



GCSE

3400UA0-1

MONDAY, 10 JUNE 2024 – MORNING

**BIOLOGY – Unit 1:
Cells, Organ Systems and Ecosystems**

HIGHER TIER

1 hour 45 minutes plus your additional time allowance

Surname _____

First name(s) _____

Centre Number _____

Candidate Number **0** _____

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 or your usual method.

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

Answer ALL questions.

Write your answers in the spaces provided in this booklet. 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.

Question 9 is a quality of extended response (QER) question where your writing skills will be assessed.

(Turn over)

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	8	
2.	12	
3.	9	
4.	7	
5.	7	
6.	7	
7.	11	
8.	13	
9.	6	
Total	80	

Answer ALL questions.

1 **IMAGE 1** in the separate diagram booklet shows a pyramid of numbers in African grassland.

(a)(i) State the producer in this pyramid. [1 mark]

(ii) UNDERLINE TWO terms from the list below that can be used to describe the zebra. [1 mark]

Producer

Secondary consumer

Carnivore

Herbivore

Primary consumer

(iii) Write the **FOOD CHAIN** that is represented by the pyramid of numbers in **IMAGE 1**. [1 mark]

(Turn over)

1 (a)(iv)

**State the source of energy for a food chain.
[1 mark]**

(v) State ONE reason why not all of the energy is passed from one stage of the food chain to the next. [1 mark]

(vi) Suggest why this pyramid of numbers is not pyramid-shaped. [1 mark]

1 (a)(vii)

IN THE SPACE BELOW DRAW A LABELLED PYRAMID OF BIOMASS for the organisms shown in IMAGE 1. Your pyramid of biomass does not need to be to scale. [2 marks]

8

(Turn over)

2 A tomato fertiliser can be used when growing tomato plants.

(a) State THREE nutrients that a tomato fertiliser may contain. [3 marks]

1. _____

2. _____

3. _____

(b) Tony grows tomato plants in his greenhouse. He designed an investigation to see if using fertiliser made a difference to the mass of his tomatoes. He grew one tomato plant adding the fertiliser once a week and left one plant without fertiliser. After three months he measured the mass of 10 tomatoes from each plant.

Identify the independent and dependent variables for the investigation. [2 marks]

Independent variable

Dependent variable

- 2 (c) **TABLE 2** in the separate diagram booklet shows the results for the experiment.
- (i) Tony calculated the mean mass of tomatoes grown **WITH FERTILISER** without including an anomalous result.

CIRCLE THE ANOMALOUS RESULT in **TABLE 2**. [1 mark]

- (ii) Calculate the mean mass of tomatoes grown **WITHOUT FERTILISER**. **WRITE YOUR ANSWER** in **TABLE 2** TO THE NEAREST **WHOLE NUMBER**. [2 marks]

Space for working:

- (iii) State the conclusion that Tony can make from the results in **TABLE 2**. [1 mark]

(Turn over)

2 (d)(i) Tony ensured that this investigation was a fair test.

State ONE variable that Tony would have controlled. [1 mark]

(ii) Each tomato plant produced many tomatoes, from which Tony chose ten.

Suggest why this step in Tony’s method could have caused inaccuracies in his results, and what he could have done to improve the investigation. [2 marks]

Reason for inaccuracies

Suggestion for improvement

3 IMAGE 3.1 in the separate diagram booklet shows a sample of blood viewed down a light microscope.

(a) DRAW LABELLED ARROWS on IMAGE 3.1 to show: [1 mark]

- **ONE red blood cell**
- **ONE white blood cell.**

(b)(i) The blood of a human male contains 43 cm^3 of plasma per kg of body mass.

The volume of blood in a human male of mass 62 kg is 4670 cm^3 .

Calculate the percentage of plasma in the blood of this male.

WRITE YOUR ANSWER TO TWO SIGNIFICANT FIGURES. [3 marks]

Percentage = _____

3 (b)(ii)

State ONE function of plasma. [1 mark]

3 (c) Health professionals can use a full blood count (FBC) to monitor health. TABLE 3.2 in the separate diagram booklet shows some values from an FBC for three patients, A, B and C. The normal ranges are also shown.

Use TABLE 3.2 and your knowledge to explain:

(i) why patient A is most likely to suffer low blood oxygen levels; [2 marks]

3 (c)(ii)

why patient **B** is most at risk of infectious disease. [2 marks]

9

- 4** In 2022, a report by the Senedd Climate Change Committee noted that during 2020, there were over 105 000 incidents in Wales of untreated sewage being released into streams, rivers and the sea. Following extreme rainfall, sewage treatment works are allowed to release untreated sewage into streams, rivers and the sea.

MAP 4.1 in the separate diagram booklet shows a river and the location of a sewage treatment works.

In June 2020, a survey was carried out in a river at two locations, **A** and **B**, as shown on **MAP 4.1**. The number and different types of invertebrates at each location was recorded.

TABLE 4.2 in the separate diagram booklet shows the results of the survey.

TABLE 4.3 in the separate diagram booklet can be used to assess the level of pollution and oxygen concentrations in rivers.

- (a)** State the scientific term that is used to describe any organisms that can be used to monitor levels of pollution. [1 mark]
-

4 (b) Use TABLES 4.2 AND 4.3 to draw conclusions about the OXYGEN CONCENTRATIONS in the river at locations A and B. [2 marks]

Oxygen concentration at location A = _____

Oxygen concentration at location B = _____

(c) The release of untreated sewage into streams can result in an algal bloom, which in turn can reduce oxygen levels. Explain how algal blooms can result in reduced oxygen levels. [4 marks]

continue your answer on the next page

(Turn over)

7

5 **IMAGE 5.1** in the separate diagram booklet shows an illustration of part of the lower surface of a leaf from a cress plant.

(a)(i) State the names of the type of cells labelled **A** and **B** in **IMAGE 5.1**. [2 marks]

A _____

B _____

(ii) Measure the length of line **X–X** on **IMAGE 5.1**. [1 mark]

Length = _____ mm

(iii) The actual length of the cell measured by line **X–X** on **IMAGE 5.1** is $20\ \mu\text{m}$. Calculate the magnification of the drawing. [2 marks]

(1 mm = $1000\ \mu\text{m}$)

Magnification = \times _____

(Turn over)

5 continued

An investigation was carried out into the changes in the mean size of the stomata of a cress plant. The plant was left on a windowsill and the changes were recorded over a 24-hour period. The results are shown in GRAPH 5.2 in the separate diagram booklet.

