GCE AS/A LEVEL

2400U10-1

MONDAY, 15 MAY 2023 – MORNING

BIOLOGY – AS UNIT 1

BASIC BIOCHEMISTRY AND CELL ORGANISATION

1 hour 30 minutes plus your additional time allowance

Surname: _____

First name(s): _____

Centre Number: _____

Candidate Number: 2 _____

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	12	
2.	13	
3.	10	
4.	11	
5.	13	
6.	12	
7.	9	
Total	80	

ADDITIONAL MATERIALS

A calculator and a ruler.

ITEMS INCLUDED WITH QUESTION PAPER

A separate Diagram Booklet.

The Diagram Booklet MUST be handed in to the invigilators and sent for marking.

INSTRUCTIONS TO CANDIDATES

Use black ink, black ball – point pen, black felt tip or your usual method.

Write your name, centre number and candidate number in the spaces on the front cover.

Answer ALL questions.

Write your answers in the spaces provided. If you run out of space, use the additional pages at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part – question.

The assessment of the quality of extended response (QER) will take place in question 7.

The quality of written communication will affect the awarding of marks.

ANSWER ALL QUESTIONS.

1. Look at IMAGE 1.1 for Question 1 in the separate Diagram Booklet.

Lysozyme is an enzyme found in saliva and tears. It hydrolyses the carbohydrates in bacterial cell walls. Lysozyme, shown in IMAGE 1.1, is a single polypeptide containing 129 amino acids.

continued on the next page . . .

Question 1 continued

1. (a) Lysozyme shows primary, secondary and tertiary structure.

(i) State what is meant by primary structure.

[1 mark]

continued on the next page . . .

Question 1 (a) continued

1. (a) (ii) Look at TABLE 1.2 for Question 1 (a) (ii) in the separate Diagram Booklet.

Use the information given and your own knowledge to COMPLETE TABLE 1.2 to explain how the secondary and tertiary structures of lysozyme are illustrated in IMAGE 1.1

[2 marks]

continued on the next page . . .

Question 1 (a) continued

1. (a) (iii) The cytoplasm of bacterial cells is HYPERTONIC to saliva and tears. Suggest how the destruction of the cell wall of bacteria by lysozyme results in the death of the bacteria.

9

[3 marks]

continued on the next page . . .

Question 1 (a) continued

1. (a) (iv) Lysozyme works by an induced fit mechanism. Explain what this means.

[1 mark]

continued on the next page . . .

Question 1 continued

1. (b) Look at GRAPH 1.3 for Question 1 (b) in the separate Diagram Booklet.

The effect of pH on the activity of lysozyme is shown in GRAPH 1.3

(i) Describe and explain the effect of pH on the activity of lysozyme.

[3 marks]

continued on the next page . . .

Question 1 (b) continued

1. (b) (ii) Lysozyme has a wider range of pH activity than many other enzymes.

I. Use GRAPH 1.3 to find the range of pH over which lysozyme is more than 50% active.

Range = _____ to _____

[1 mark]

continued on the next page . . .

Question 1 (b) (ii) continued

1. (b) (ii) II. Use the information in the question to suggest ONE advantage of lysozyme having a wider range of pH activity than many other enzymes.

_____

_____

_____

_____

[1 mark]

(Total for Question 1 = 12 marks)

2. Look at IMAGE 2.1 for Question 2 in the separate Diagram Booklet.

IMAGE 2.1 shows metaphase during cell division of three cells of the mosquito, CULEX PIPIENS.

The mosquito has a diploid number of $2n = 6$

continued on the next page . . .

Question 2 continued

2. (a) (i) Insert the correct letter (A, B or C) into the table below to indicate which stage of cell division is represented by each cell.

Metaphase of:	Letter
Mitosis	
Meiosis I	
Meiosis II	

[2 marks]

continued on the next page . . .

Question 2 (a) continued

2. (a) (ii) Look at the table for Question 2 (a) (ii) in the separate Diagram Booklet.

In the table, state TWO differences in the daughter cells of CULEX PIPIENS following mitosis and meiosis.

[2 marks]

continued on the next page . . .

Question 2 continued

2. (b) Look at GRAPH 2.2 for Question 2 (b) in the separate Diagram Booklet.

GRAPH 2.2 shows some changes seen in a cell undergoing mitosis.

continued on the next page . . .

Question 2 (b) (i) continued

2. (b) (i) Calculate the rate of increase in distance between the centromeres of the sister chromatids between 15 and 30 minutes.

Space for working:

Rate = _____ µm minute^{-1}

[2 marks]

(Turn over)

Question 2 (b) continued

2. (b) (ii) Suggest how GRAPH 2.2 provides evidence to show what happens to the chromosomes during anaphase of mitosis.

[2 marks]

Question 2 continued

2. (c) Look at IMAGE 2.3 for Question 2 (c) in the separate Diagram Booklet.

The micrograph in IMAGE 2.3 shows onion plant cells undergoing mitosis.

continued on the next page . . .

Question 2 (c) continued

2. (c) (i) USE THE SCALE BAR to calculate the magnification of IMAGE 2.3

Space for working:

Magnification = × _____

[2 marks]

continued on the next page . . .

Question 2 (c) continued

2. (c) (ii) On IMAGE 2.3 label:

A ONE cell in anaphase

B ONE cell in metaphase

[1 mark]

continued on the next page . . .

Question 2 (c) continued

2. (c) (iii) Suggest from which part of the onion plant the cells in IMAGE 2.3 were taken. Explain your answer.

[2 marks]

(Total for Question 2 = 13 marks)

3. (a) Red blood cells need to take in glucose and oxygen from the blood plasma. Glucose is a polar molecule and oxygen is non – polar.

The uptake of glucose and oxygen by red blood cells was measured separately at increasing external concentrations of these two molecules.

continued on the next page . . .

Question 3 (a) continued

Look at GRAPH 3.1 for Question 3 (a) in the separate Diagram Booklet.

GRAPH 3.1 shows the rate of uptake of glucose and oxygen.

3. (a) (i) Look at TABLE 3.2 for Question 3 (a) (i) in the separate Diagram Booklet.

continued on the next page . . .

Question 3 (a) (i) continued

COMPLETE TABLE 3.2

to identify:

- **which line on GRAPH 3.1 represents glucose and which represents oxygen;**
- **the type of transport used by each substance.**

[2 marks]

continued on the next page . . .

Question 3 (a) continued

3. (a) (ii) Explain the difference in the shape of lines A and B shown on GRAPH 3.1

[4 marks]

Question 3 continued

3. (b) Red blood cells are packed full of haemoglobin. When mature, they do not contain any of the organelles usually found in eukaryotic cells.

Using this information and your knowledge of CELL STRUCTURE conclude why mature red blood cells:

continued on the next page . . .

Question 3 (b) continued

3. (b) (i) cannot make haemoglobin;

[2 marks]

3. (b) (ii) can only transport substances across the cell membrane against a concentration gradient at very low rates.

[2 marks]

(Total for Question 3 = 10 marks)

4. Look at IMAGE 4.1 for Question 4 in the separate Diagram Booklet.

Starch is made up of two molecules, amylose and amylopectin, shown in IMAGE 4.1

Look at IMAGE 4.2 for Question 4 in the separate Diagram Booklet.

IMAGE 4.2 shows sections of amylose and amylopectin.

continued on the next page . . .

Question 4 continued

4. (a) (i) State the general name given to BONDS X and Y.

_____

[1 mark]

4. (a) (ii) State ONE similarity and ONE difference between amylose and amylopectin, shown in IMAGE 4.1 and IMAGE 4.2

Similarity _____

_____

_____

_____

Difference _____

_____

_____

[2 marks]

continued on the next page . . .

