



GCE AS/A LEVEL

2400U10-1

FRIDAY, 20 MAY 2022 – AFTERNOON

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.	10	
2.	7	
3.	11	
4.	14	
5.	14	
6.	15	
7.	9	
Total	80	

(Turn over)

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.**

(Turn over)

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.

(Turn over)

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.

(Turn over)

ANSWER ALL QUESTIONS.

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

IMAGE 1.1 shows simple squamous epithelial tissue from the alveoli of the lungs.

- (a) Explain how the shape of the cells is adapted to their function within the tissue.**

[1 mark]
(Turn over)

Question 1 continued

- 1. (b) Look at IMAGE 1.2 for Question 1 (b) in the separate Diagram Booklet.**

IMAGE 1.2 shows a cross – section of the urinary bladder lined with stratified epithelial tissue with a variable number of cell layers.

IMAGE 1.2 shows this tissue when the bladder is relatively empty.

continued on the next page . . .

(Turn over)

Question 1 (a) continued

**1. (a) (i) Name the structure
labelled X on IMAGE 1.2**

[1 mark]

continued on the next page . . .

(Turn over)

Question 1 (b) continued

- 1. (b) (ii) State why the cells in
IMAGE 1.2 are referred to
as a “tissue”.**

[1 mark]

continued on the next page . . .

(Turn over)

Question 1 (b) continued

1. (b) (iii) Explain why some of the cells appear not to have a nucleus in IMAGE 1.2

[1 mark]

continued on the next page . . .

(Turn over)

Question 1 (b) continued

- 1. (b) (iv) With reference to IMAGE 1.1 and IMAGE 1.2 describe the main difference between the two types of epithelial tissue.**

[1 mark]

continued on the next page . . .

(Turn over)

Question 1 continued

- 1. (c) (i) When the bladder is full, the cells become wider and flatter. Suggest how this property of the epithelial tissue allows the bladder to perform its function.**

[1 mark]

continued on the next page . . .

(Turn over)

Question 1 (c) continued

- 1. (c) (ii) The width of cell A in IMAGE 1.2 is 50 μm . Cell A is shown at 42% of its maximum width. Calculate the maximum width of this cell. GIVE YOUR ANSWER TO THREE SIGNIFICANT FIGURES.**

Space for working:

(Turn over)

Question 1 (c) (ii) continued

Maximum width = _____ μm

[2 marks]

continued on the next page . . .

(Turn over)

Question 1 (c) continued

- 1. (c) (iii) With reference to the actual width of cell A, calculate the magnification of IMAGE 1.2**

Space for working:

(Turn over)

Question 1 (c) (iii) continued

Magnification = $\times$ _____

[2 marks]

(Total for Question 1 = 10 marks)

(Turn over)

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

IMAGE 2.1 shows a molecular model of a phospholipid, a component of cell membranes.

- (i) Structures A and B are both types of fatty acids. Identify both types and explain the difference in their shapes.

[2 marks]

continued on the next page . . .

(Turn over)

Question 2 (a) continued

- 2. (a) (ii) Look at IMAGE 2.2 for Question 2 (a) (ii) in the separate Diagram Booklet. IMAGE 2.2 shows two examples of phospholipid bilayers. Membrane 1 has phospholipids containing only type A fatty acids and membrane 2 has phospholipids containing both type A and type B.**

continued on the next page . . .

(Turn over)

Question 2 (a) (ii) continued

Using the information provided and your own knowledge, explain which membrane you would expect to be more permeable to small molecules.

[2 marks]

(Turn over)

Question 2 continued

- 2. (b) (i) Fatty acids are also found as part of triglycerides.**

State how triglycerides differ from phospholipids in their structure and in their function in cells.

(Turn over)

[2 marks]

continued on the next page . . .

(Turn over)

Question 2 (b) continued

2. (b) (ii) State how the relative proportions of type A and B fatty acids in the diet can affect human health.

[1 mark]

(Total for Question 2 = 7 marks)

(Turn over)

3. (a) In 1958 Meselson and Stahl conducted an investigation into DNA replication.

- Bacteria were grown in a culture medium that contained only the heavy isotope of nitrogen, ^{15}N . After many generations, the bacterial DNA contained only the heavy isotope of nitrogen.**

continued on the next page . . .

(Turn over)

Question 3 (a) continued

- **Some of the bacteria were then transferred to another culture medium containing only the lighter isotope of nitrogen, ^{14}N .**
- **DNA was extracted from the bacteria and centrifuged at the START (before cell division), and then after 1, 2 and 3 cell divisions. Heavier DNA was found towards the bottom of the tube after centrifuging.**

continued on the next page . . .

(Turn over)

Question 3 (a) continued

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

**IMAGE 3.1 shows the
distribution of DNA in the tubes
at the start and after Division 1
and Division 2.**

**The graphs represent the
relative densities of DNA but
they are not in the correct order.**

continued on the next page . . .

(Turn over)

Question 3 (a) continued

- 3. (a) (i) DRAW LINES on IMAGE 3.1 to match up the tubes with the correct graphs.**

[1 mark]

- (ii) Look at IMAGE 3.2 for Question 3 (a) (ii) in the separate Diagram Booklet. IMAGE 3.2 is a grid.**

On the grid, SKETCH THE GRAPH you would expect to see for Division 3.

[3 marks]

continued on the next page . . .

(Turn over)

Question 3 continued

- 3. (b) Look at IMAGE 3.3 for Question 3 (b) in the separate Diagram Booklet.**

IMAGE 3.3 shows a DNA replication fork.

- (i) On IMAGE 3.3, mark the position of ONE molecule of DNA polymerase with the letter X.**

[1 mark]

continued on the next page . . .

(Turn over)

Question 3 (b) continued

3. (b) (ii) Describe the role of DNA helicase in this process.

[1 mark]

continued on the next page . . .

(Turn over)

Question 3 (b) continued

3. (b) (iii) Explain how IMAGE 3.3 shows that DNA is replicated by a semi – conservative mechanism.

(Turn over)

[2 marks]

continued on the next page . . .

(Turn over)

Question 3 continued

- 3. (c) DNA polymerase has a proof – reading function, this means that it will check that it has replicated the DNA correctly and repair it if it is incorrectly synthesised. Use your knowledge of protein synthesis to suggest the importance of the proof – reading role to the organism.**
-
-
-

(Turn over)

[illegible]

(Turn over)

[3 marks]

(Total for Question 3 = 11 marks)

(Turn over)

- 4. Beetroot contains a red pigment called betalain, which is stored within the cell vacuole. When the cell membranes are disrupted the pigment leaks out into the surrounding solution, colouring it red.**

Some students investigated the permeability of the membranes of beetroot cells. A colorimeter was used to measure the absorbance of the surrounding solution.

The absorbance of the solution is proportional to the concentration of betalain.

continued on the next page . . .

(Turn over)

Question 4 continued

The students made the following prediction:

“The absorbance recorded will be directly proportional to the temperature of incubation.”

The experiment was carried out as follows:

- 6 cubes of fresh beetroot were washed in cold water for 1 minute.**
- The cubes were transferred into separate boiling tubes, each containing 20 cm³ of water.**

continued on the next page . . .

(Turn over)

Question 4 continued

- **The boiling tubes were incubated for 10 minutes in beakers at different temperatures which were maintained with the addition of hot or cold water.**
- **3 cm³ of water from around the beetroot cubes was removed and a colorimeter was used to measure the absorbance, at 540 nm, of each solution.**

continued on the next page . . .

(Turn over)

Question 4 continued

The experiment was repeated three times, the results are shown in TABLE 4.1 provided for Question 4 in the separate Diagram Booklet.

- 4. (a) (i) State which temperature provided the most reliable results and use your knowledge of cell structure to explain why this might be the case.**

(Turn over)

[2 marks]

continued on the next page . . .

(Turn over)

Question 4 (a) continued

- 4. (a) (ii) Look at GRAPH 4.2 for
Question 4 (a) (ii) in the
separate Diagram Booklet.**

**Plot the mean results from
TABLE 4.1 on GRAPH 4.2**

[3 marks]

continued on the next page . . .

(Turn over)

Question 4 (a) continued

- 4. (a) (iii) Explain why the students' prediction was not entirely correct.**

[1 mark]

continued on the next page . . .

(Turn over)

Question 4 (a) continued

**4. (a) (iv) Use your knowledge of
cell membrane structure
to explain the shape of
GRAPH 4.2**

(Turn over)

[2 marks]

continued on the next page . . .

(Turn over)

Question 4 continued

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

Another group of students investigated how the type of surrounding solution affected the permeability of membranes in beetroot. They tested water, acid and ethanol. IMAGE 4.3 shows the experiment after incubation at 20°C for 10 minutes.

continued on the next page . . .

(Turn over)

Question 4 (b) continued

- 4. (b) (i) Using your knowledge of the structure of membranes, conclude how both ACID and ETHANOL affect the membrane and explain the appearance of the solution in these tubes.**

(Turn over)

[3 marks]

continued on the next page . . .

(Turn over)

Question 4 (b) continued

4. (b) (ii) The students also noted that the beetroot in the water had increased in size. Explain this observation.

(Turn over)

47

[3 marks]

(Total for Question 4 = 14 marks)

(Turn over)

- 5. Human milk contains all the nutrients a young baby needs in exactly the right proportions. It is formed in the mammary glands by small groups of milk – producing cells in structures called lobules. These cells absorb molecules from the blood and use them to synthesise the lipids, carbohydrates and proteins found in milk.**

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

IMAGE 5.1 shows a milk – producing cell.

continued on the next page . . .

(Turn over)

Question 5 continued

Lactose is synthesised in the Golgi body and is transported in vesicles through the cytoplasm. The vesicles increase in diameter as they move towards the plasma membrane. The vesicle membranes fuse with the plasma membrane and the vesicles empty their contents out of the cell. Lipids are also secreted in droplets.

continued on the next page . . .

(Turn over)

Question 5 continued

- 5. (a) Use the information provided and your own knowledge to answer the following questions.**
- (i) State the name of the process by which the vesicles empty their contents out of the milk – producing cell.**
-
-

[1 mark]

continued on the next page . . .

(Turn over)

Question 5 (a) continued

**5. (a) (ii) Identify the organelle
labelled A and explain
its role in the function of
this cell.**

[2 marks]

continued on the next page . . .

(Turn over)

Question 5 (a) continued

5. (a) (iii) Use IMAGE 5.1 to suggest how the cell avoids a continual increase in the area of its cell surface membrane.

[1 mark]

continued on the next page . . .

(Turn over)

Question 5 continued

- 5. (b) Look at IMAGE 5.2 for Question 5 (b) in the separate Diagram Booklet.**

The main carbohydrate in milk is lactose. IMAGE 5.2 shows a molecule of lactose.

- (i) COMPLETE IMAGE 5.2 in the space provided on the diagram to show the digestion of lactose.**

[2 marks]

continued on the next page . . .

(Turn over)

Question 5 (b) continued

5. (b) (ii) State:

I. the type of reaction;

[1 mark]

**II. the names of the
products of digestion
of lactose.**

[1 mark]

continued on the next page . . .

(Turn over)

Question 5 continued

- 5. (c) Some people are lactose intolerant and in recent years it has been possible to produce lactose free milk and milk products using the enzyme lactase.**

One way to do this is to pour the milk through a column of alginate beads containing immobilised lactase.

continued on the next page . . .

(Turn over)

Question 5 (c) continued

**Look at GRAPH 5.3 for
Question 5 (c) in the separate
Diagram Booklet.**

**GRAPH 5.3 shows the activity
of free lactase and immobilised
lactase at different temperatures.**

continued on the next page . . .