- (b)(i) State ONE conclusion that can be drawn from GRAPH 5.2 about when stomata open and close. [1 mark]**

- (ii) Explain ONE advantage to plants of being able to change the size of their stomata. [1 mark]**

7

6 There are two methods of producing ATP in the body:

- aerobic respiration
- anaerobic respiration

However, at the start of exercise, the body will use ATP that is already available in small amounts in muscle cells.

(a) Other than ATP, state the products of aerobic and anaerobic respiration. [3 marks]

Aerobic: _____ and

Anaerobic: _____

(b) State why anaerobic respiration is not suitable as a source of energy for continuous exercise. [1 mark]

6 (c) GRAPH 6.1 in the separate diagram booklet shows how the source of ATP for muscle contraction changes over a two-minute period of exercise in an athlete.

TABLE 6.2 in the separate diagram booklet shows information about ATP in muscle cells.

(i) Use GRAPH 6.1 to suggest why it is important that muscle cells have a small amount of ATP available at the start of exercise. [1 mark]

6 (c)(ii)

Use the data from TABLE 6.2 to compare the efficiency of aerobic and anaerobic respiration. Give the reason for the difference in efficiency. [2 marks]

7

(Turn over)

7 **GRAPH 7.1** in the separate diagram booklet shows the mean age of death for the population of Wales between 1990 and 2018.

(a) Use **GRAPH 7.1** to compare the trends in mean age of death for females and males in Wales between 1990 and 2018. [3 marks]

7 (b) The mean daily energy intake per person in the UK has increased from 13 000 kJ in 1960 to 14 000 kJ in 2018.

Explain how the change in mean daily energy intake between 1960 and 2018 has had a negative effect on health. [2 marks]

7 (c) The Global Burden of Disease Study (GBDS) collects data from more than 7000 researchers in 156 countries. The data records premature deaths and disabilities linked to 350 diseases. Scientists used the data from the GBDS to model an ‘optimal diet’. They claim that following this optimal diet from age 20 would extend average life expectancy by 10 years for females and 13 years for males. TABLE 7.2 in the separate diagram booklet compares a typical Western diet with the optimal diet.

(i) Suggest how the change in consumption of fruit and vegetables from a typical Western diet to an optimal diet is likely to benefit health. [2 marks]

7 (c)(ii)

**State TWO benefits to health of reducing the consumption of sugar-sweetened drinks.
[2 marks]**

**(d) Evaluate the strength of the evidence collected by scientists in the GBDS study.
[2 marks]**

8 IMAGE 8.1 in the separate diagram booklet shows part of a starch molecule and carbohydrase.

(a)(i) State the name of the model used to explain enzyme action. [1 mark]

**(ii) All enzymes are proteins.
State what determines the shape of the active site of an enzyme. [1 mark]**

- 8 (b)** An investigation was carried out to study the rate of digestion of starch by carbohydrase, using a light sensor linked to a data logger. The light sensor detects the intensity of light passing through a solution. **IMAGE 8.2** in the separate diagram booklet shows how the investigation was set up.

The following method was used.

- A lamp was placed above a beaker containing 100 cm^3 of 1% starch solution.
- A light sensor was placed underneath the beaker and a data logger began recording the light intensity below the beaker.
- At 5 minutes, a few drops of iodine were added to the beaker.
- At 10 minutes, 20 cm^3 of 10% carbohydrase solution was added.

The results of the investigation are shown in **GRAPH 8.3** in the separate diagram booklet.

8 (b)(i) Explain the results between 5 and 6 minutes.
[2 marks]

(ii) Calculate the mean rate of reaction between 10 and 15 minutes, using the following formula. [3 marks]

$$\text{Mean rate of reaction} = \frac{\text{change in light intensity}}{\text{time}}$$

Mean rate
of reaction = _____ lux/min

(Turn over)

8 (b)(iii)

Explain the change in light intensity between 10 and 20 minutes. [3 marks]

8 (b)(iv)

State TWO controlled variables in this experiment. [2 marks]

1. _____

2. _____

(v) **DRAW A LINE on GRAPH 8.3 to predict the results if the carbohydrase had been boiled and then cooled before being added at 10 minutes. [1 mark]**

13

- 9 A class of students observed the following demonstration of water movement through plant cells.
- A fresh potato was cut in half. The halves were labelled **A** and **B**.
 - A cavity was cut into each half as shown in **IMAGE 9.1** in the separate diagram booklet.
 - Concentrated sugar solution was placed in the cavity of **A**.
 - The cavity in **B** was left empty.
 - **A** and **B** were placed in Petri dishes containing distilled water and left for three hours.

IMAGE 9.1 shows **A** and **B** at the start of the three hours.

IMAGE 9.2 in the separate diagram booklet shows **A** and **B** after three hours.

Explain the change in the liquid level observed in the cavity of **A** after three hours. Suggest the purpose of potato **B**.
[6 marks QER]

continue your answer on the next page

(Turn over)