Question 4 continued

4. (b) Look at IMAGE 4.3 for Question 4 (b) in the separate Diagram Booklet.

In order to be absorbed into the blood, starch has to be hydrolysed to produce glucose. The digestion of amylose happens in two stages as shown in IMAGE 4.3

continued on the next page . . .

Question 4 (b) continued

4. (b) (i) State what is meant by the term hydrolysis.

[1 mark]

continued on the next page . . .

Question 4 (b) continued

4. (b) (ii) Amylopectin is digested in a similar way but needs an additional enzyme, isomaltase, for complete hydrolysis.

Explain the roles of the THREE enzymes involved in the complete hydrolysis of starch.

[3 marks]

Question 4 (b) continued

4. (b) (iii) One variety of corn used in animal feed has a lower amylose: amylopectin ratio than other varieties.

With reference to IMAGE 4.2 and IMAGE 4.3, suggest why this lower ratio results in an increase in the rate of starch hydrolysis.

[2 marks]

continued on the next page . . .

Question 4 (b) continued

4. (b) (iv) Describe a chemical test that could be used to show that starch is no longer present at the end of hydrolysis.

[2 marks]

(Total for Question 4 = 11 marks)

5. (a) Look at IMAGE 5.1 for Question 5 (a) in the separate Diagram Booklet.

IMAGE 5.1 represents part of a DNA molecule.

(i) Circle ONE nucleotide in IMAGE 5.1

[1 mark]

(ii) Using the letters A, C, T, G, label ALL the organic bases in IMAGE 5.1

One adenine is labelled already.

[2 marks]

continued on the next page . . .

Question 5 (a) continued

5. (a) (iii) Look at TABLE 5.2 for Question 5 (a) (iii) in the separate Diagram Booklet.

In the late 1940s, Erwin Chargaff published his research into the base composition of the DNA in different species. Some of his findings are shown in TABLE 5.2

continued on the next page . . .

Question 5 (a) (iii) continued

5. (a) (iii) I. Complete TABLE 5.2 to suggest values for the sea urchin.

[1 mark]

II. Based on the results in TABLE 5.2, state the conclusion that can be made regarding the base composition of DNA. Explain your answer.

_____

_____

_____

[3 marks]

continued on the next page . . .

Question 5 continued

5. (b) Meselson and Stahl also carried out investigations on DNA in the 1950s. They proposed the theory of semi – conservative replication. State what is meant by semi – conservative replication.

[2 marks]

continued on the next page . . .

Question 5 continued

5. (c) DNA contains only four different bases, but proteins can be made of up to 20 different amino acids. Explain how these four bases allow for the production of so many different proteins.

(Turn over)

[4 marks]

(Total for Question 5 = 13 marks)

6. Look at IMAGE 6.1 for Question 6 in the separate Diagram Booklet.

TRADESCANTIA, shown in IMAGE 6.1, is a house plant which is popular due to its ability to survive long periods without watering because its stems can store water.

Look at IMAGE 6.2 for Question 6 in the separate Diagram Booklet.

The solute potential of the cells of the stem was measured by using epidermal peels.

continued on the next page . . .

Question 6 continued

Each peel was mounted on a different microscope slide in a different concentration of sucrose solution, as shown in IMAGE 6.2

Look at TABLE 6.3 for Question 6 in the separate Diagram Booklet.

After 10 minutes the peels were observed under a microscope. The number of plasmolysed and unplasmolysed cells in each sample was recorded. The results are shown in TABLE 6.3

continued on the next page . . .

Question 6 continued

6. (a) (i) COMPLETE TABLE 6.3 for 1.0 mol dm^{-3} sucrose.

[2 marks]

(ii) Look at the diagram for Question 6 (a) (ii) in the separate Diagram Booklet. The diagram is a blank grid.

On the grid, use the data in TABLE 6.3 to draw a graph which shows the percentage of plasmolysed cells against sucrose concentration.

[4 marks]

continued on the next page . . .

Question 6 (a) continued

6. (a) (iii) I. Look at the formula for Question 6 (a) (iii) in the separate Diagram Booklet.

Use your graph and the formula shown to estimate the solute potential of the solution when 50% of the TRADESCANTIA cells are plasmolysed.

continued on the next page . . .

Question 6 (a) (iii) I. continued

Space for working:

Solute potential

= _____ kPa

[2 marks]

continued on the next page . . .

Question 6 (a) (iii) continued

6. (a) (iii) II. State the pressure potential of the cells in the tissue and identify the term that describes their condition at this solute concentration.

Pressure potential (ψp)

= _____ kPa

Term =

[2 marks]

continued on the next page . . .

Question 6 continued

6. (b) Suggest how the experiment could be altered to improve:

- **confidence in the results**
- **the accuracy of the estimated solute potential in TRADESCANTIA cells.**

[2 marks]

(Total for Question 6 = 12 marks)

7. DNA, mRNA, rRNA and tRNA are nucleic acids involved in protein synthesis.

For tRNA to carry out its role in protein synthesis it needs to undergo the process described below:

- an amino acid, a molecule of ATP and a molecule of tRNA bind to a tRNA – activating enzyme
- ATP is broken down releasing two phosphates and producing AMP (Adenosine mono phosphate)

continued on the next page . . .

Question 7 continued

- **the AMP binds to the amino acid to produce an activated amino acid**
- **a molecule of tRNA is then bonded to the activated amino acid**
- **to produce activated tRNA – the AMP is released in the process**

continued on the next page . . .

Question 7 continued

Describe the function of each of the four types of nucleic acid involved in protein synthesis and state where in the cell each carries out its function. (A detailed account of protein synthesis is not required.)

Use the information above to explain the role of ATP in producing activated tRNA molecules and your knowledge of enzymes to suggest why at least 20 enzymes are needed to produce all the tRNA molecules required for protein synthesis.

(Turn over)

Question 7 continued

(Turn over)

(Turn over)

(Turn over)

(Turn over)

(Turn over)

(Turn over)

(Turn over)

(Turn over)

(Turn over)

(Turn over)

(Turn over)

(Turn over)

[9 marks QER]

(Total for Question 7 = 9 marks)

END OF PAPER

TOTAL 80 MARKS

Question number	Additional pages, if required. Write the question number(s) in the left - hand margin.

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GCSE

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MONDAY, 15 MAY 2023 – MORNING

BIOLOGY – AS UNIT 1

BASIC BIOCHEMISTRY AND CELL ORGANISATION

The Diagram Booklet MUST be handed in to the invigilators and sent for marking.