(Turn over)

Question 5 (c) continued

5. (c) (i) Using GRAPH 5.3 and your own knowledge, compare the relative lactase activity of the free and immobilised lactase at the following temperatures.

Explain each answer.

I. Below 50°C.

(Turn over)

[2 marks]

5. (c) (i) II. Above 50°C.

(Turn over)

[3 marks]

continued on the next page . . .

(Turn over)

Question 5 (c) continued

**5. (c) (ii) Lactose is a reducing sugar.
Explain why it is not
possible to use Benedict's
reagent to monitor the
progress of the digestion
of lactose by lactase.**

(Turn over)

61

[1 mark]

(Total for Question 5 = 14 marks)

(Turn over)

- 6. Fibrinogen is a soluble glycoprotein produced in liver cells and secreted into the plasma. It contains three types of polypeptide chain.**

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

IMAGE 6.1 shows the formation and secretion of fibrinogen.

continued on the next page . . .

(Turn over)

Question 6 continued

6. (a) Use IMAGE 6.1 and your knowledge of proteins and protein synthesis to answer the following questions.

(i) Name the highest level of protein structure shown by fibrinogen.

[1 mark]

continued on the next page . . .

(Turn over)

Question 6 (a) continued

6. (a) (ii) Explain the role of the rough endoplasmic reticulum in the production of fibrinogen.

[2 marks]

continued on the next page . . .

(Turn over)

Question 6 (a) continued

6. (a) (iii) Suggest the role of the Golgi body in the production of fibrinogen.

(Turn over)

[2 marks]

continued on the next page . . .

(Turn over)

Question 6 continued

- 6. (b) Look at IMAGE 6.2 for Question 6 (b) in the separate Diagram Booklet.**

Thrombin is an enzyme which is secreted into blood plasma when tissues are damaged.

It catalyses the conversion of fibrinogen, in plasma, into the insoluble, fibrous protein, fibrin. Fibrin seals wounds in tissue. This is represented in IMAGE 6.2.

continued on the next page . . .

(Turn over)

Question 6 (b) continued

**Fibrin is a fibrous protein,
fibrinogen is a globular protein.**

**Using the information provided,
explain how the conversion of
fibrinogen to fibrin allows the
formation of a blood clot.**

(Turn over)

[3 marks]

continued on the next page . . .

(Turn over)

Question 6 continued

- 6. (c) Look at IMAGE 6.3 and
IMAGE 6.4 for Question 6 (c)
in the separate Diagram Booklet.**

**Thrombin catalyses the
hydrolysis of an
arginine – glycine bond in
fibrinogen as shown in
IMAGE 6.3**

continued on the next page . . .

(Turn over)

Question 6 (c) continued

Name the type of bond broken in IMAGE 6.3 and explain why thrombin can catalyse this reaction, but it would not catalyse the breaking of a glycine – arginine bond as shown in IMAGE 6.4

[2 marks]
(Turn over)

Question 6 continued

- 6. (d) Leeches are organisms which feed by sucking blood. Their saliva contains many components, including a protein called hirudin.**

Look at GRAPH 6.5 for Question 6 (d) in the separate Diagram Booklet.

GRAPH 6.5 shows the inhibitory effect of hirudin on the activity of thrombin.

continued on the next page . . .

(Turn over)

Question 6 (d) continued

- 6. (d) (i) Using your knowledge of enzymes, identify and explain the type of inhibition shown by hirudin and suggest how hirudin enables the leech to feed effectively.**

(Turn over)

[4 marks]

continued on the next page . . .

(Turn over)

Question 6 (d) continued

- 6. (d) (ii) Leeches for medical use
are farmed in South Wales
as a source of hirudin.
Suggest a use for hirudin
in medicine.**

[1 mark]

(Total for Question 6 = 15 marks)

(Turn over)

- 7. Look at IMAGE 7.1 for Question 7 in the separate Diagram Booklet. A eukaryotic cell cycle is represented in IMAGE 7.1**

When looking at a group of cells under the microscope, cells undergoing mitosis can be seen as they will have visible chromosomes.

Look at the formula for Question 7 in the separate Diagram Booklet. The mitotic index, which represents the proportion of cells undergoing mitosis within a group of cells, can be calculated as shown.

continued on the next page . . .

(Turn over)

Question 7 continued

Cyclins are a family of regulatory proteins that control the progression of the cell cycle.

The concentration of cyclin B peaks at the start of mitosis before dropping rapidly as the cells exit mitosis. Some mutations result in abnormally high concentrations of cyclin B.

continued on the next page . . .

(Turn over)

Question 7 continued

Describe the events occurring during interphase that are necessary before mitosis can occur.

Using examples, explain why some tissues in humans naturally have a higher mitotic index than others.

Suggest and explain the possible effects of abnormally high concentrations of cyclin B.

(Turn over)

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(Turn over)

(Turn over)

[illegible]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

(Turn over)

[illegible]

(Turn over)

(Turn over)

(Turn over)

[illegible]

(Turn over)

[illegible]

(Turn over)

(Turn over)

(Turn over)

91

[9 marks QER]

(Total for Question 7 = 9 marks)

END OF PAPER

TOTAL 80 MARKS

(Turn over)

[illegible]

(Turn over)

[illegible]

(Turn over)

[illegible]

(Turn over)

[illegible]