6

END OF PAPER

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

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DIAGRAM BOOKLET

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

Surname _____

First name(s) _____

Centre Number _____

Candidate Number 0 _____

IMAGE 1

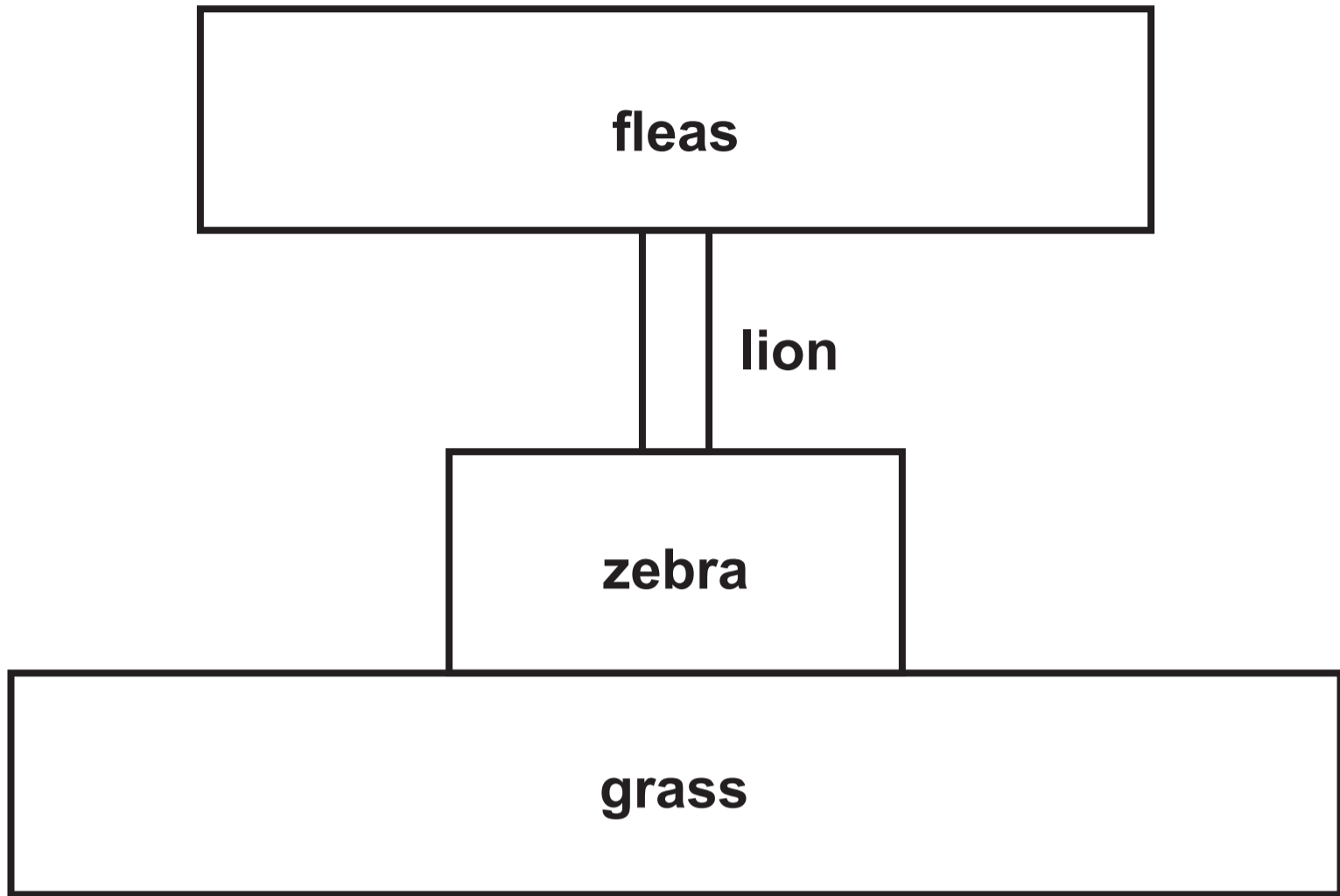


TABLE 2

Treatment of tomato plants	Mass of each tomato (g)										Mean mass of tomatoes (g)
	1	2	3	4	5	6	7	8	9	10	
With fertiliser	36	33	34	46	37	32	33	34	35	37	35
Without fertiliser	28	30	29	32	30	31	27	28	32	29	

IMAGE 3.1

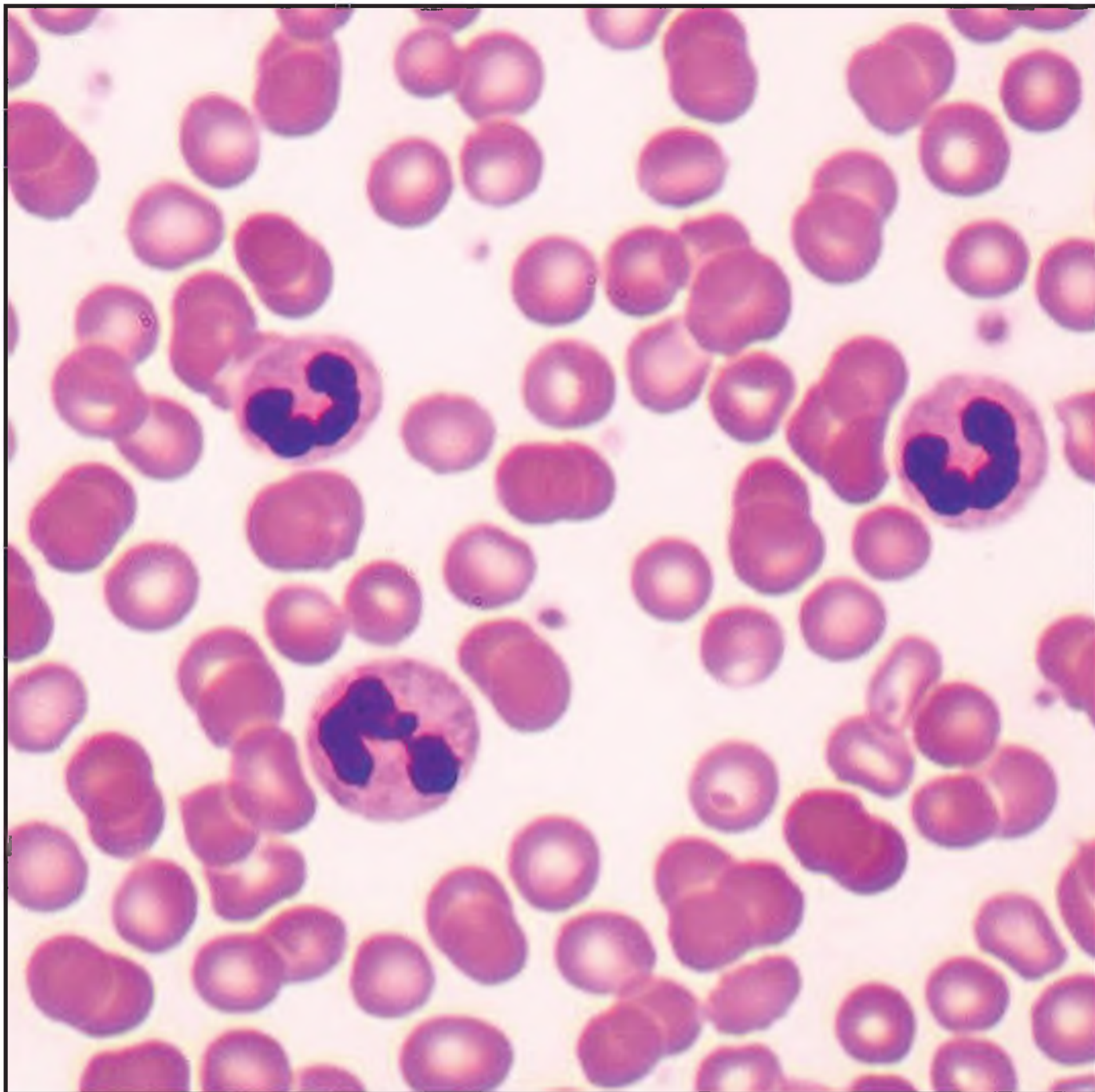


TABLE 3.2

Component of blood	Concentration in blood (a.u.)			
	Normal range	Patient A	Patient B	Patient C
Haemoglobin	13.2–14.8	10.9	13.5	13.2
Red blood cells	4.5–5.2	4.4	4.6	5.1
White blood cells	2.0–7.0	5.9	0.4	1.3
Platelets	199.2–292.1	234.4	313.3	42.4

