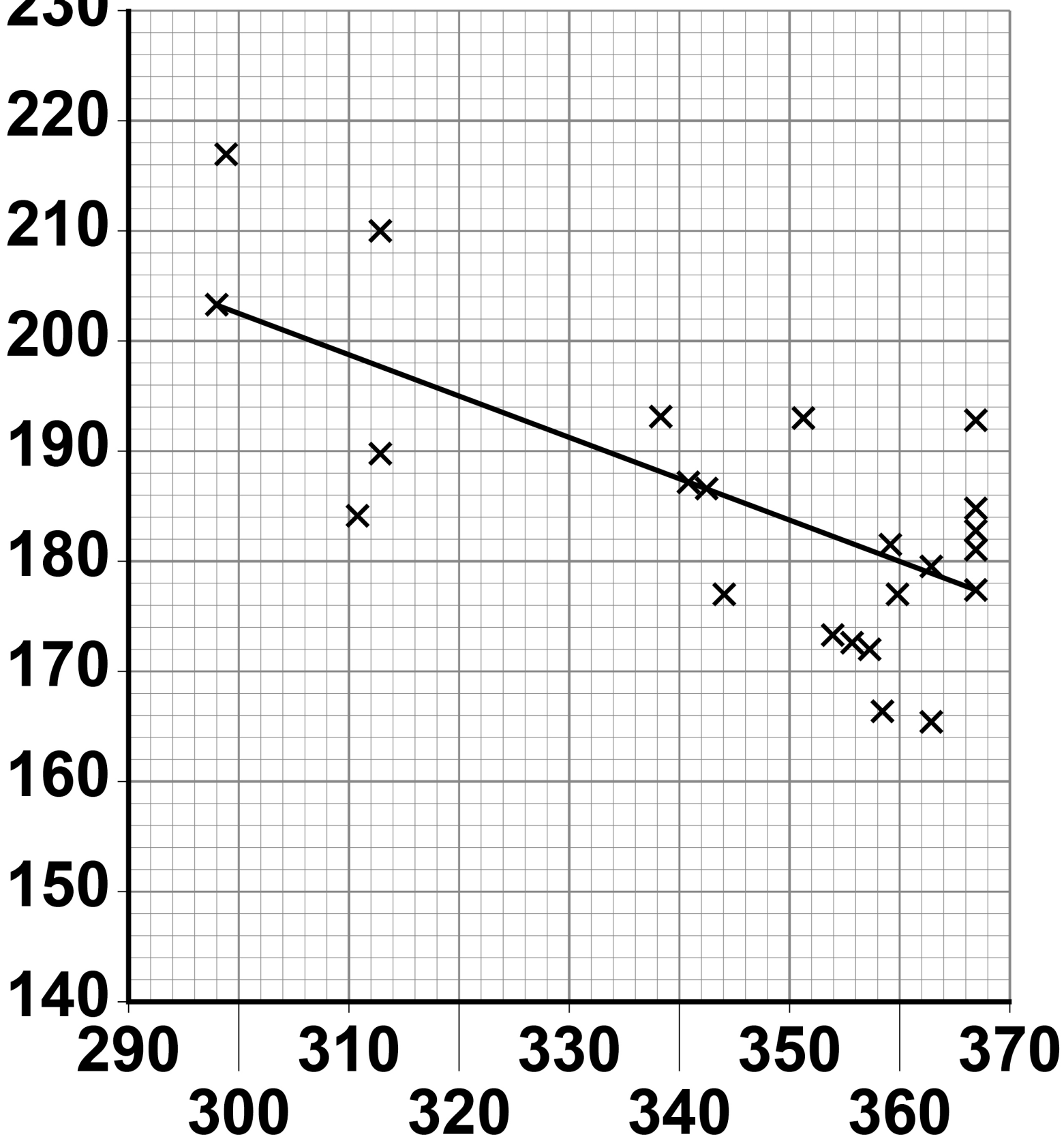
Give your answer as number of stomata per mm^2 per 10-year period.

Show your working. [2 marks]

Number of stomata per mm^2 per 10-year period _____

[Turn over]

REPEAT OF FIGURE 10



KEY

Each plotted point represents mean stomatal density from 10 leaves from one tree

Line shows line of best fit, which shows a statistically significant change.

0 9 . 4

A journalist saw FIGURE 10 and suggested that future increases in atmospheric carbon dioxide concentration could result in less transpiration.

Evaluate his suggestion. [4 marks]

10

1 0 . 1

Describe how mRNA is formed by transcription in eukaryotes. [5 marks]

76

[Turn over]

1 0 . 2

Describe how a polypeptide is formed by translation of mRNA. [6 marks]

[Turn over]

80

1 0 . 3

Define 'gene mutation' and explain how a gene mutation can have:

- **no effect on an individual**
- **a positive effect on an individual.**

[4 marks]


8 2

END OF QUESTIONS

15

Additional page, if required.

Write the question numbers in the left-hand margin.

Additional page, if required.

Write the question numbers in the left-hand margin.

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For Examiner's Use	
Question	Mark
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