GCE AS/A LEVEL

2400U10-1

FRIDAY, 20 MAY 2022 – AFTERNOON

**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: _____

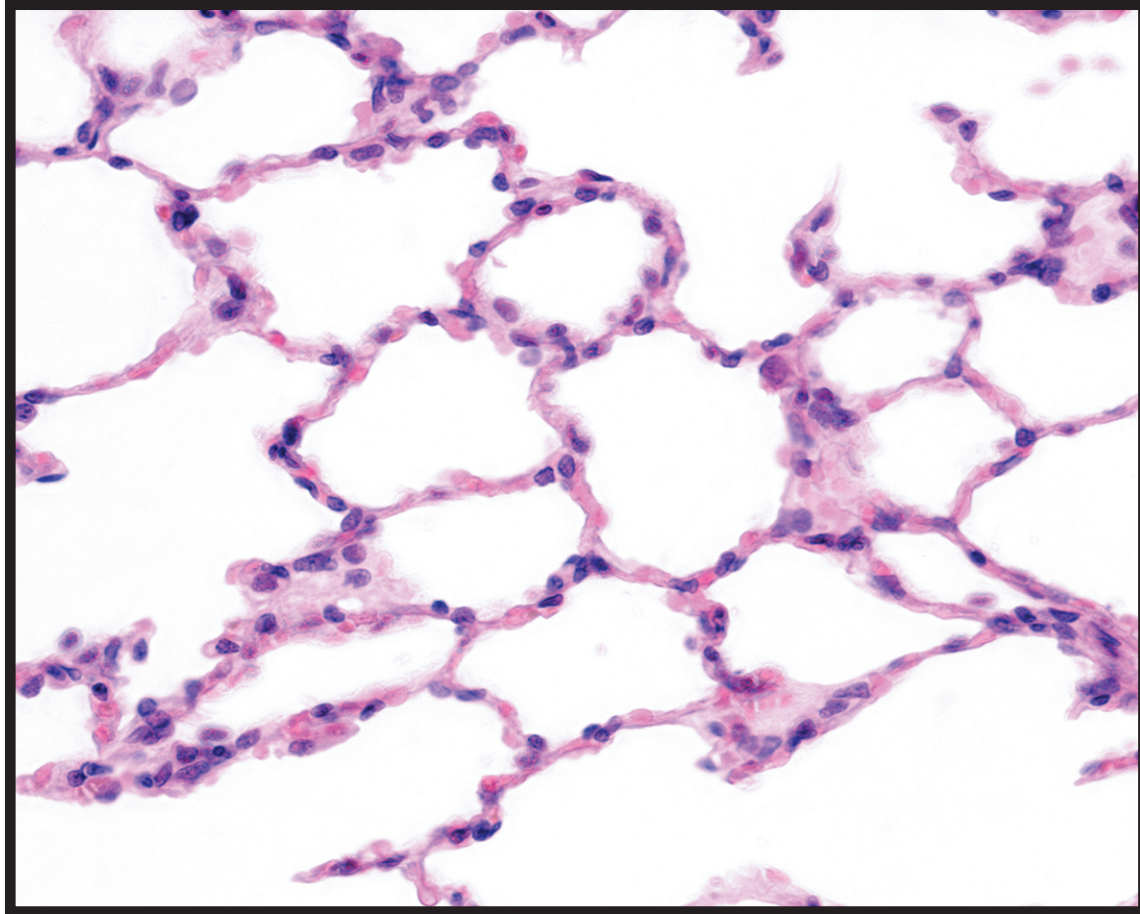
First name(s): _____

Centre Number: _____

Candidate Number: 2

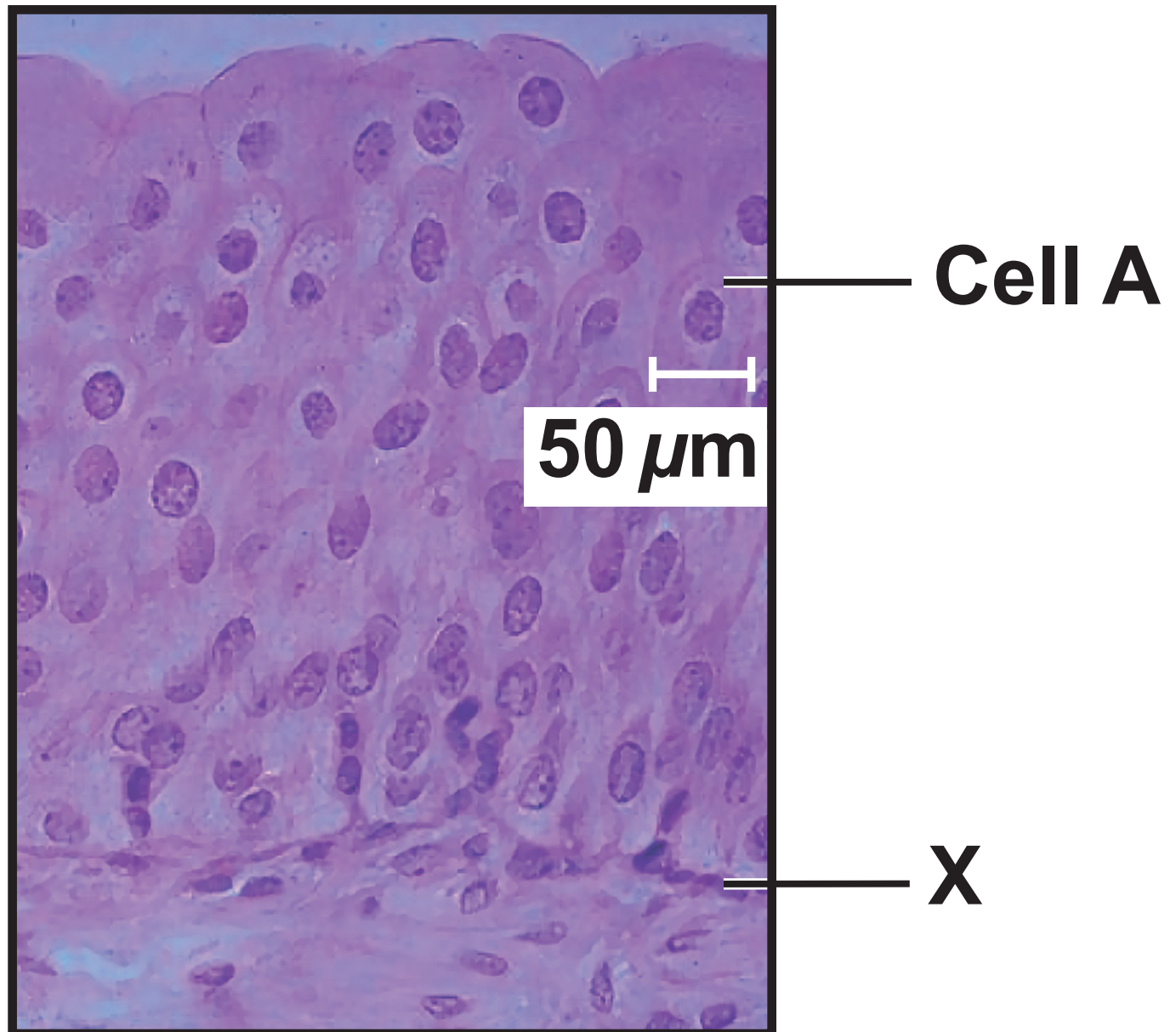
Question 1

IMAGE 1.1



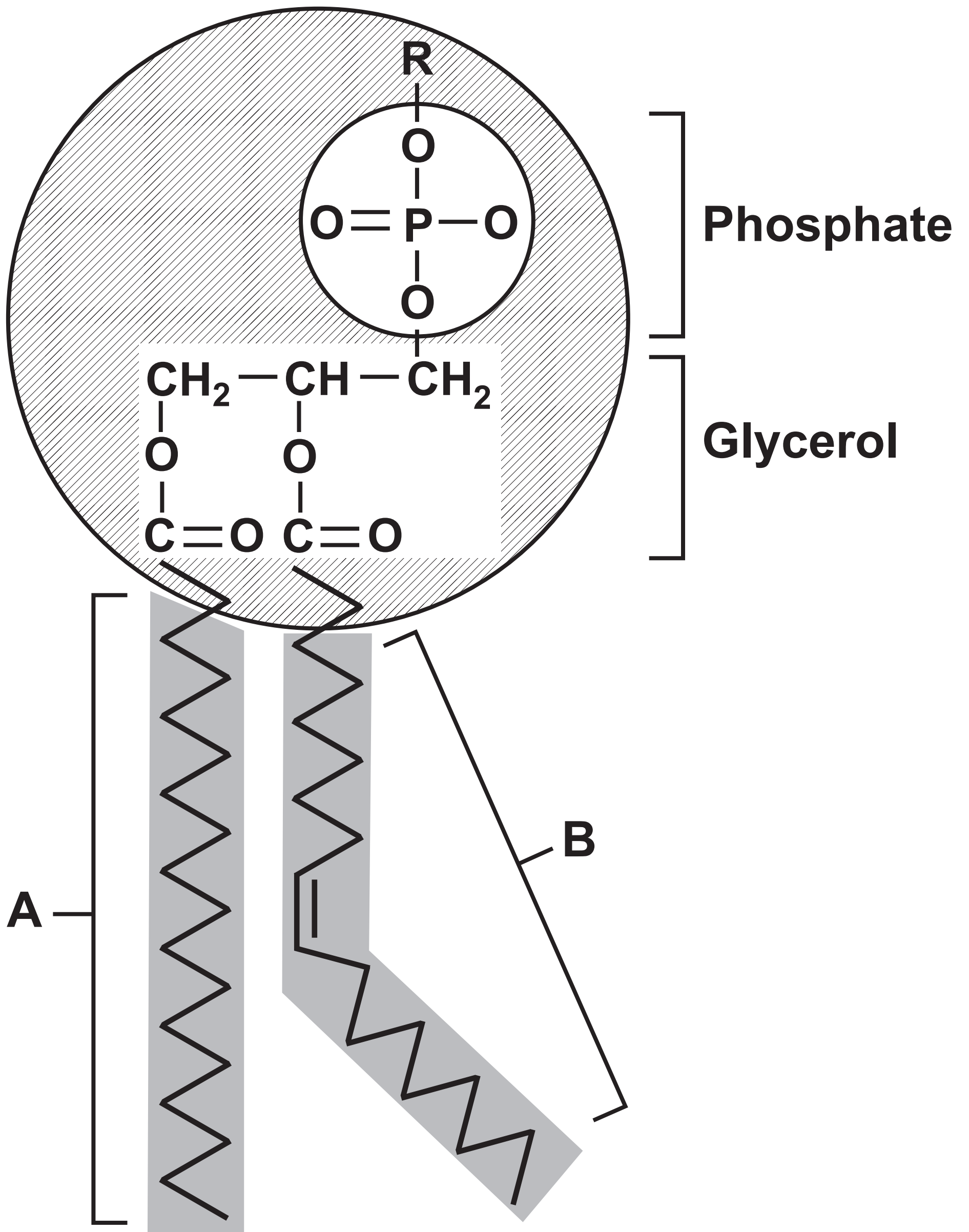
Question 1 (b)

IMAGE 1.2



Question 2 (a)

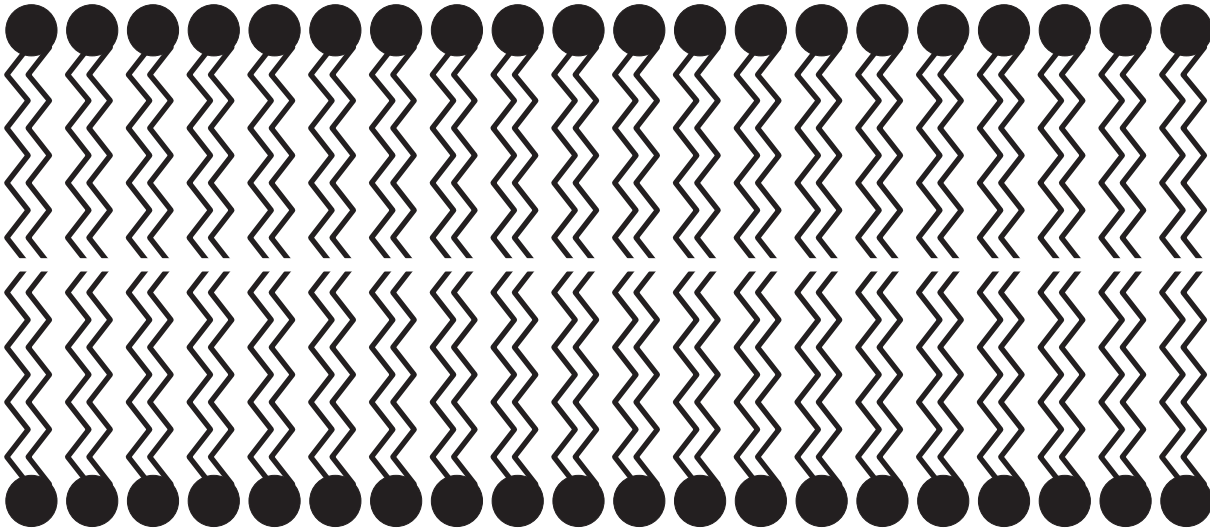
IMAGE 2.1



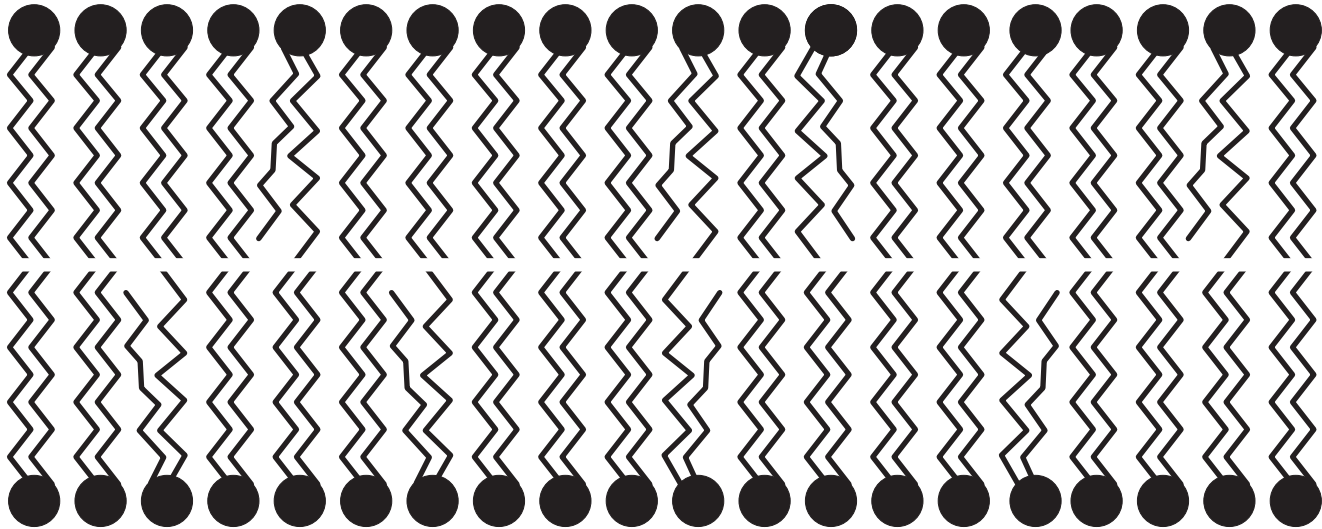
Question 2 (a) (ii)

IMAGE 2.2

Membrane 1



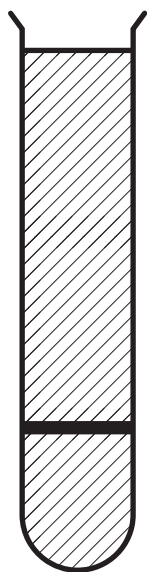
Membrane 2



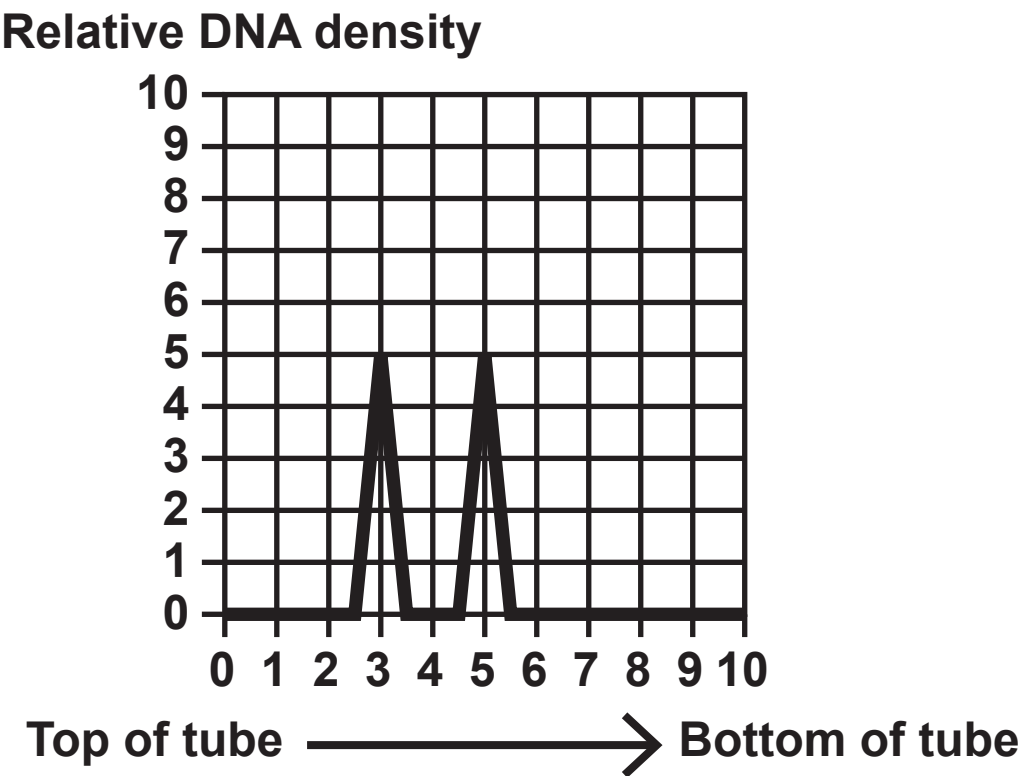
Question 3 (a)