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MAP 4.1

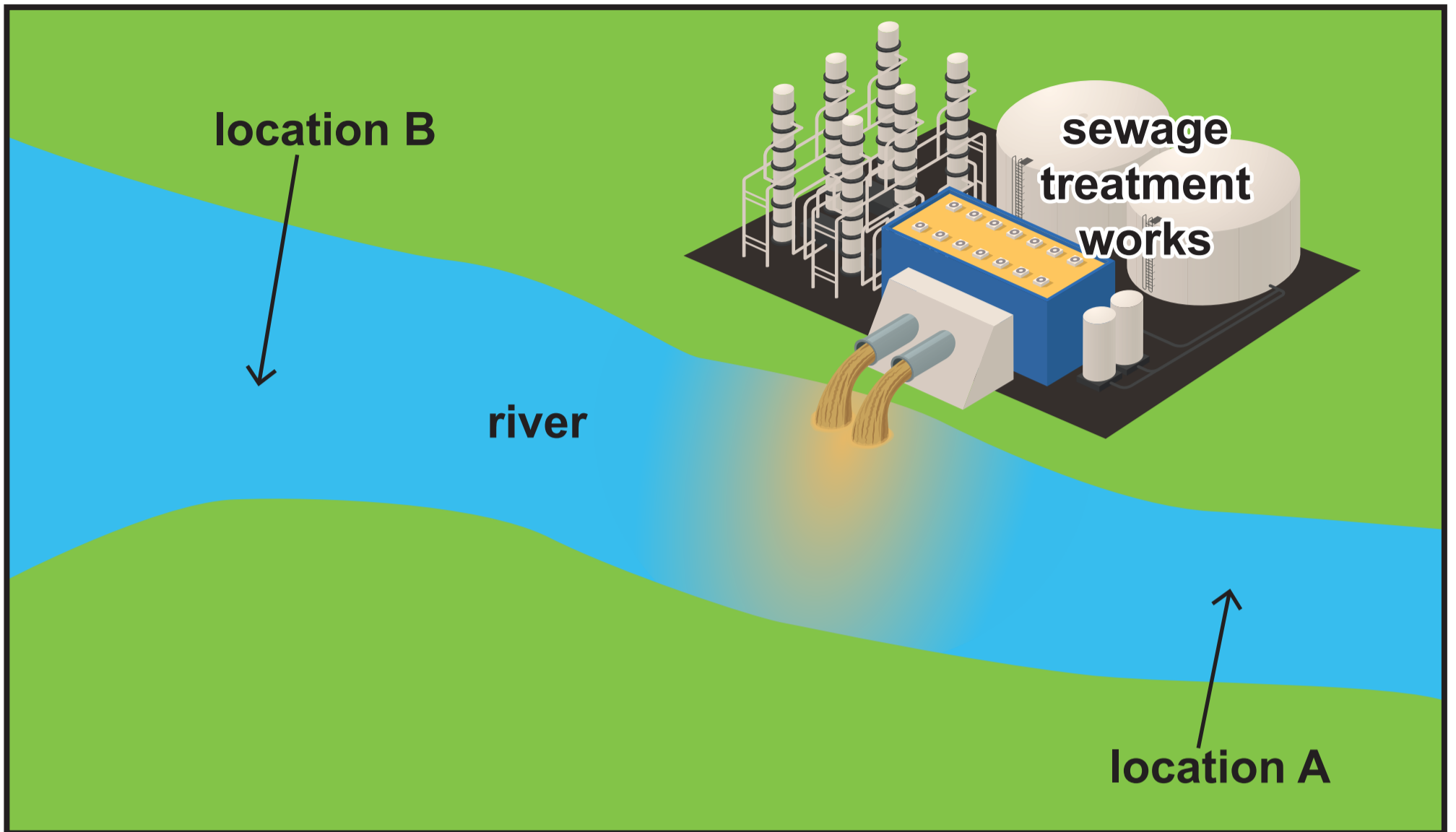


TABLE 4.2

Invertebrates	Number of invertebrates found	
	Location A	Location B
stonefly nymph	55	0
mayfly nymph	12	0
caddisfly larva	2	0
leech	3	0
sludge worm	0	33
rat-tailed maggot	0	27

TABLE 4.3

Invertebrates present	Level of pollution	Oxygen concentration
none	very high	no oxygen
rat-tailed maggot	high	low
sludge worm		
leech	moderate	moderate
blood worm		
caddisfly larva	low	moderate to high
mayfly nymph	none	high
stonefly nymph		