Diagram Booklet

Surname: _____

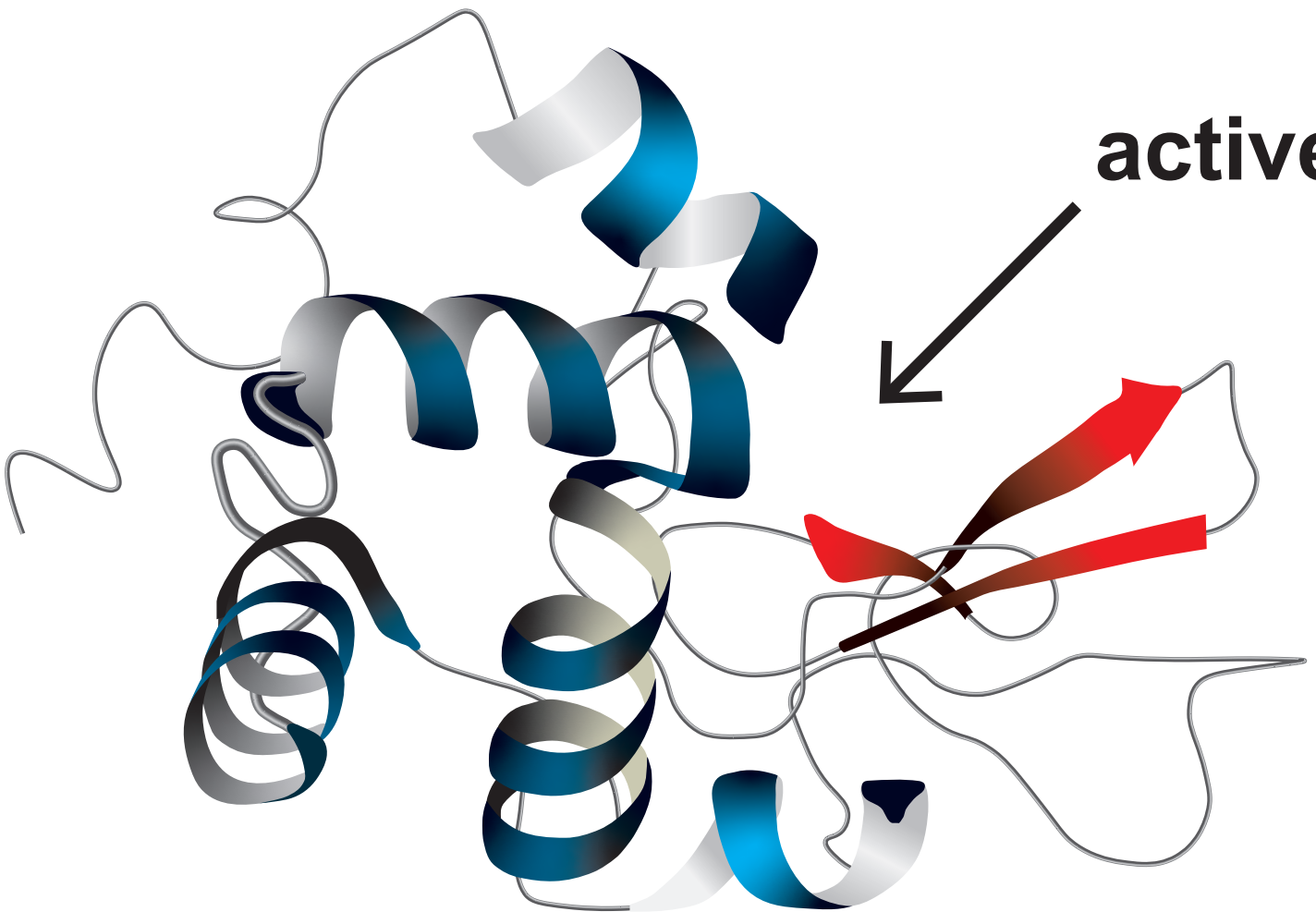
First name(s): _____

Centre Number: _____

Candidate Number: 2 _____

Question 1

IMAGE 1.1



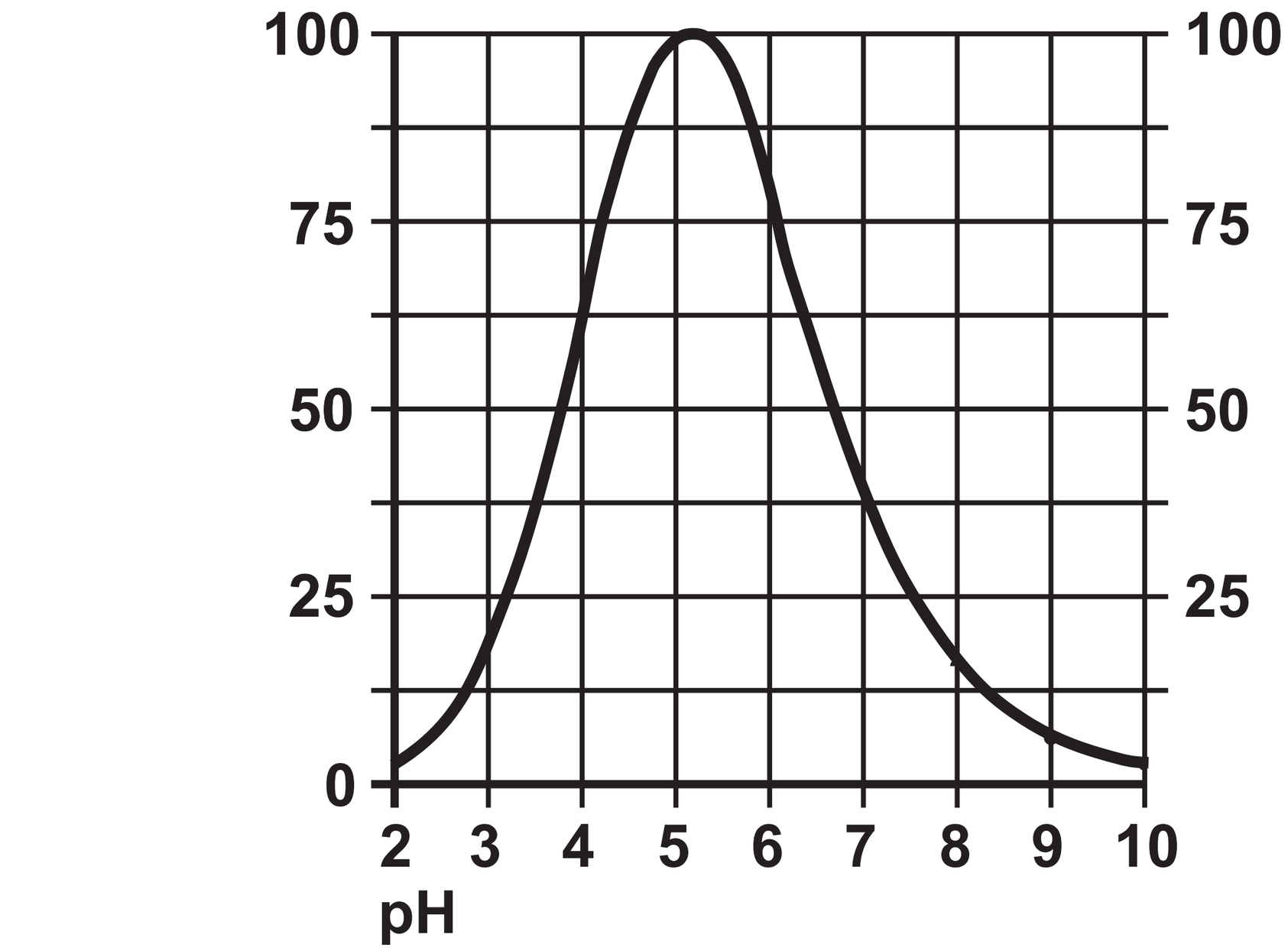
Question 1 (a) (ii)