IMAGE 3.1

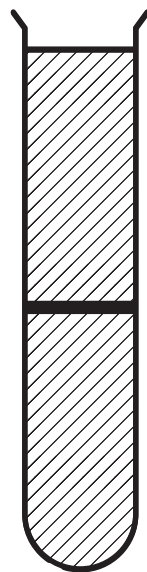
TUBE – Start



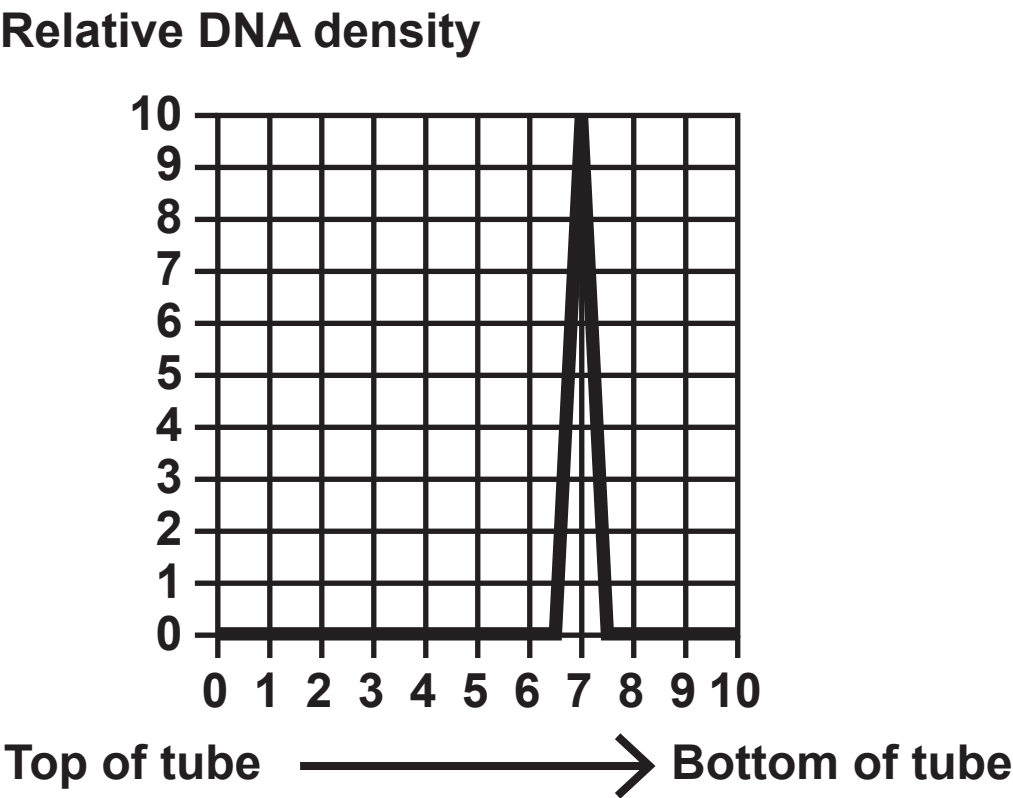
Graph A



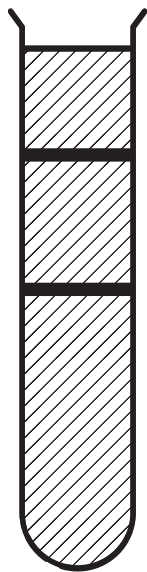
TUBE – Division 1



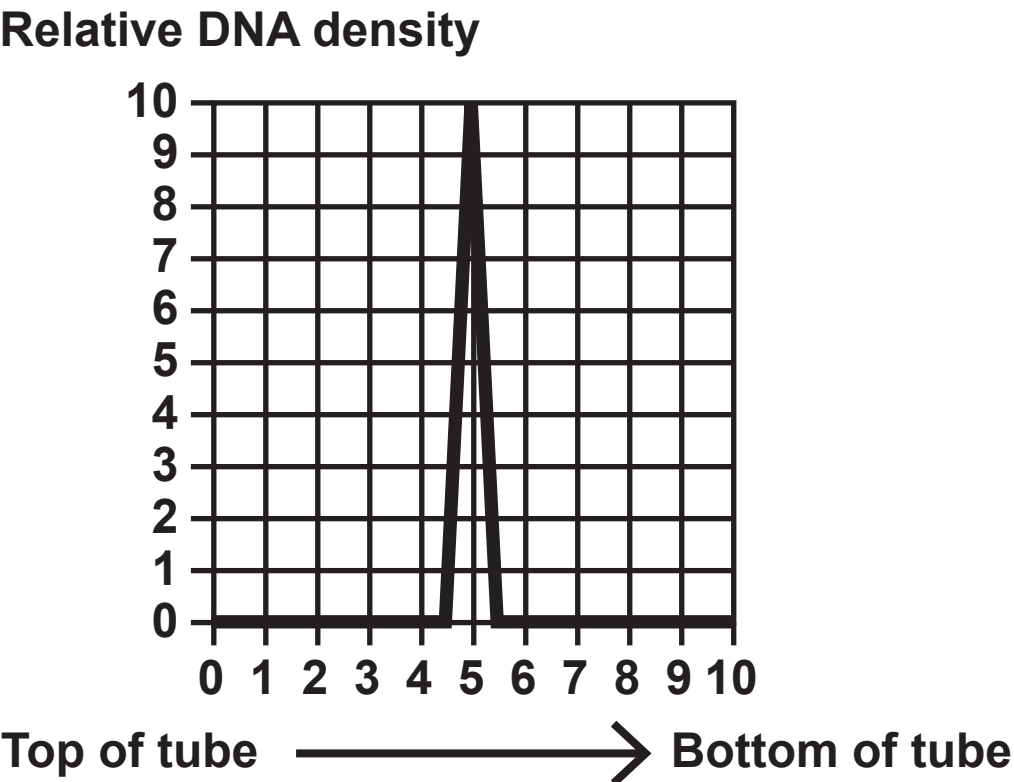
Graph B



TUBE – Division 2



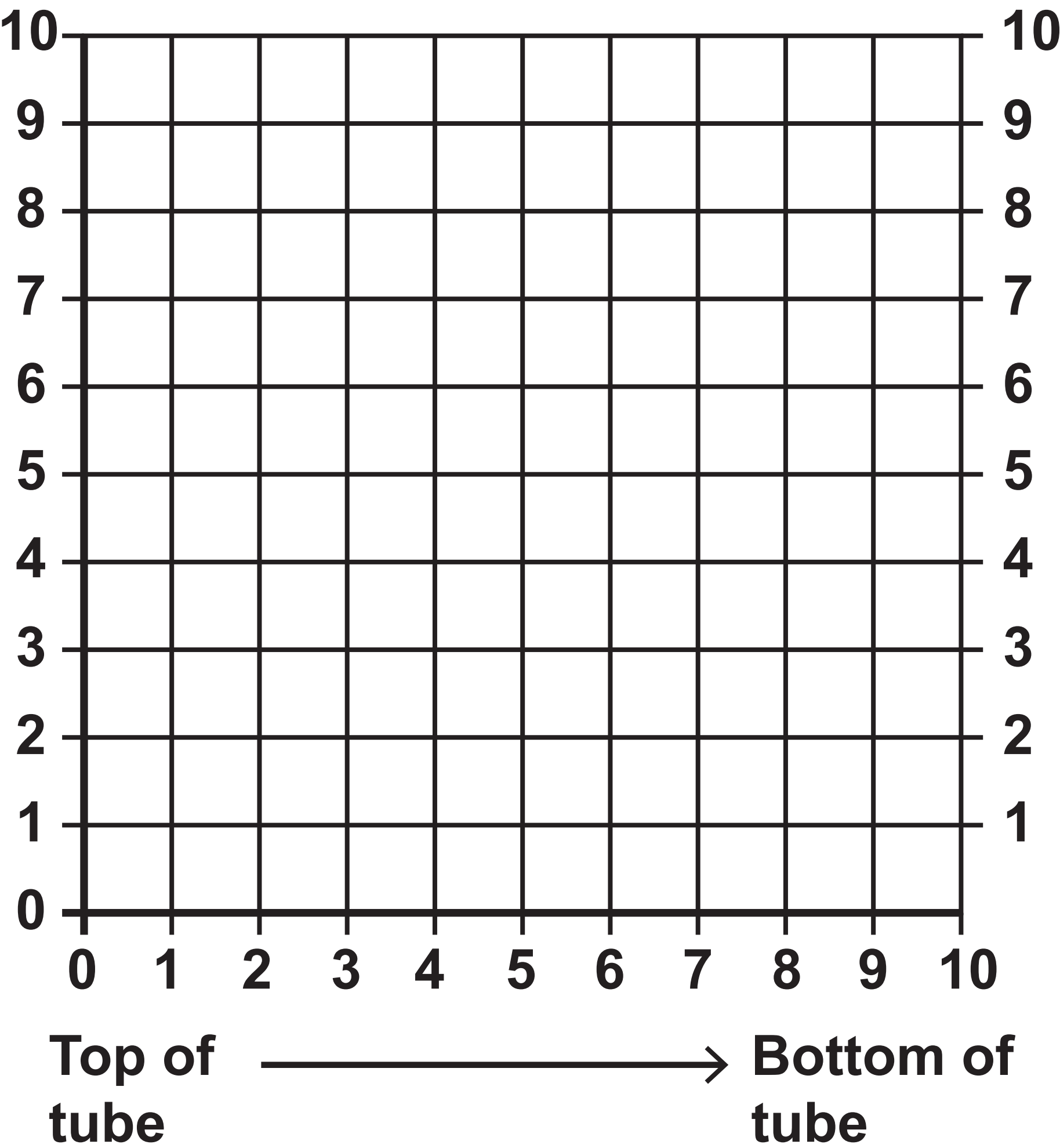
Graph C



Question 3 (a) (ii)