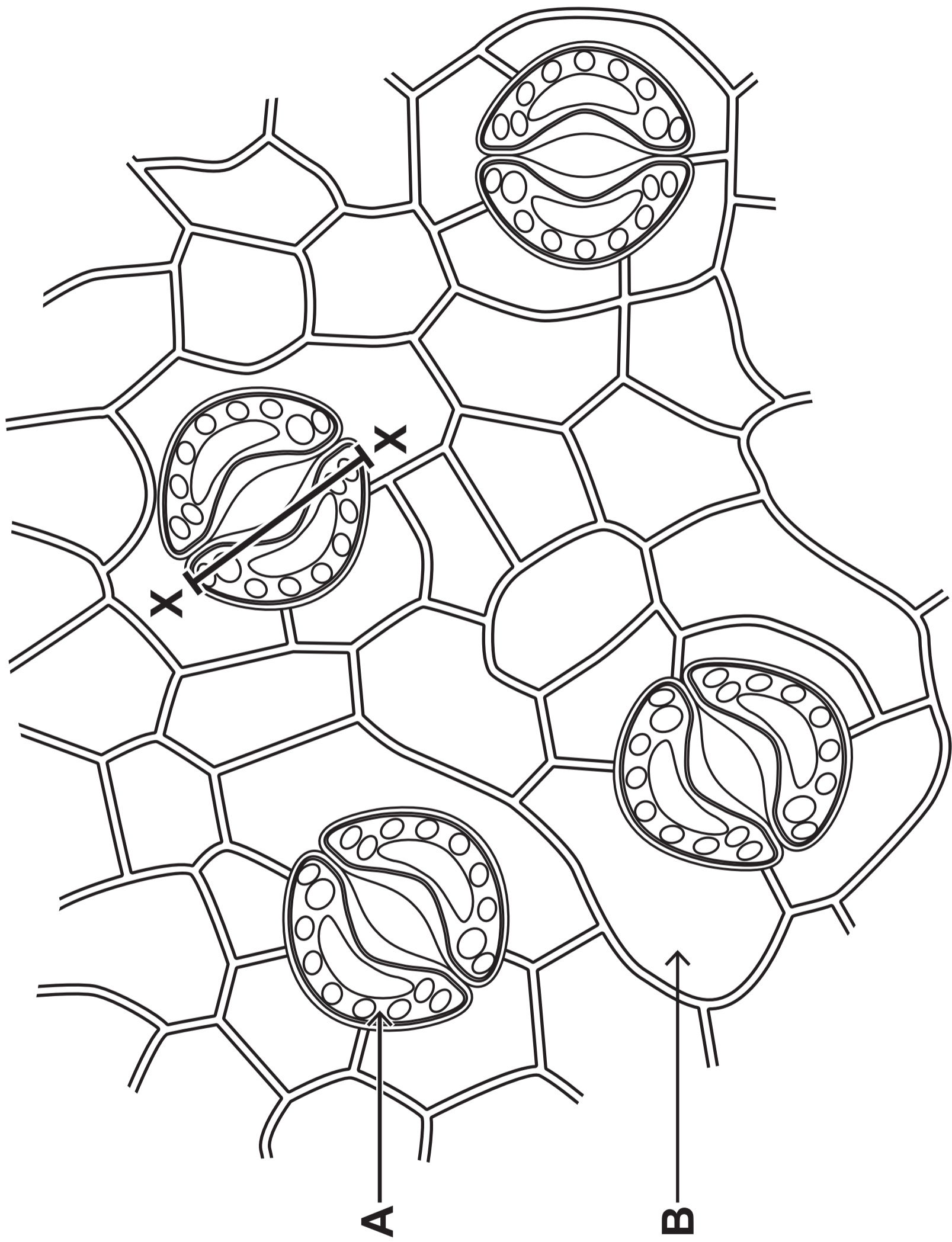
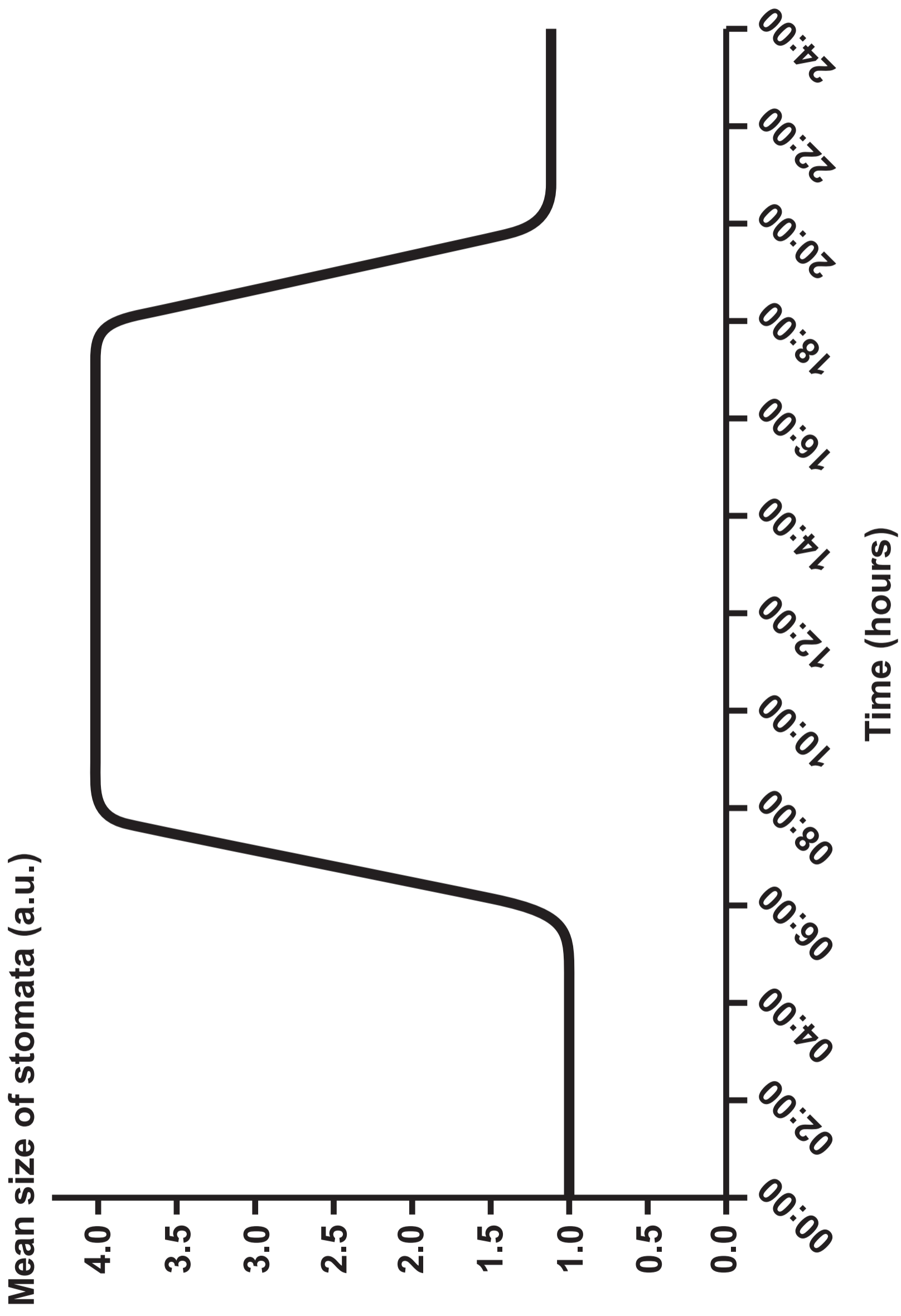