TABLE 1.2

Level of structure	Explanation
Secondary	
Tertiary	

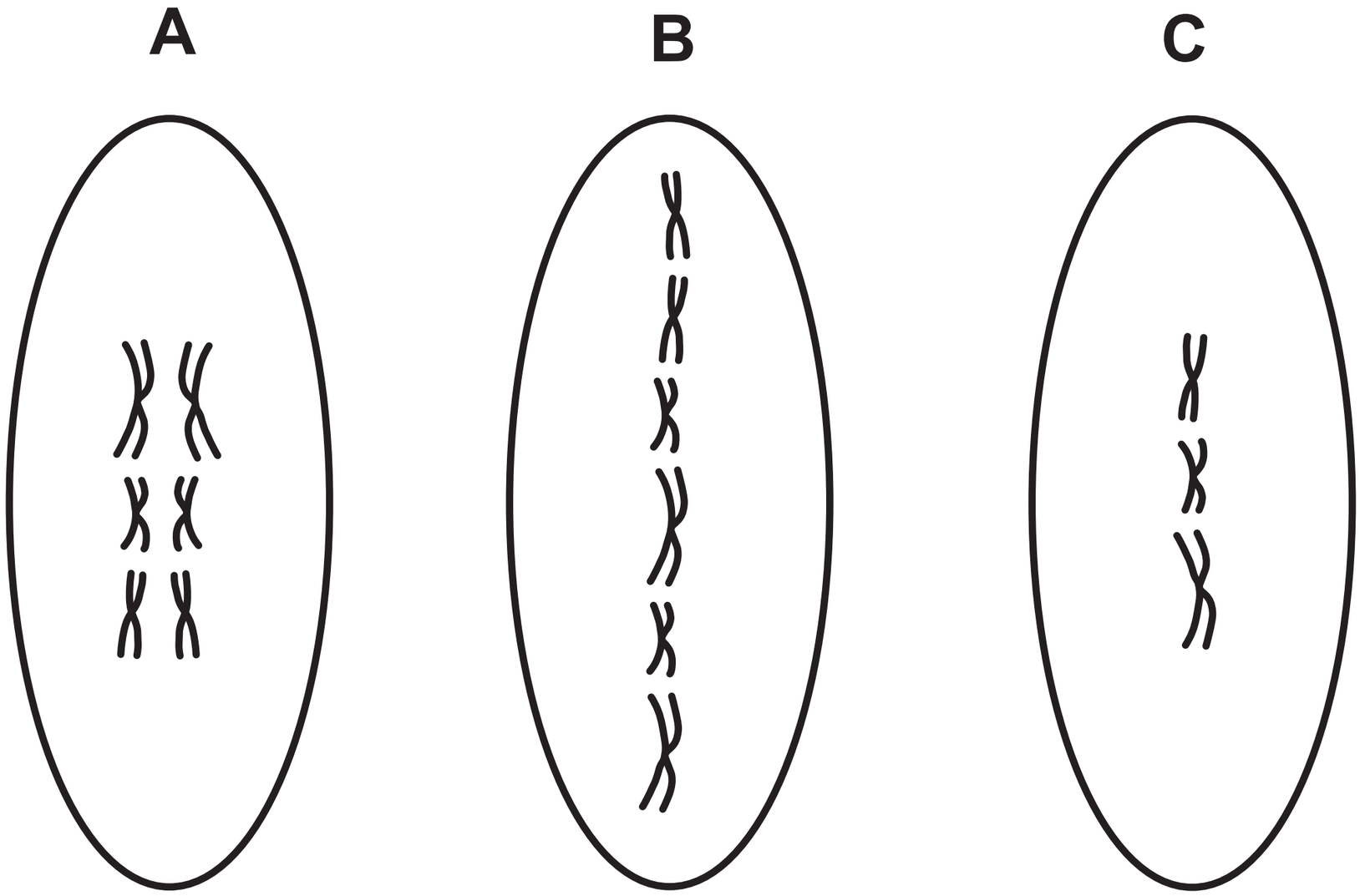
Question 1 (b)

GRAPH 1.3



Question 2

IMAGE 2.1



Question 2 (a) (ii)

Table

Difference	Mitosis	Meiosis
1		
2		

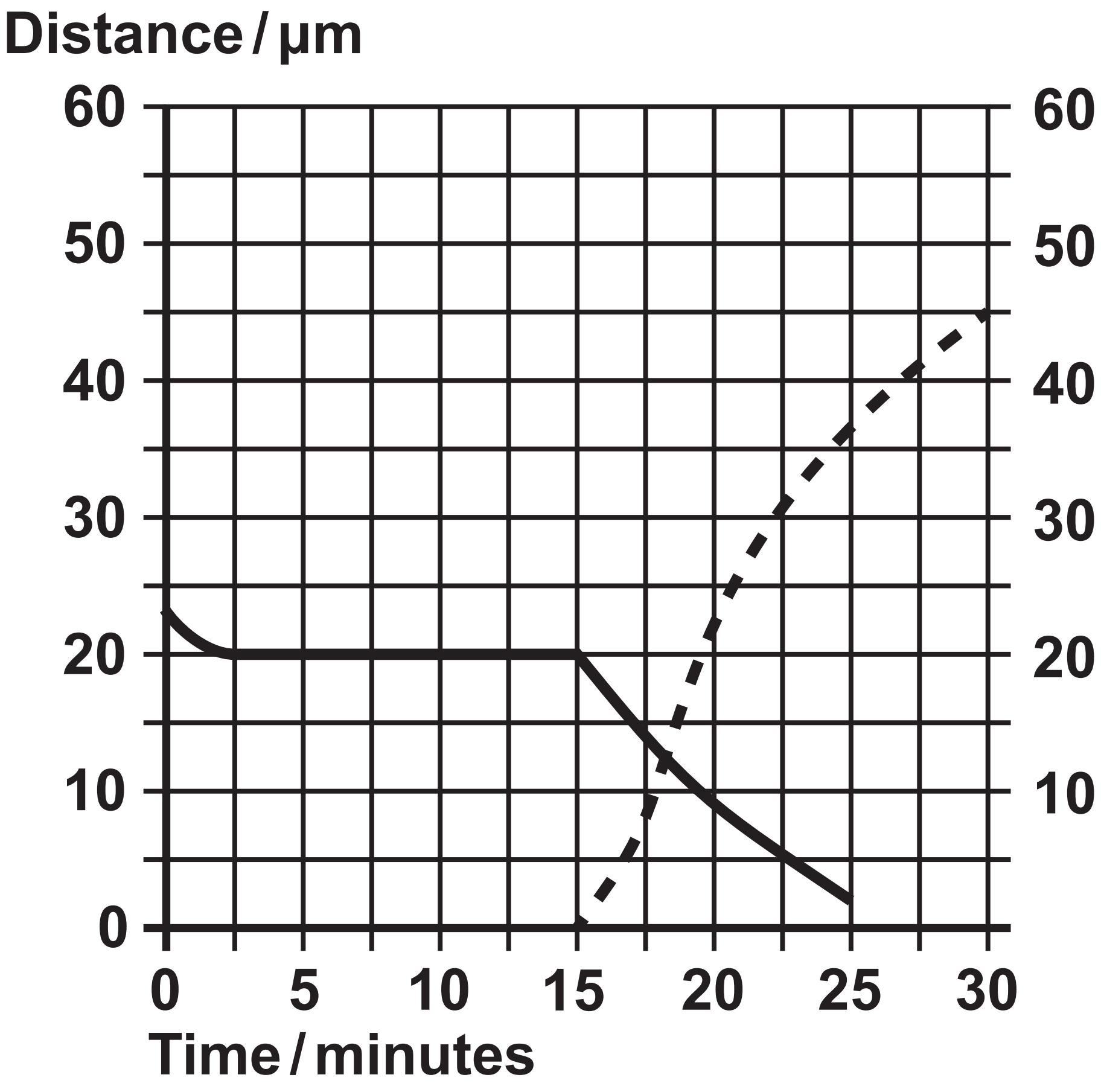
Question 2 (b)

GRAPH 2.2

Key:

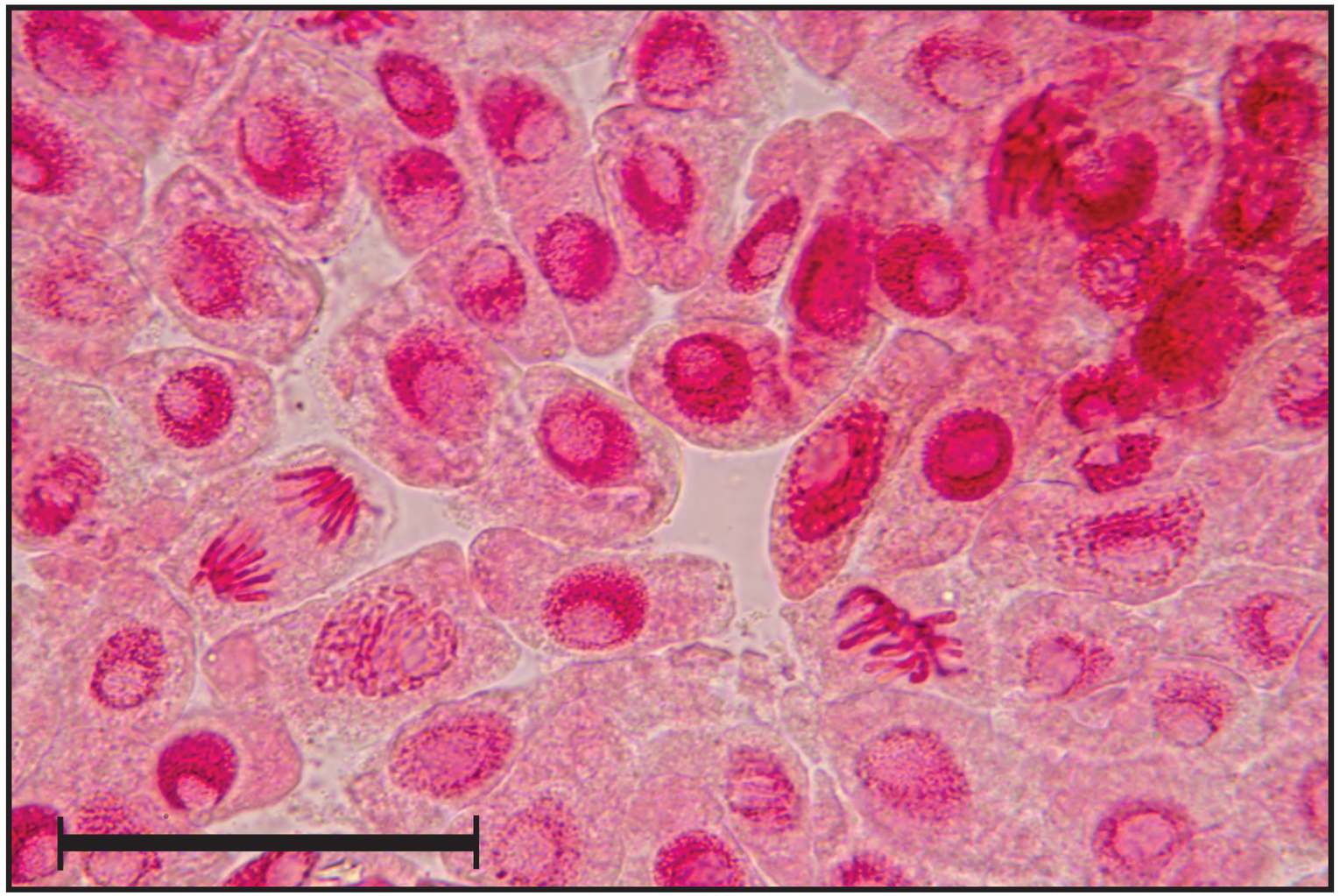
——— Distance between the centromeres and spindle poles.

- - - Distance between the centromeres of the sister chromatids



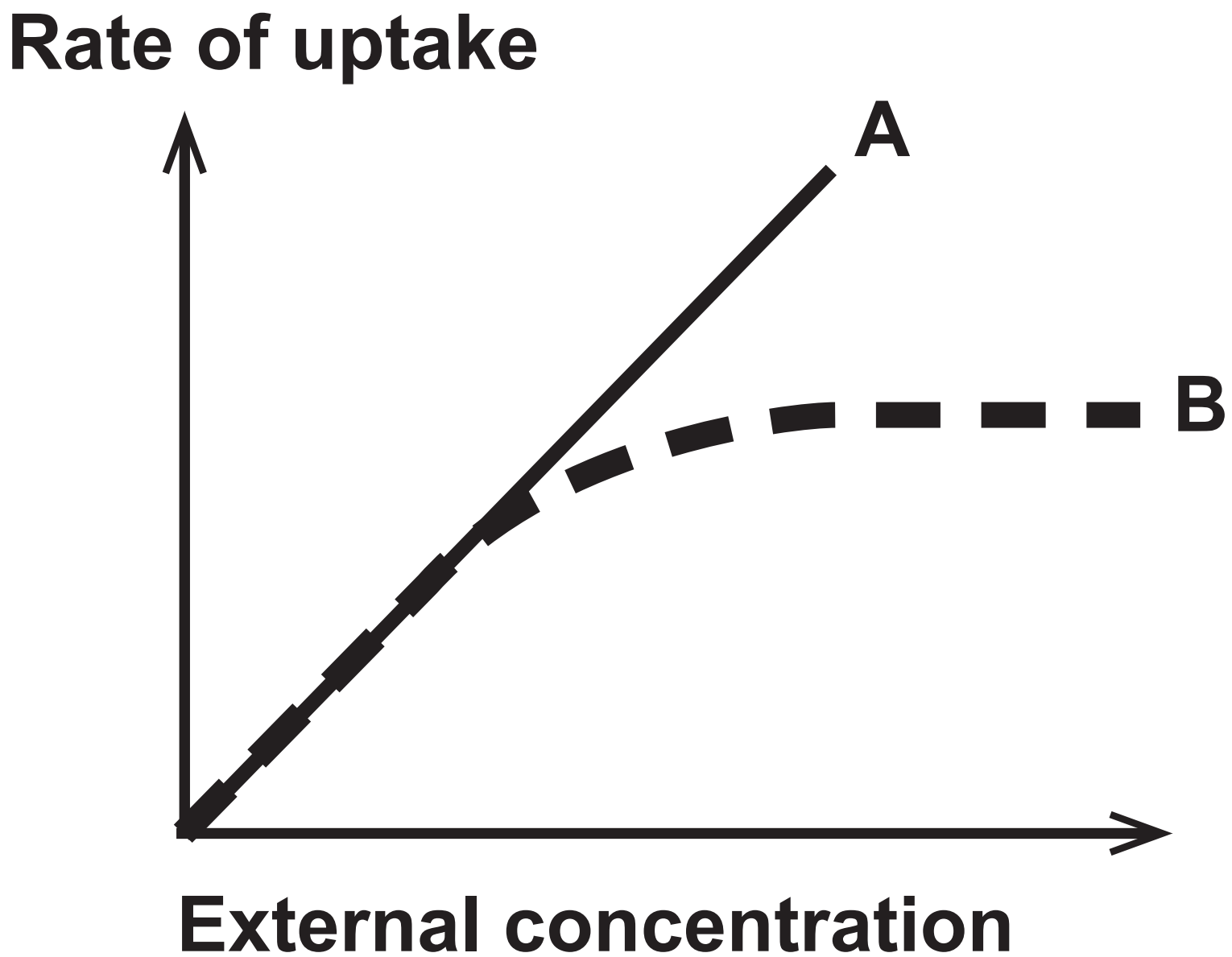
Question 2 (c)

IMAGE 2.3



Question 3 (a)

GRAPH 3.1



Question 3 (a) (i)