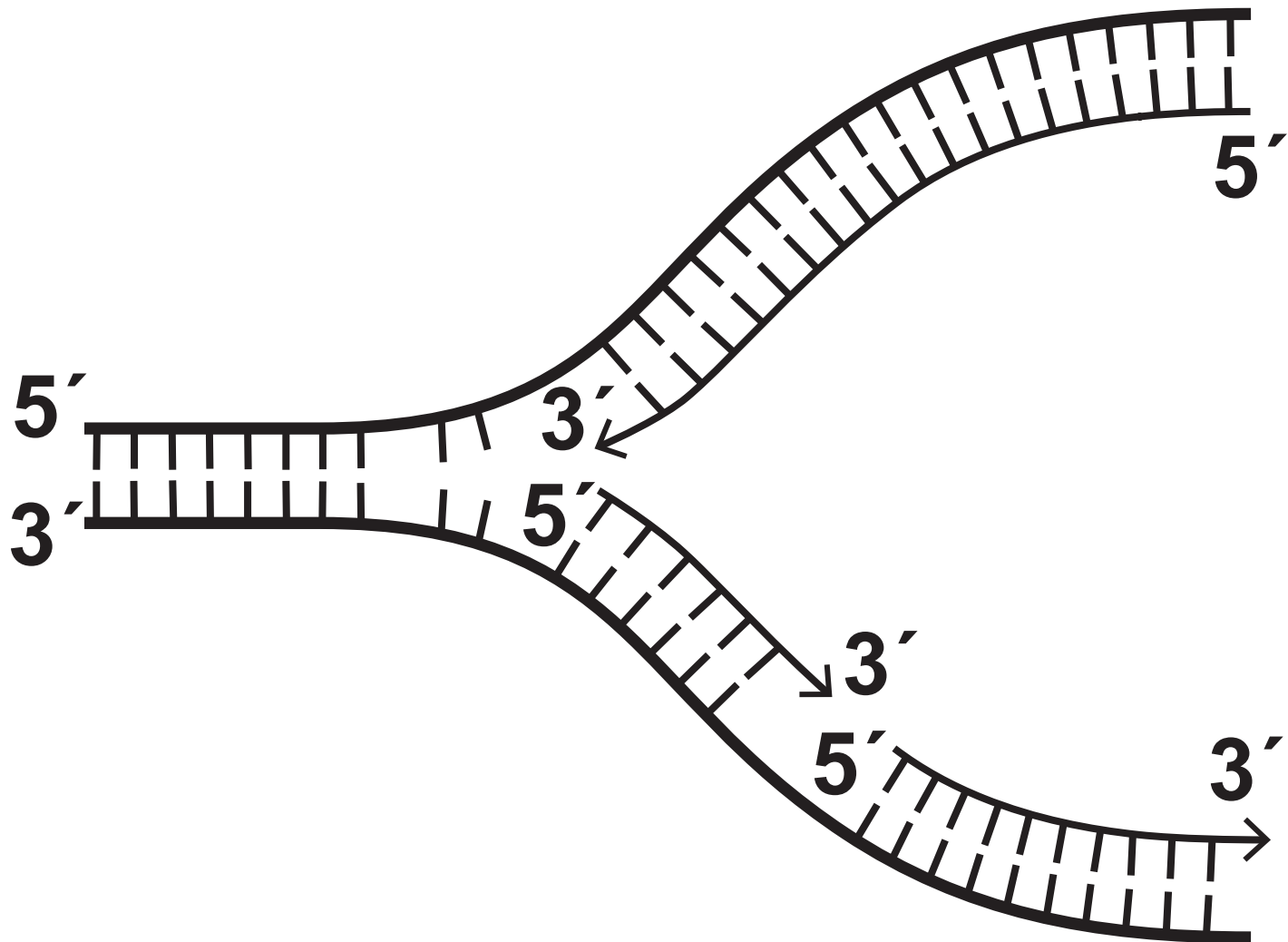
IMAGE 3.2

Relative DNA density



Question 3 (b)

IMAGE 3.3



Question 4

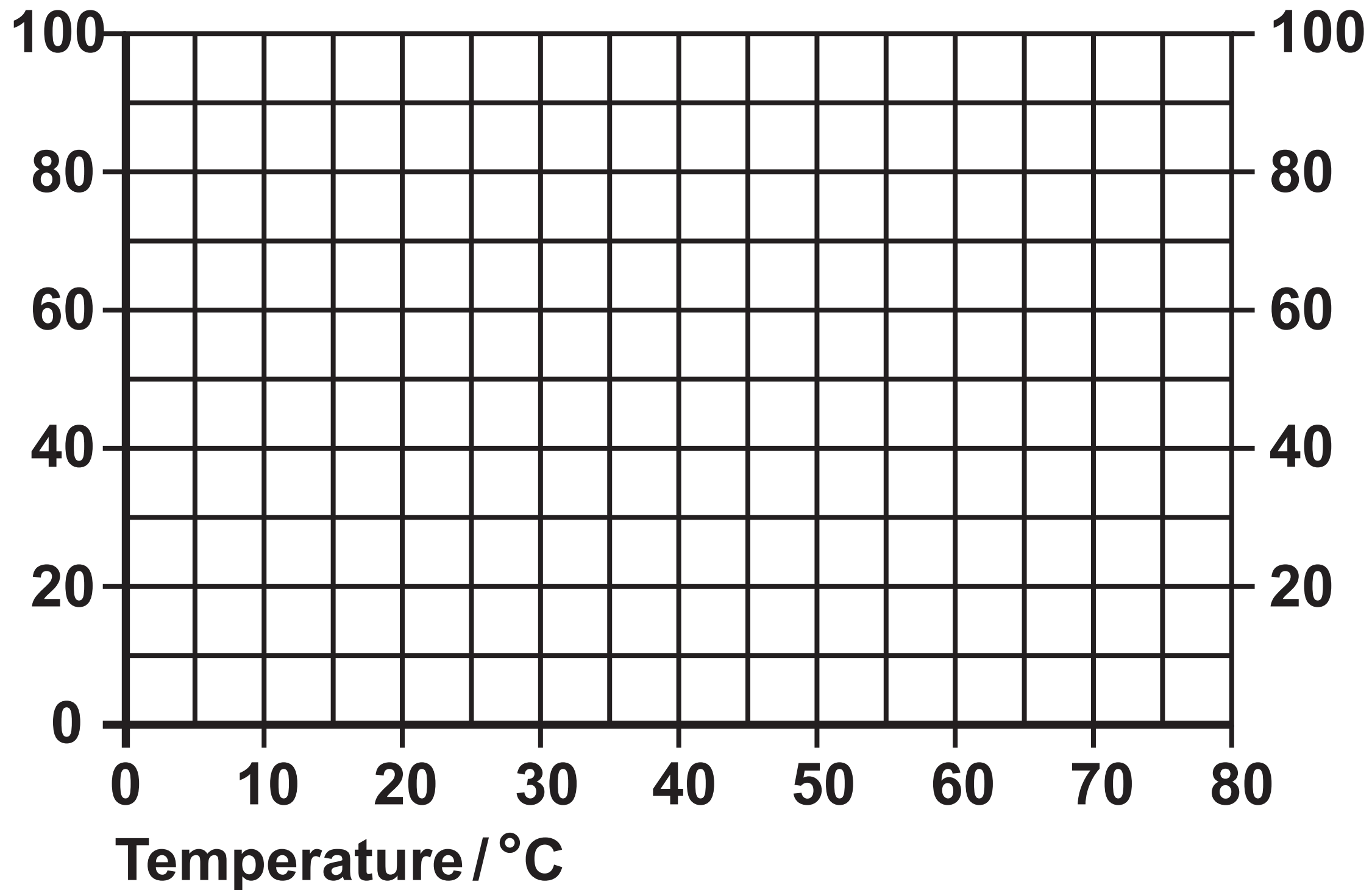
TABLE 4.1

Incubation temperature / °C	Absorbance at 540 nm / a.u.			
	Experiment 1	Experiment 2	Experiment 3	Mean
10	11	14	20	15
30	17	22	21	20
40	19	23	33	25
60	54	69	72	65
70	94	95	96	95
80	98	98	98	98

Question 4 (a) (ii)

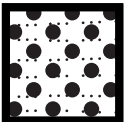
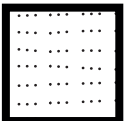
GRAPH 4.2

**Mean absorbance at
540 nm / arbitrary units**

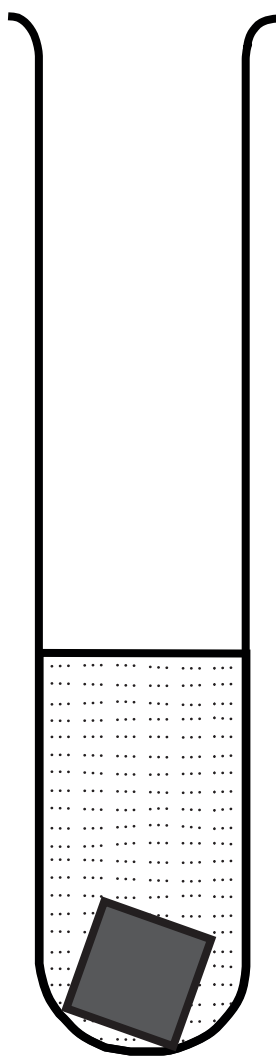


Question 4 (b)