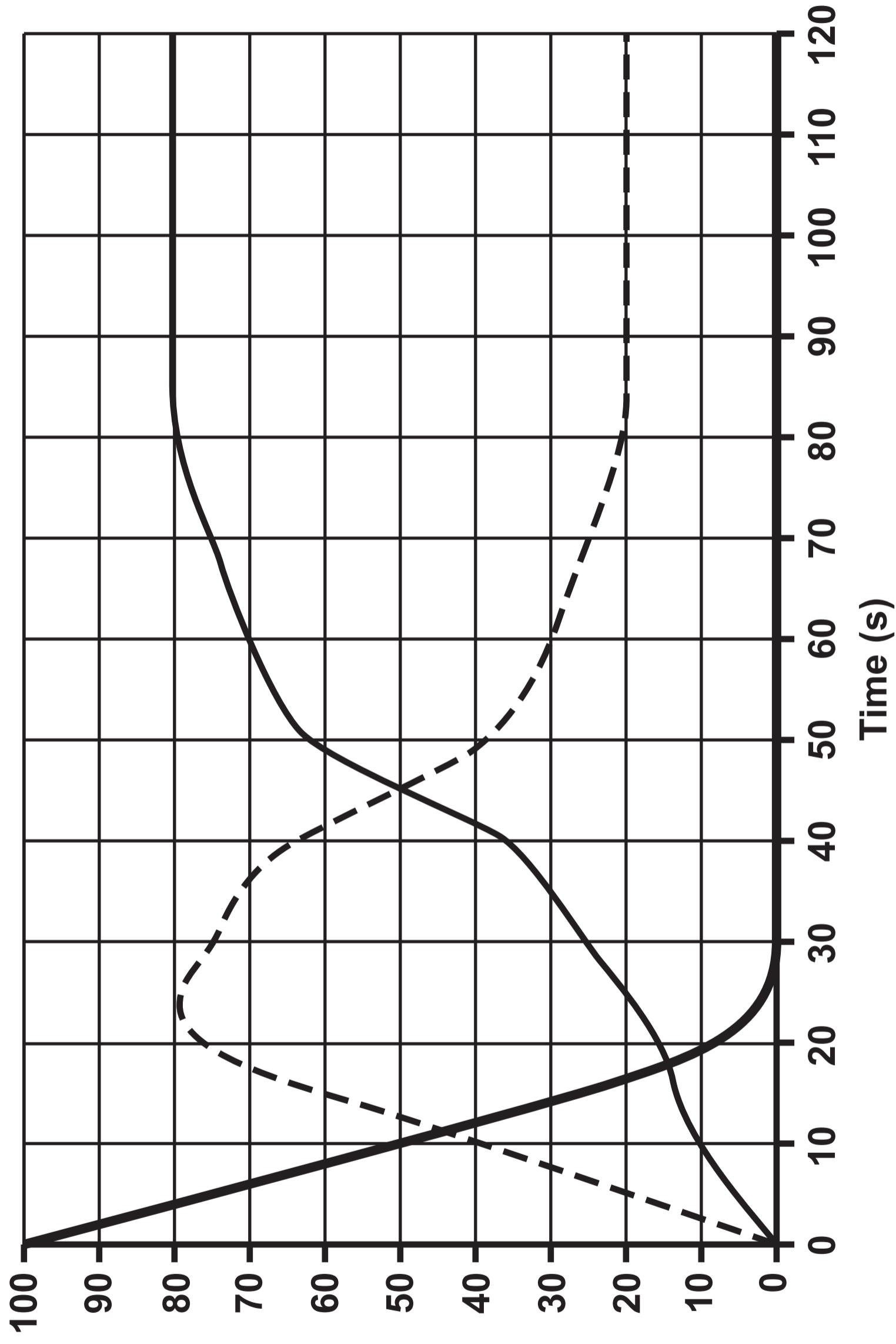
IMAGE 5.1

GRAPH 5.2



GRAPH 6.1

Percentage of total energy



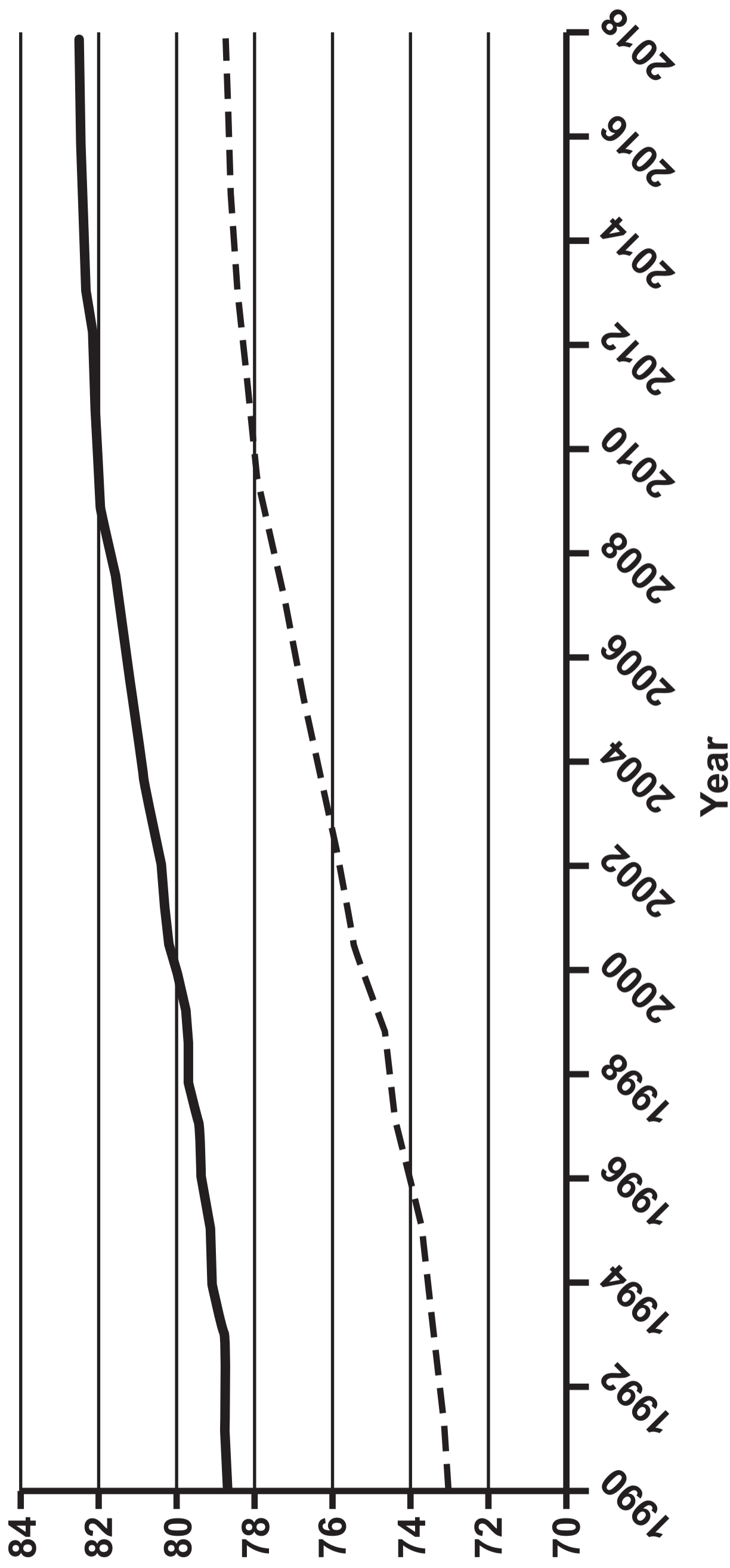
KEY:
—— ATP already available in small amounts in muscle cells
- - - - ATP from anaerobic respiration
—— ATP from aerobic respiration