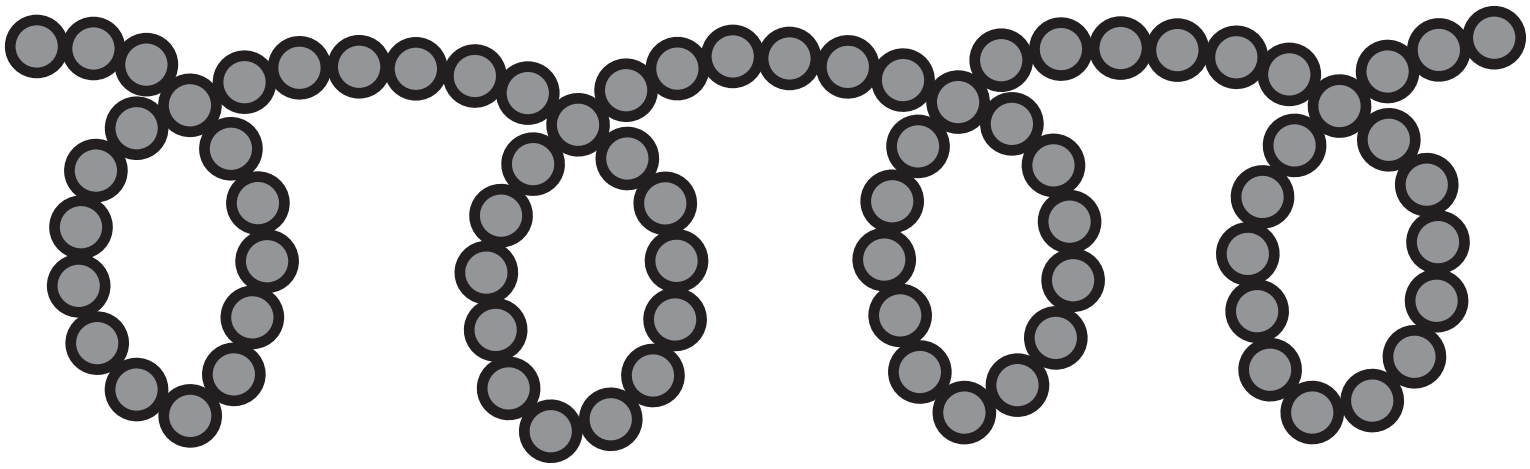
TABLE 3.2

Line	Substance	Type of transport
A	_____	_____ _____ _____
B	_____	_____ _____ _____