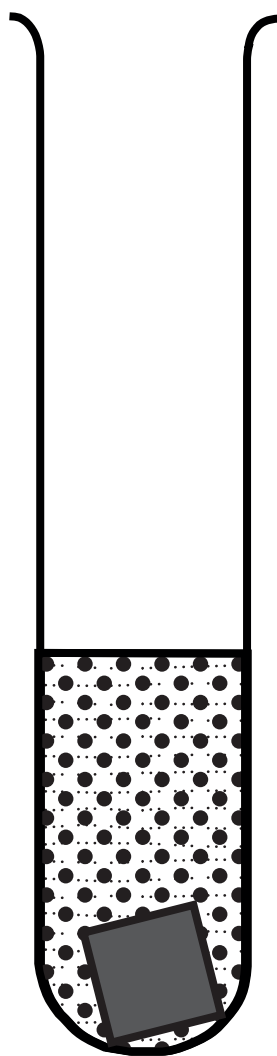
IMAGE 4.3

Key:  cube of beetroot
 red – coloured solution
 clear solution

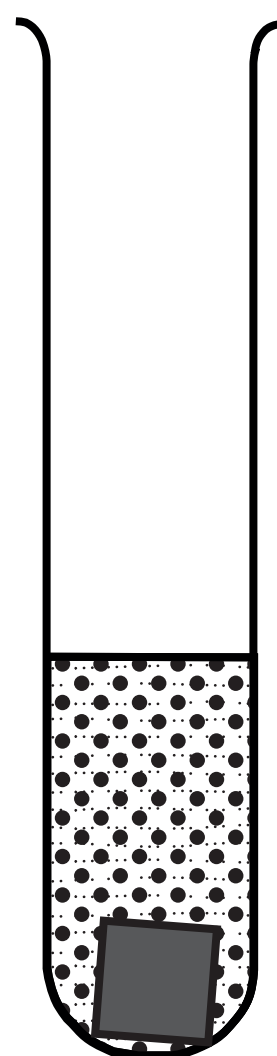
Water



Acid

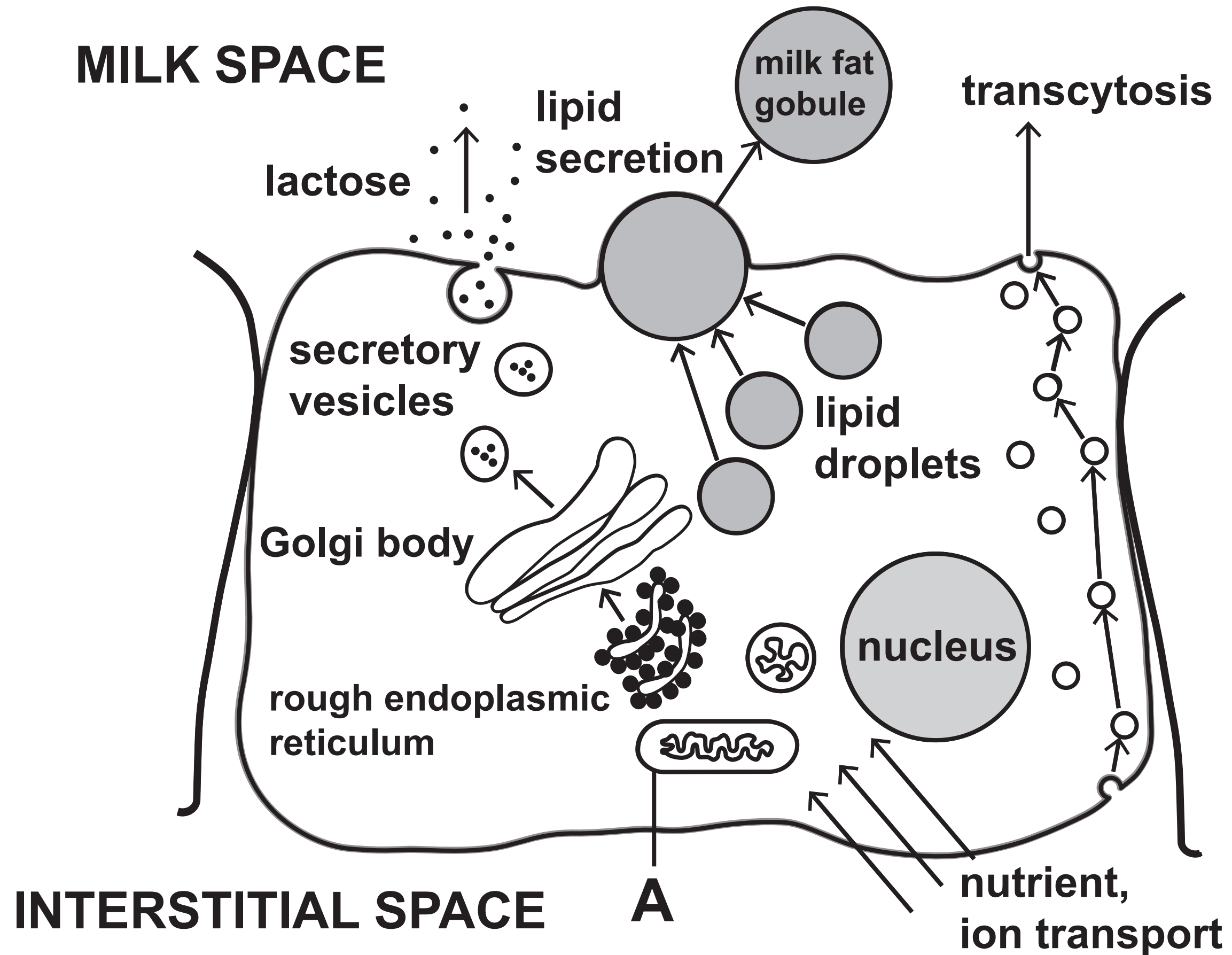


Ethanol



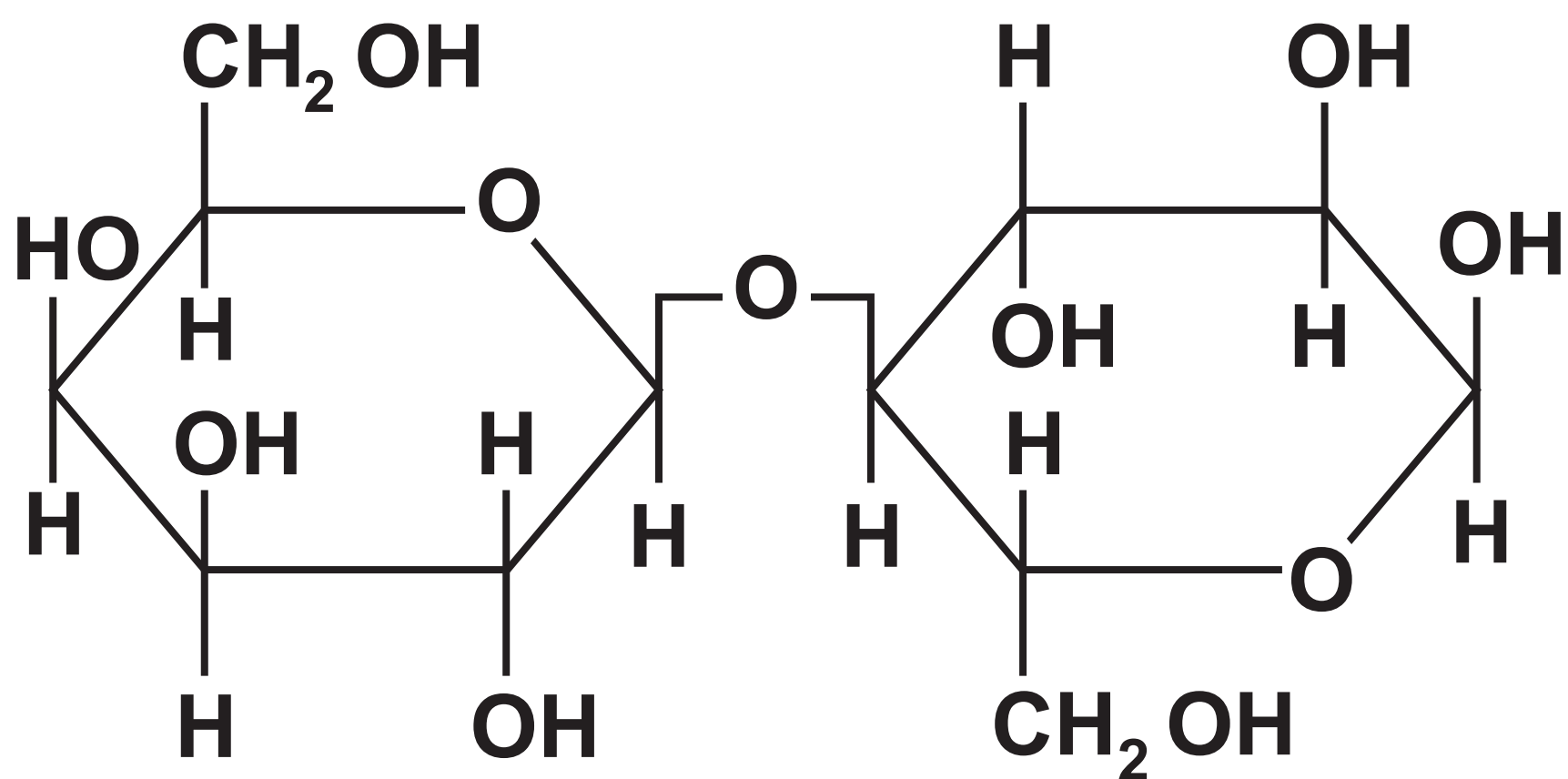
Question 5

IMAGE 5.1



Question 5 (b)

IMAGE 5.2

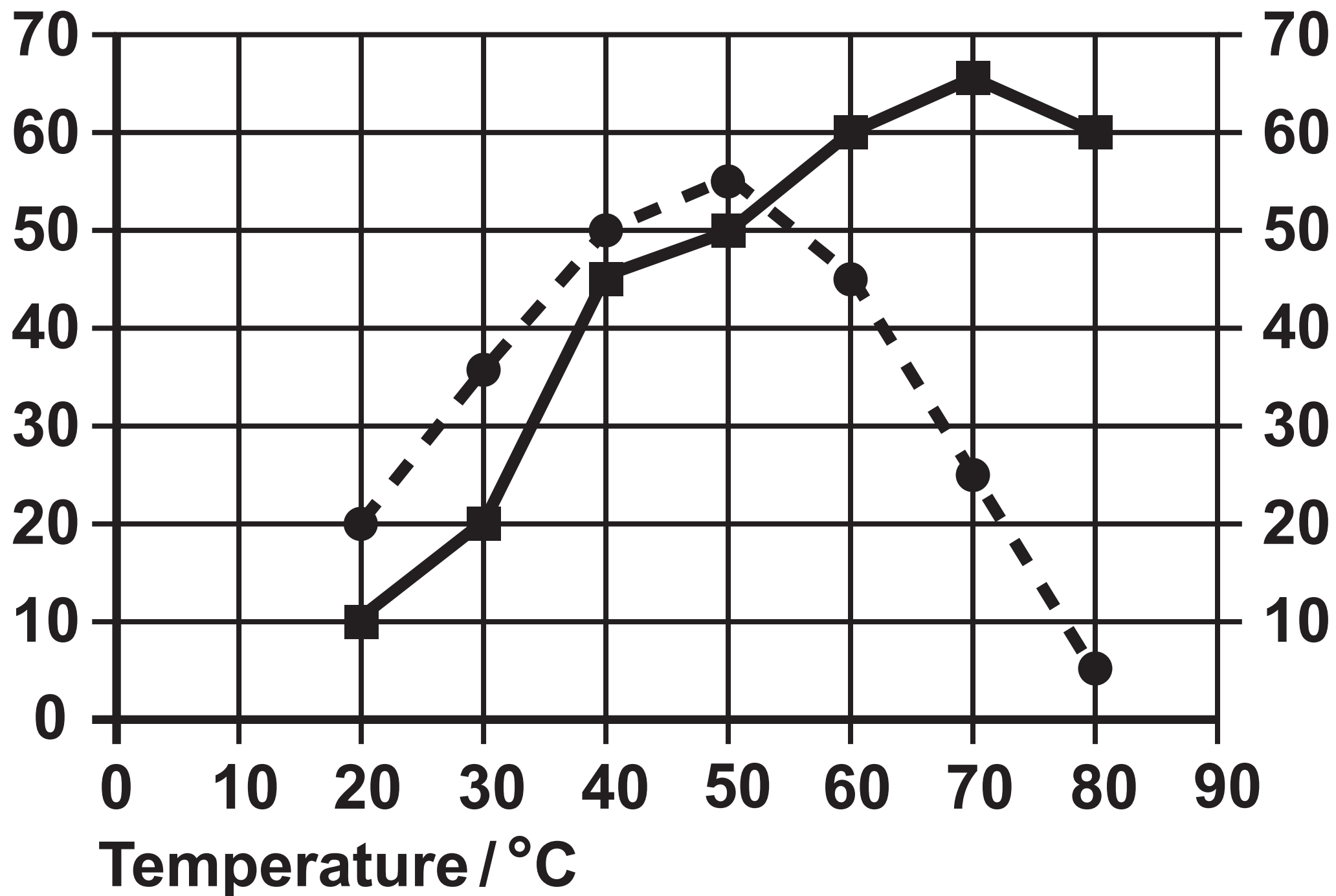


Question 5 (c)