TABLE 6.2

	ATP already available in muscle cells	ATP produced from aerobic respiration	ATP produced from anaerobic respiration
Type of exercise used for	high-intensity exercise	continuous exercise	high-intensity exercise
Duration of ATP source	0 – 25 seconds	hours	15 seconds – 2 minutes
Molecules of ATP produced per molecule of glucose		38	2

GRAPH 7.1

Mean age of death (years)



KEY: — Females - - - Males

TABLE 7.2

Food	Typical Western diet (g)	Optimal diet (g)
Wholegrains	50	225
Vegetables	250	400
Fruit	200	400
Nuts	0	25
Legumes	0	200
Fish	50	200
Refined grains	150	50
Red meat	100	0
Processed meat	50	0
White meat	75	50
Sugar-sweetened drinks	500	0

IMAGE 8.1

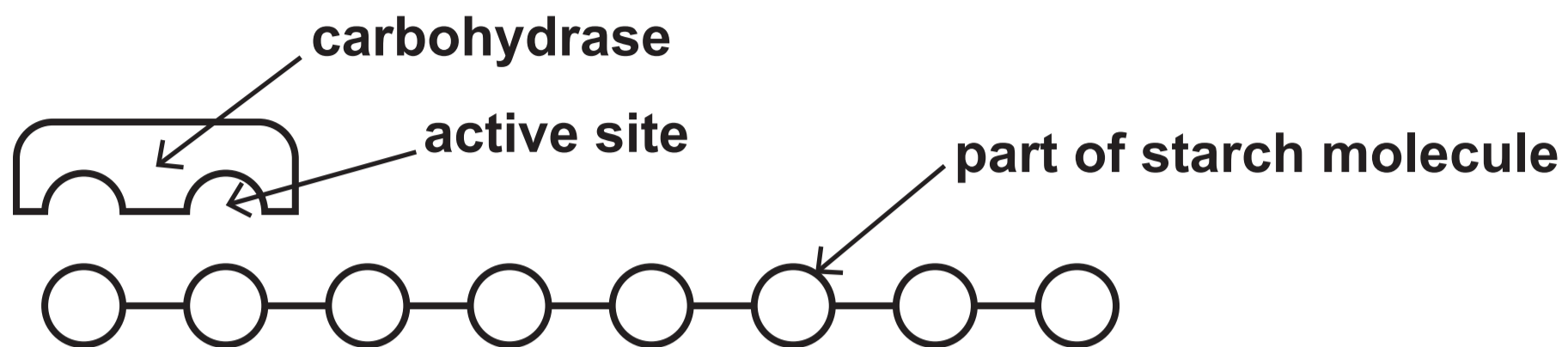
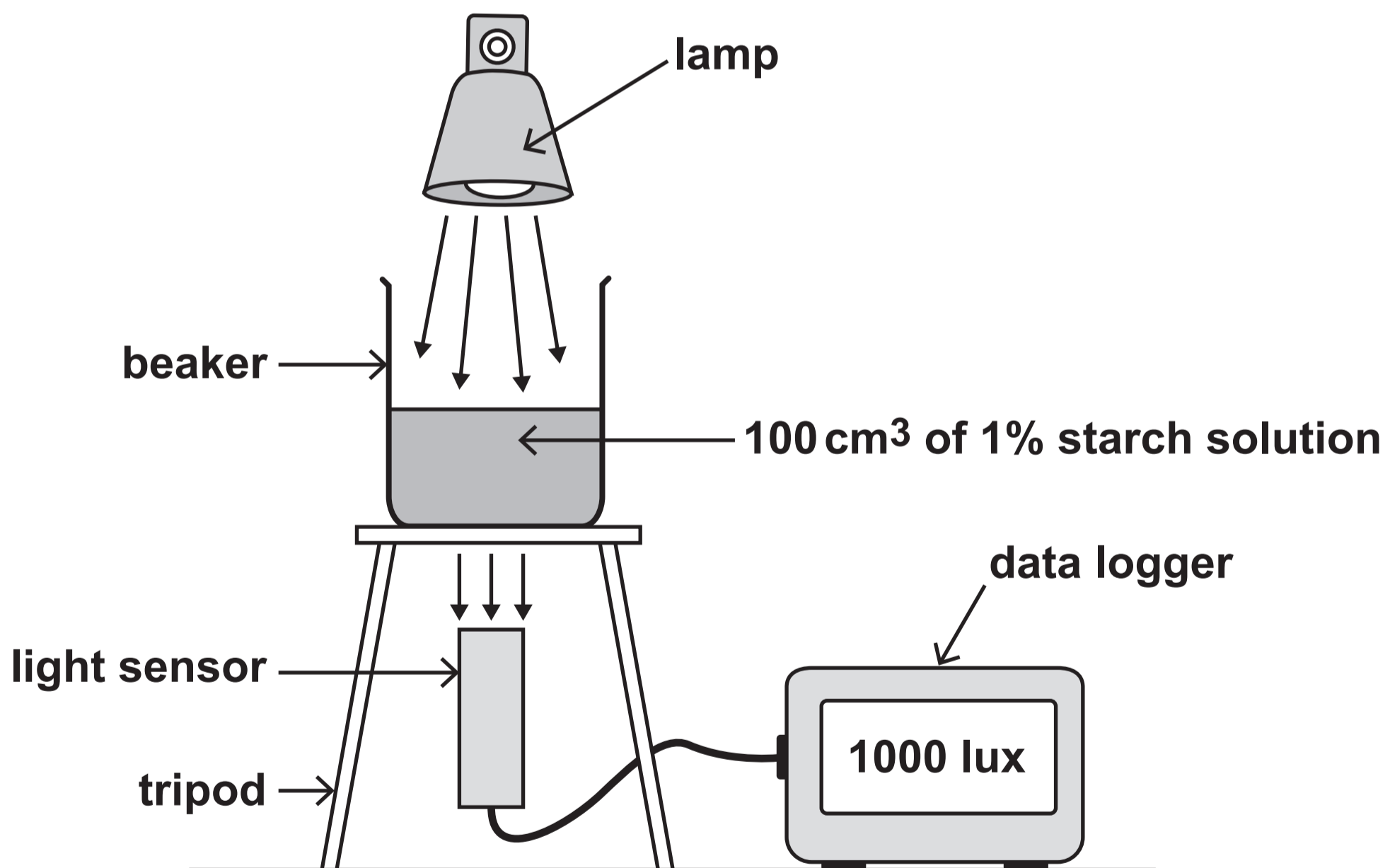