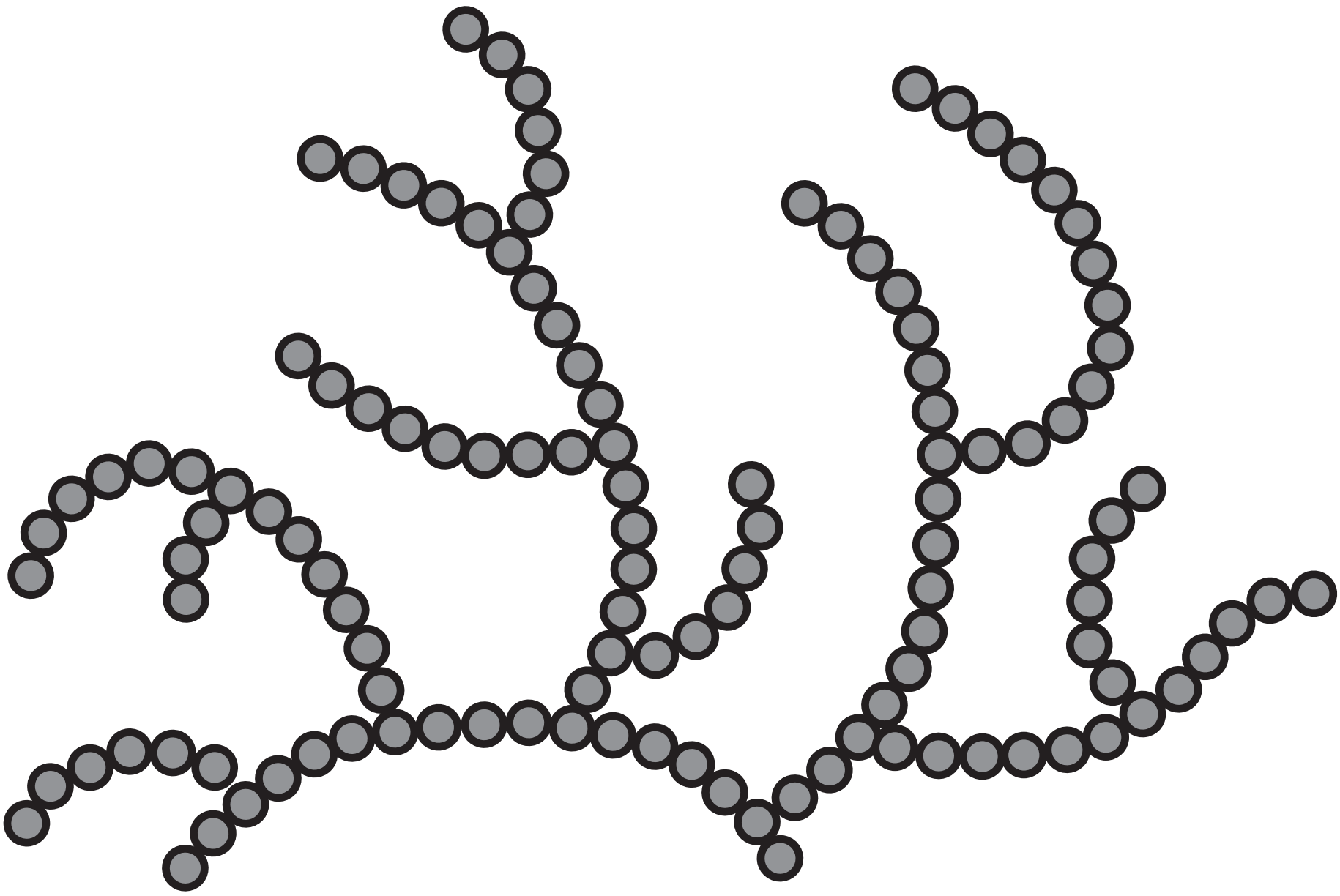
Question 4

IMAGE 4.1

Amylose

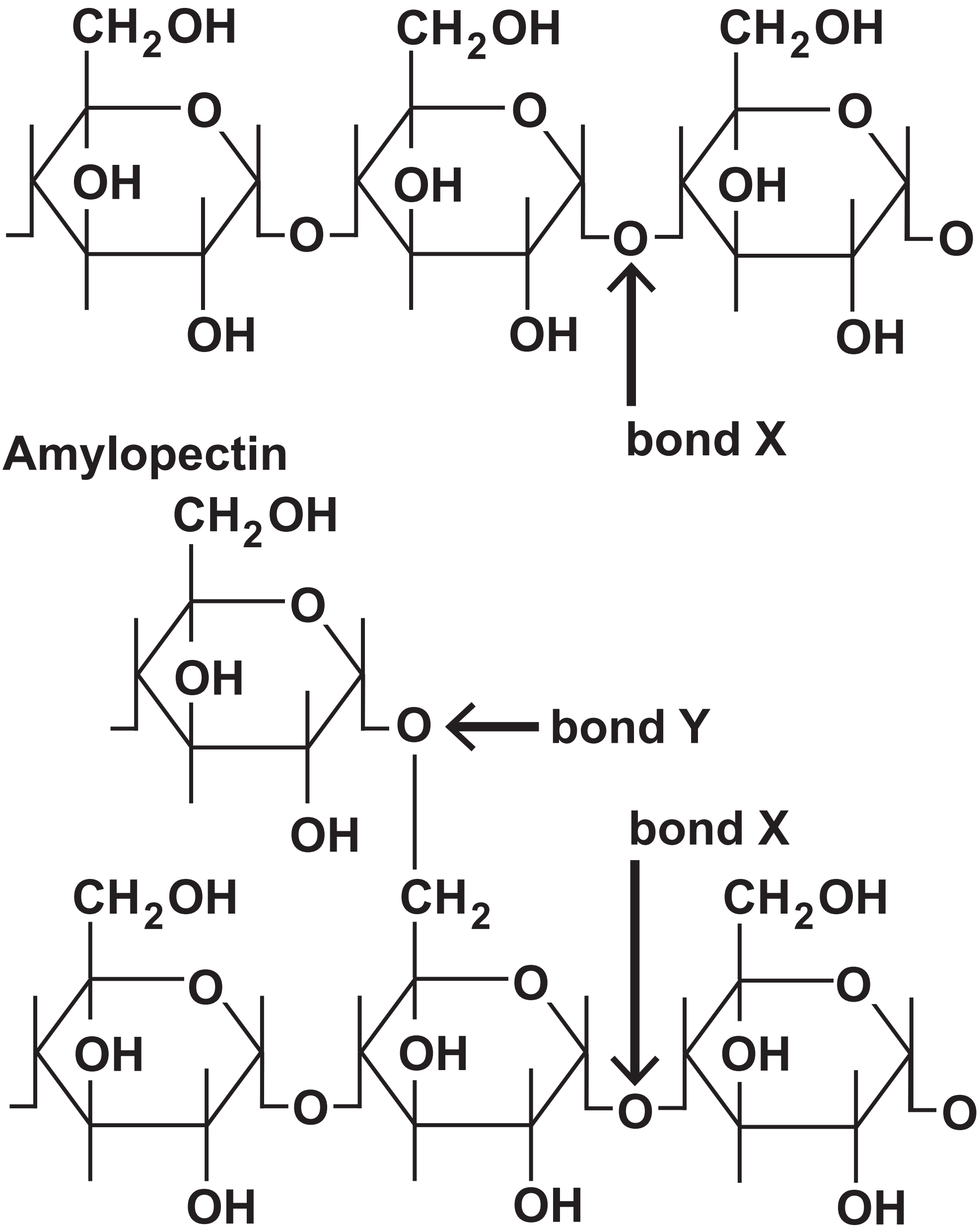


Amylopectin



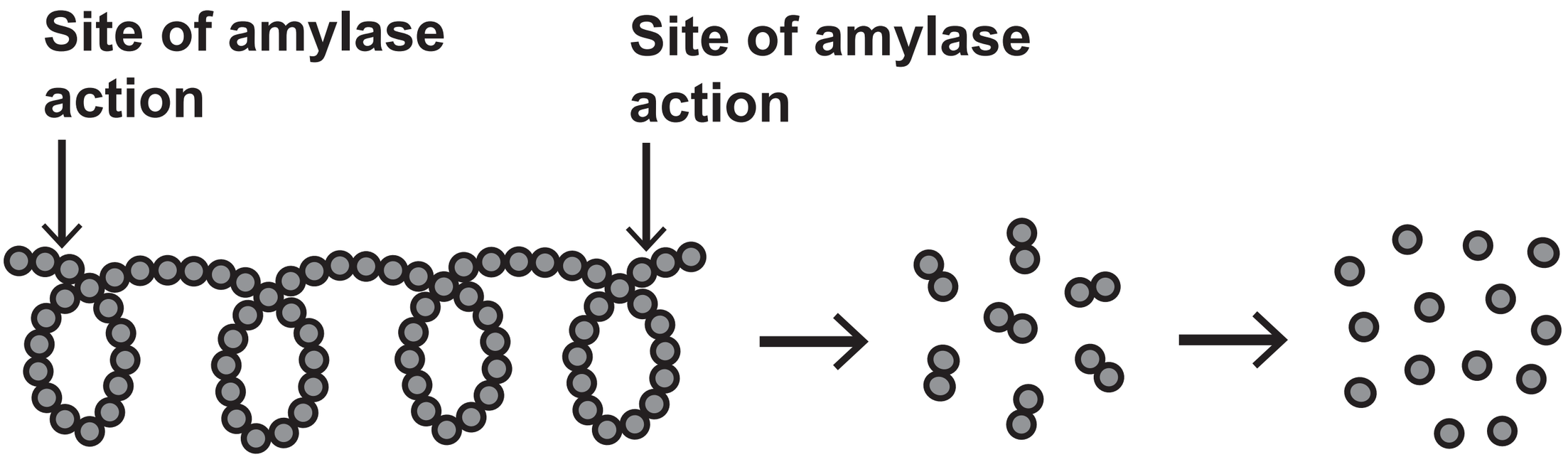
Question 4

IMAGE 4.2



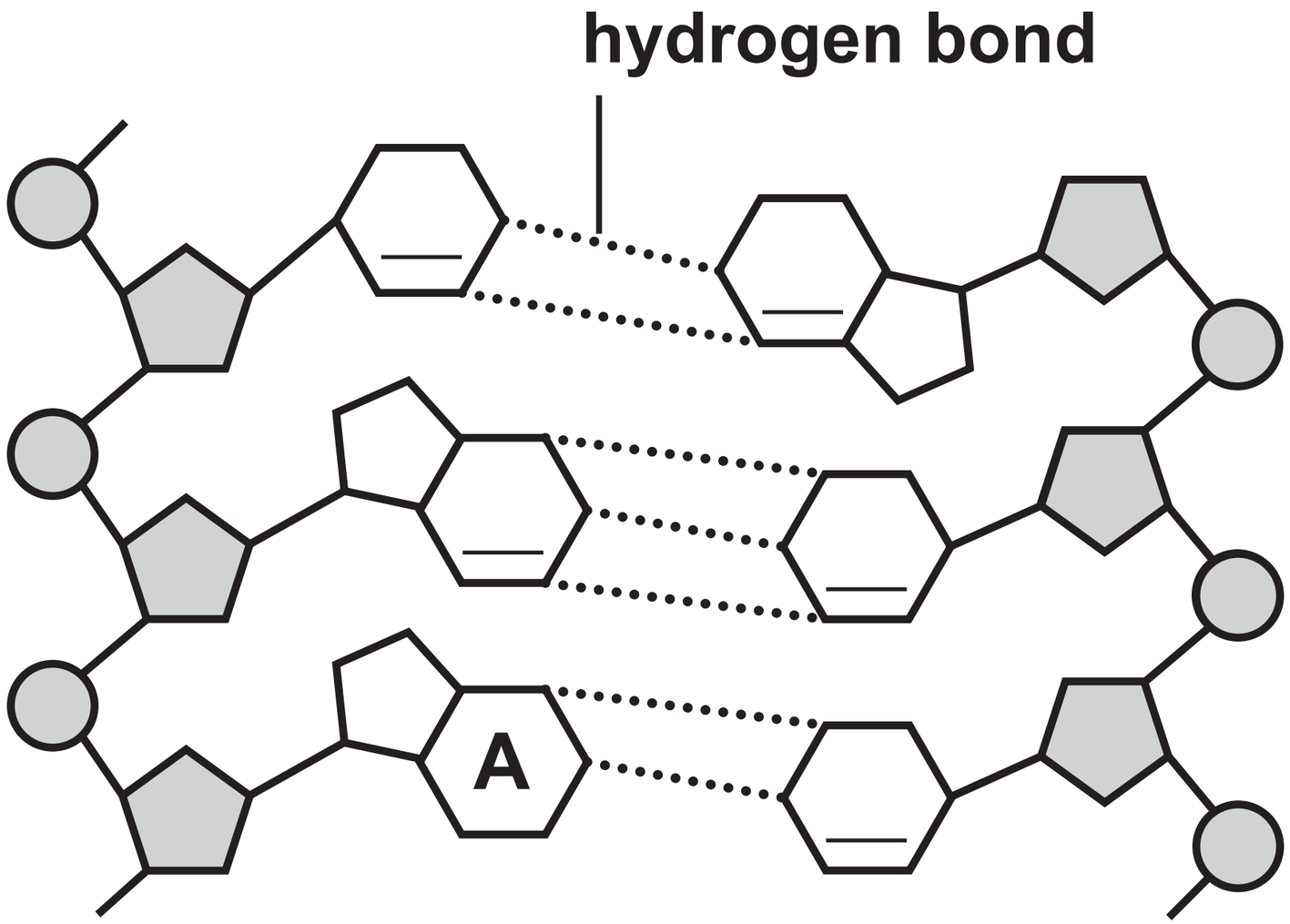
Question 4 (b)