GRAPH 5.3

Key: - ● - Free lactase
— ■ — Immobilised lactase

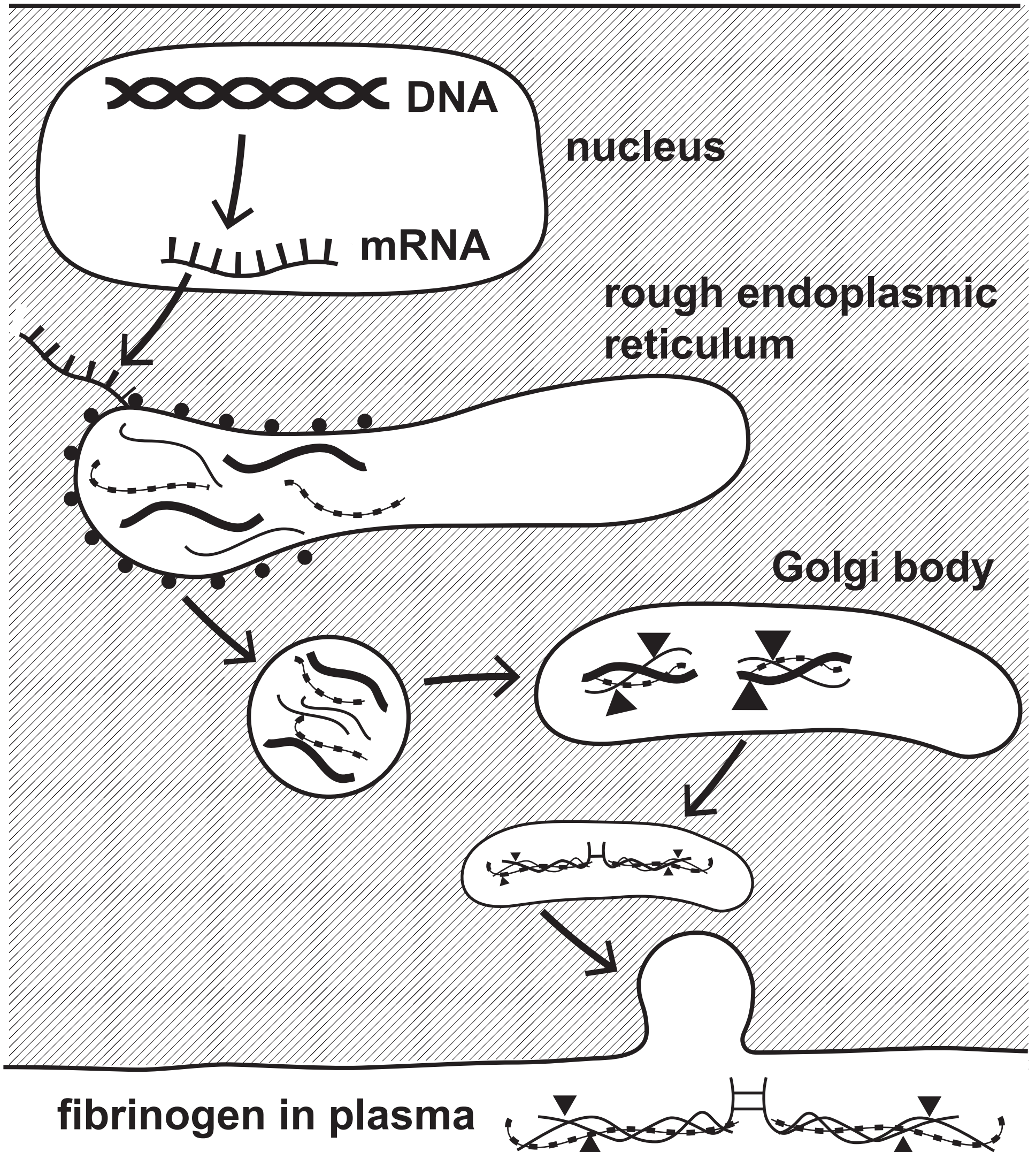
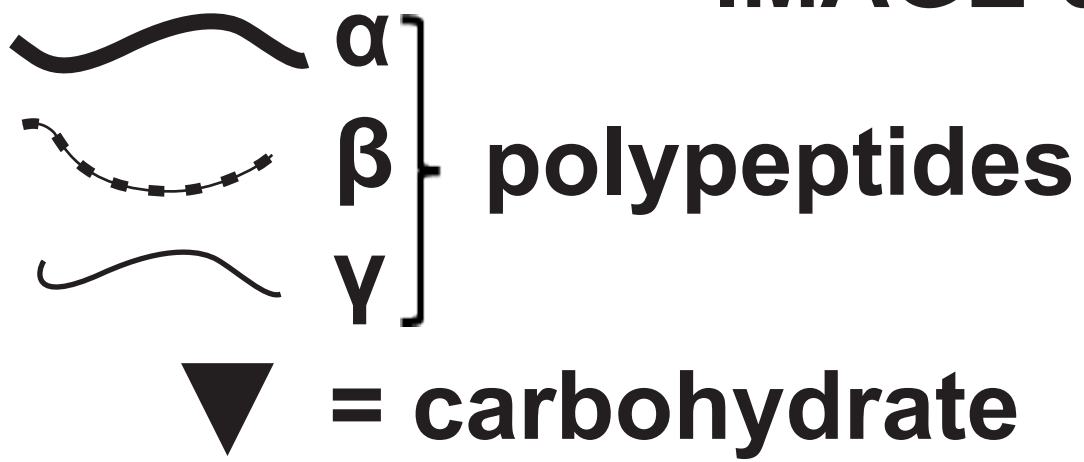
Relative lactase activity / %



Question 6

Key:

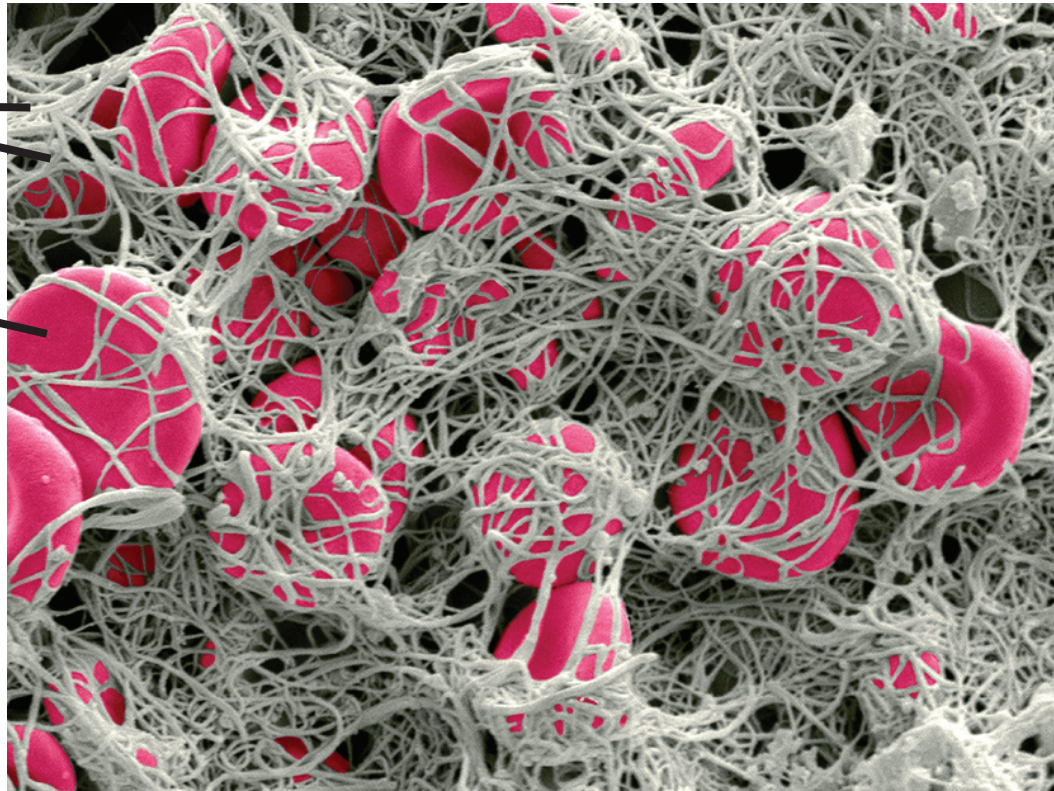
IMAGE 6.1



Question 6 (b)

IMAGE 6.2

fibrin
red blood
cell



Question 6 (c)

IMAGE 6.3

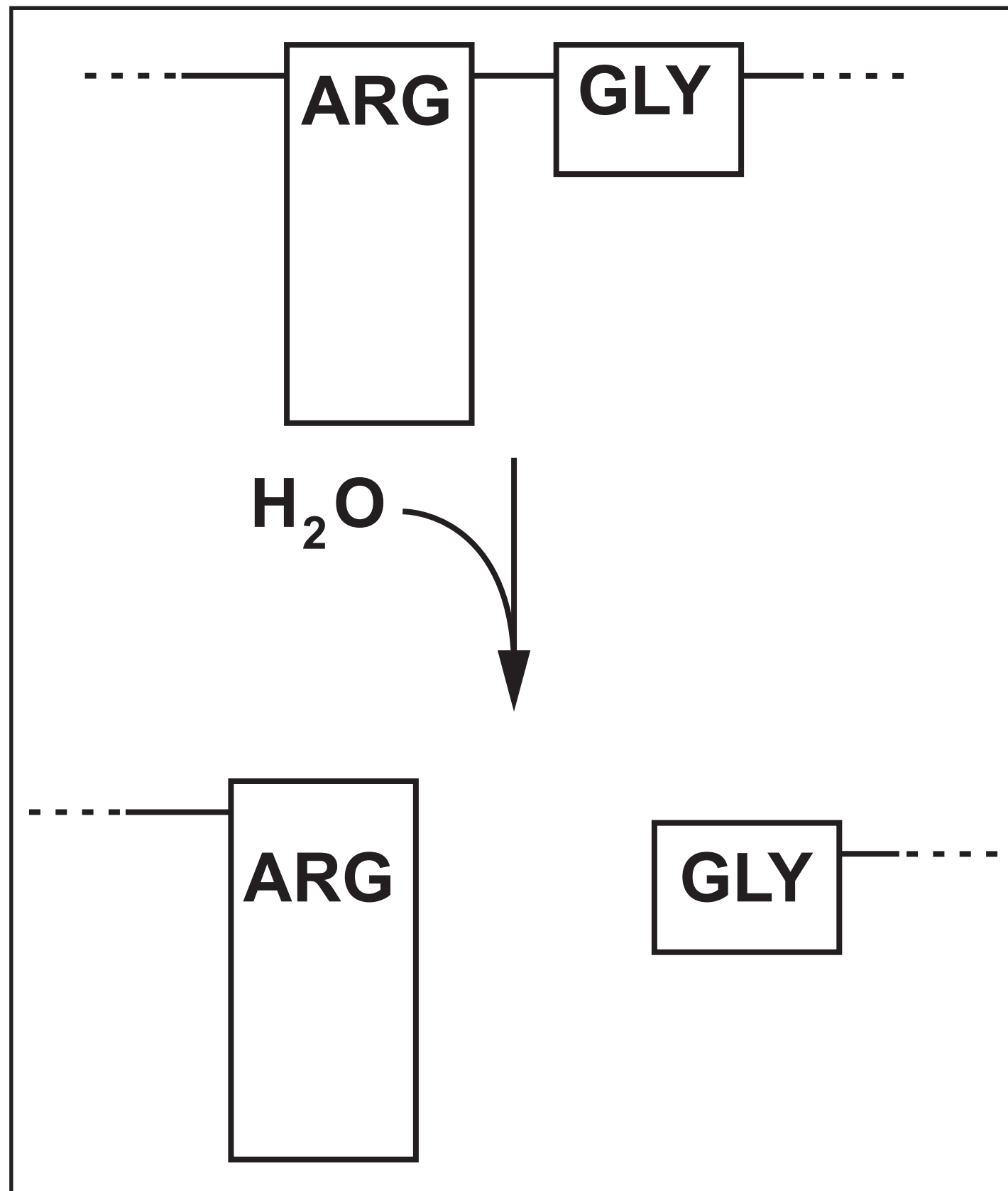
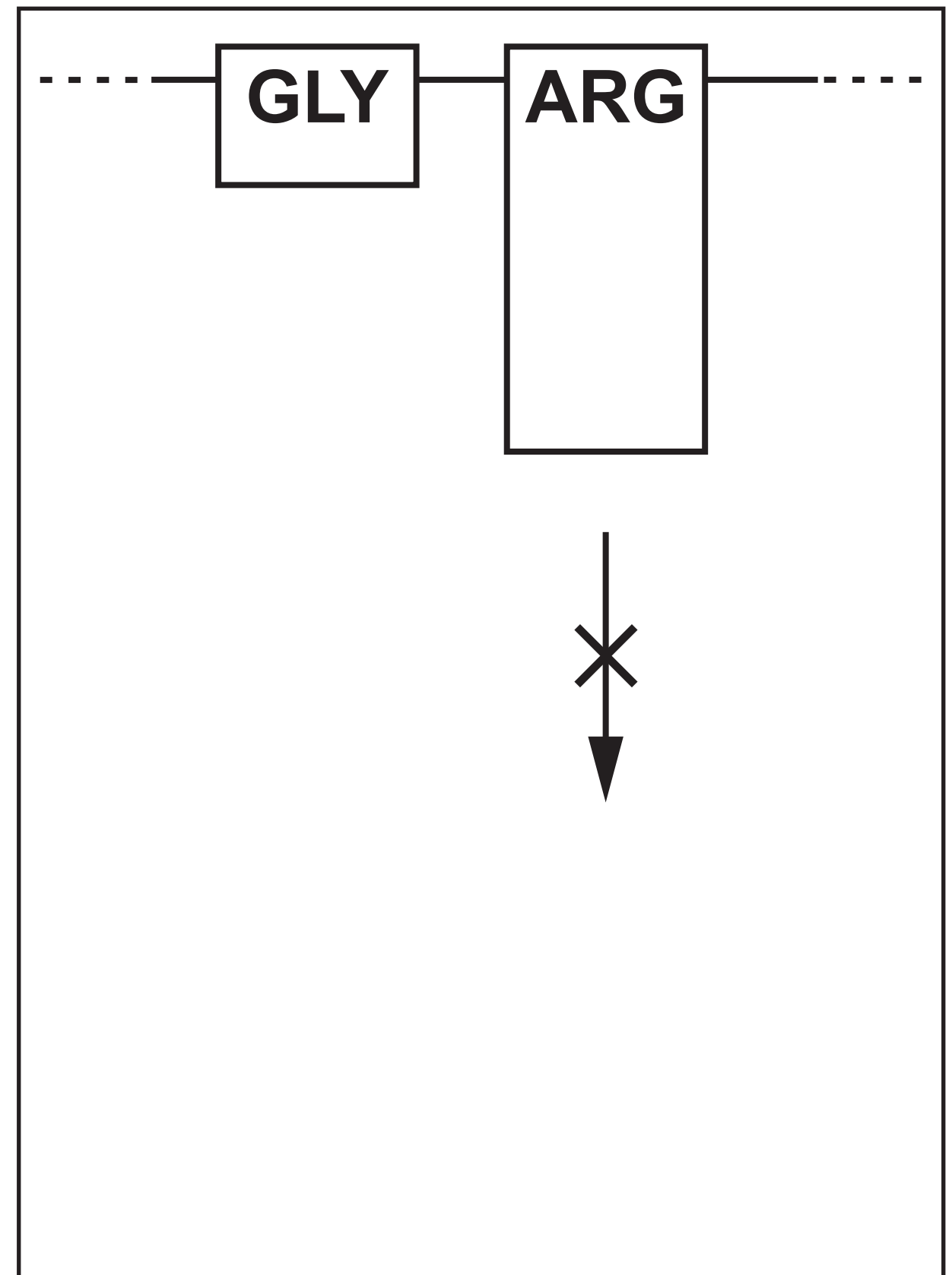