IMAGE 8.2



GRAPH 8.3

Intensity of light (lux)

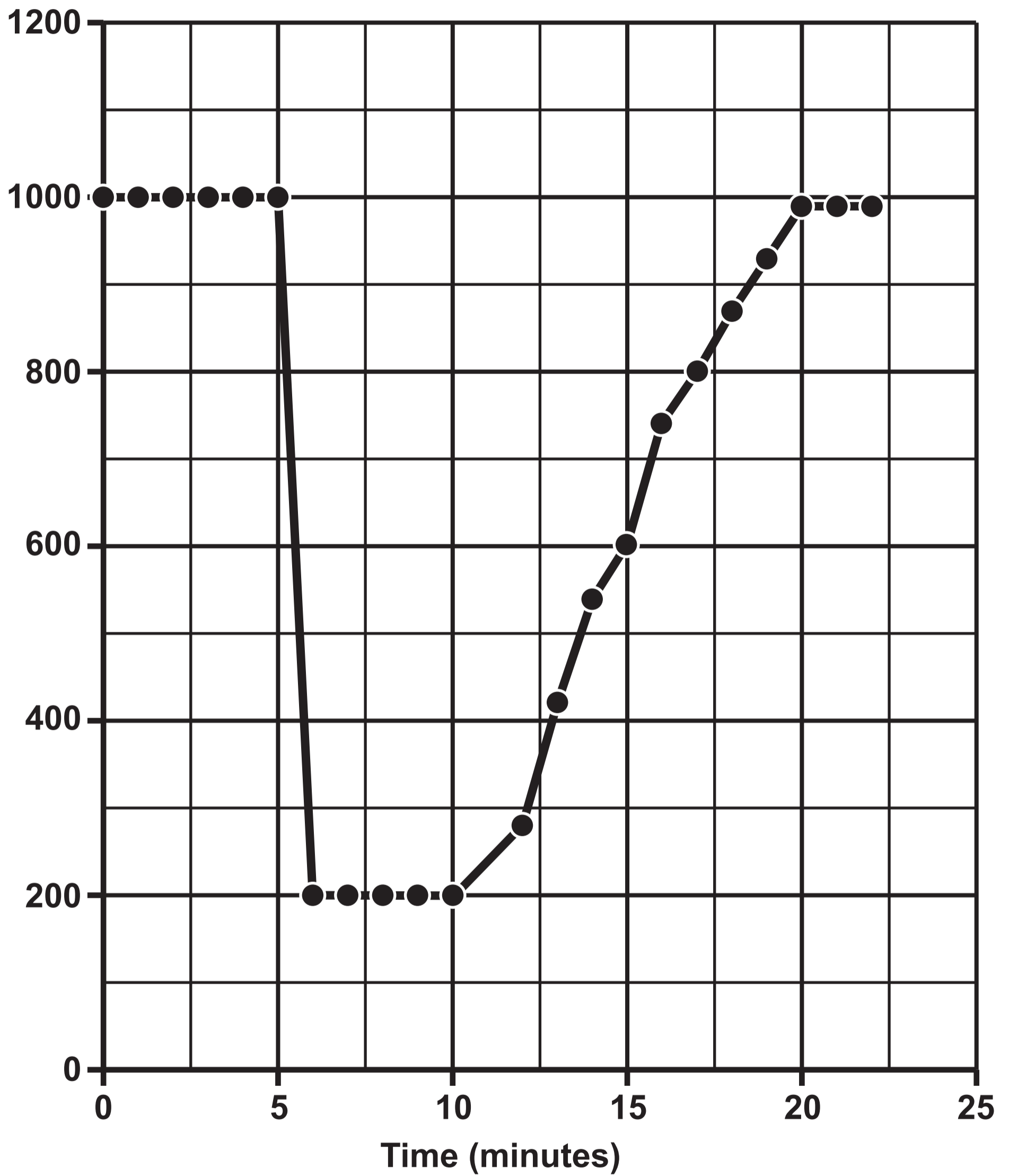


IMAGE 9.1

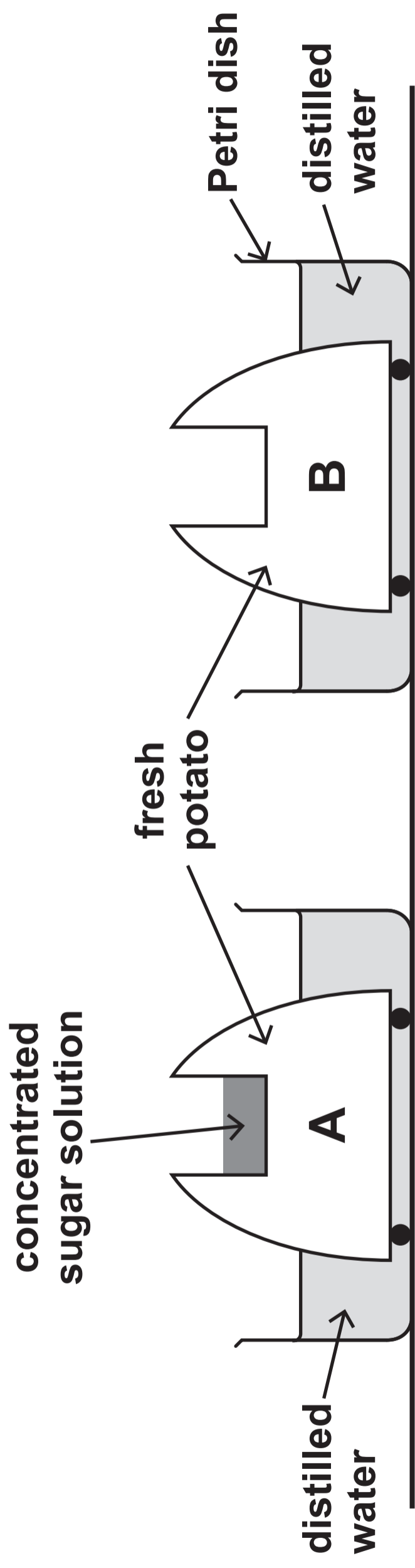


IMAGE 9.2