IMAGE 4.3



Question 5 (a)

IMAGE 5.1



Question 5 (a) (iii)

TABLE 5.2

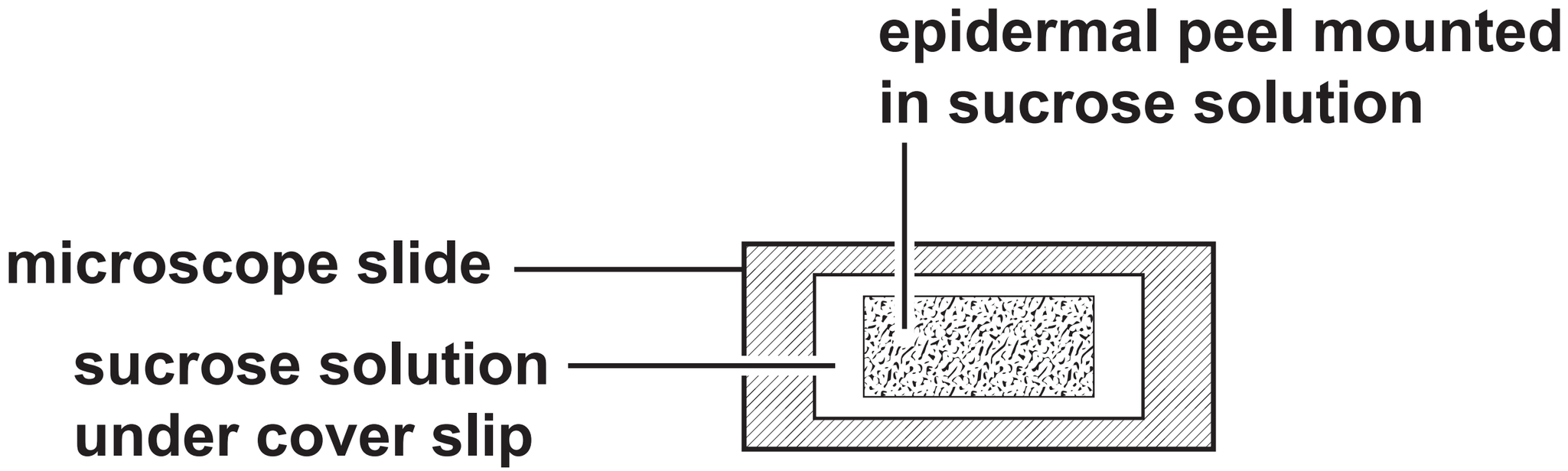
Organism	Percentage of base			
	Adenine	Guanine	Cytosine	Thymine
maize	26.8	22.8	23.2	27.2
chicken	28.0	22.0	21.6	28.4
yeast	31.3	18.7	17.1	32.9
sea urchin	32.8			

Question 6

IMAGE 6.1

Question 6

IMAGE 6.2



Question 6

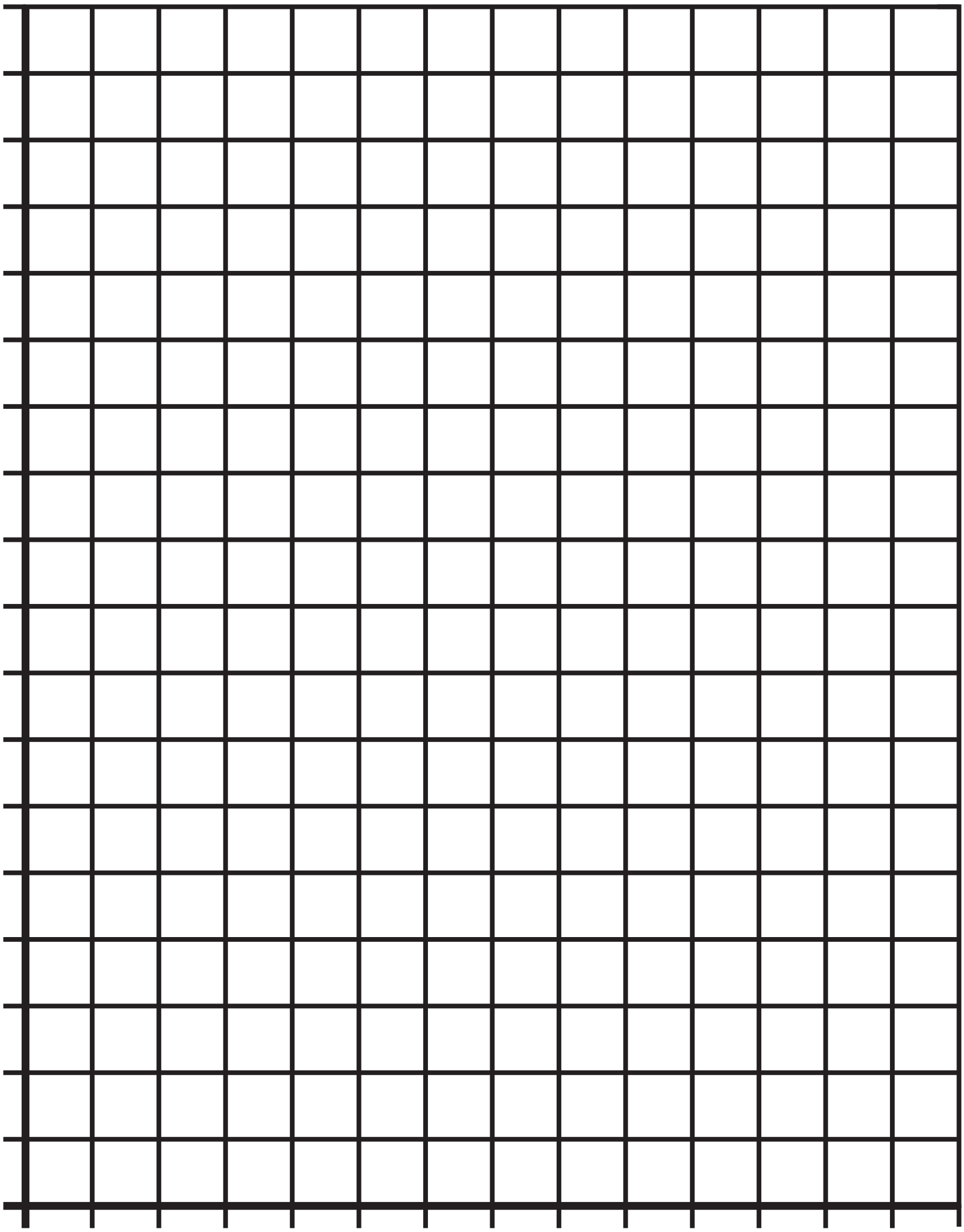
TABLE 6.3

Sucrose concentration / mol dm^{-3}	Number of plasmolysed cells	Number of unplasmolysed cells	Total cells counted	Percentage of cells plasmolysed
0.0	0	165	165	0
0.2	19	173	190	10
0.4	90	110	200	45
0.6	88	72	160	55
0.8	81	54	135	60
1.0	175	75		

Question 6 (a) (ii)

Blank grid

Plasmolysed cells (%)



Sucrose concentration (mol dm^{-3})

Question 6 (a) (iii)

Formula

Solute potential (ψs) = – (sucrose concentration × 24.35)