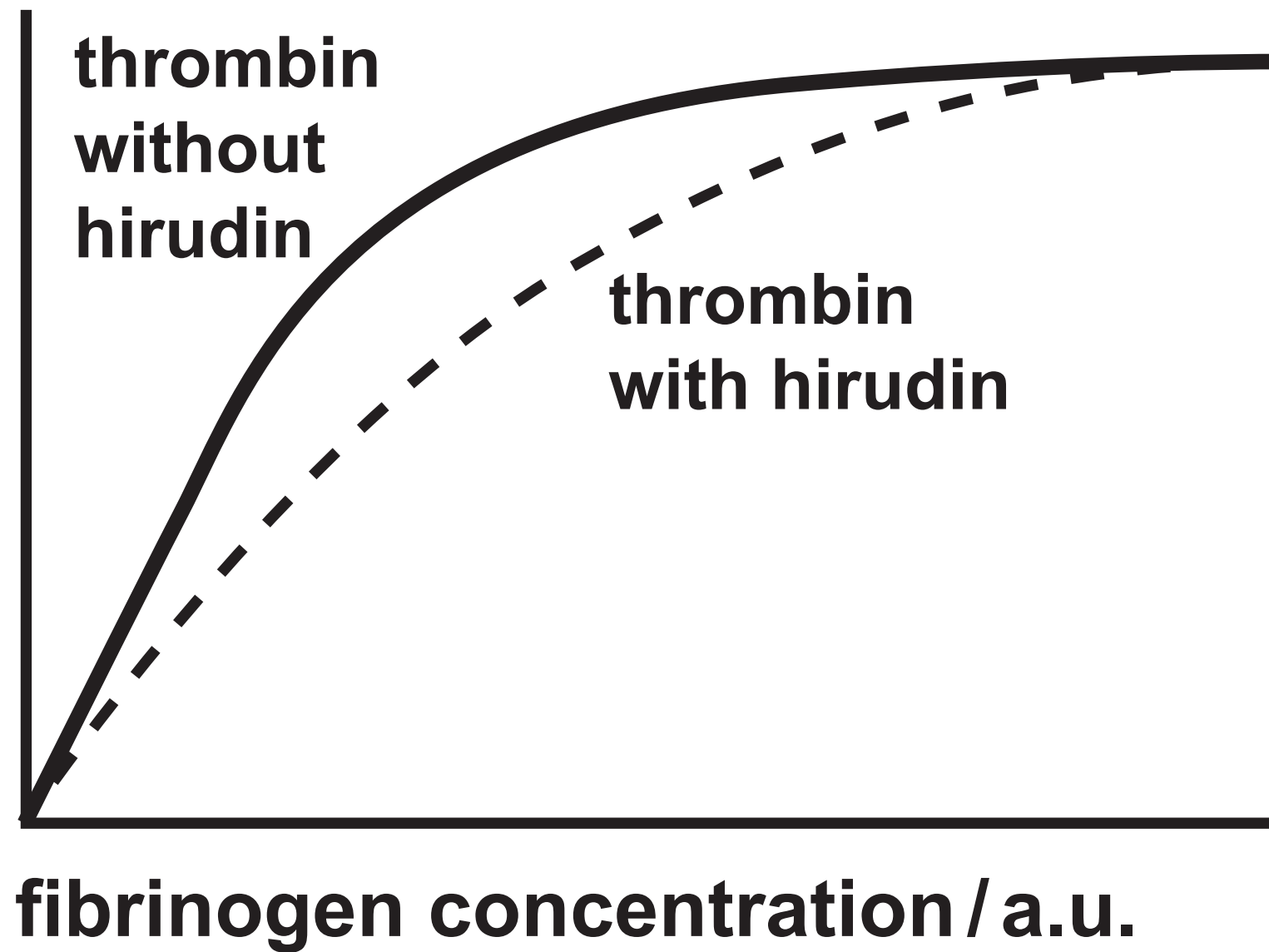
IMAGE 6.4



Question 6 (d)

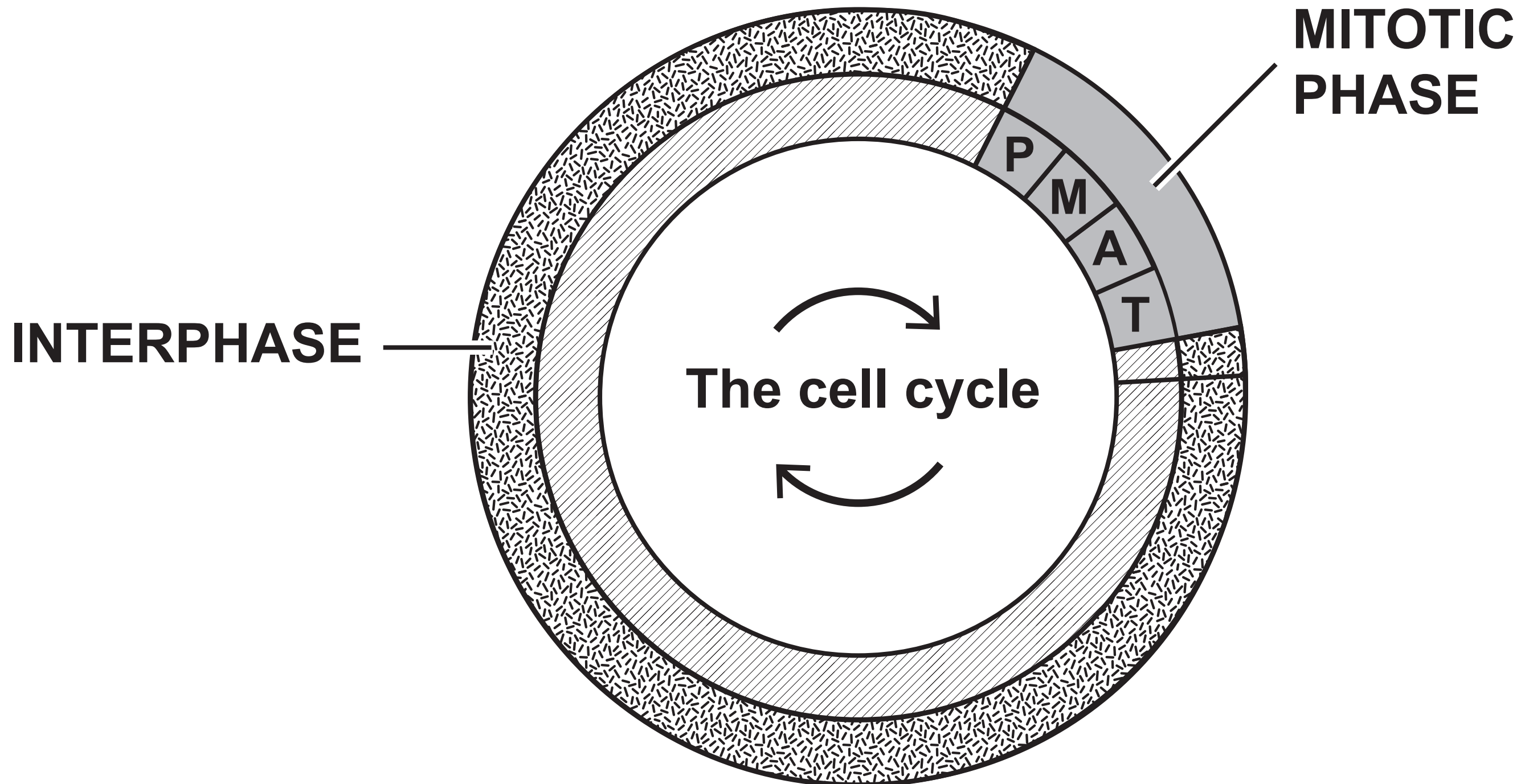
GRAPH 6.5

Activity of thrombin / a.u.



Question 7

IMAGE 7.1



Question 7

Formula

$$\text{Mitotic index} = \frac{\text{cells in mitosis}}{\text{total number of cells in field of view}}$$