GCE AS/A LEVEL

2400U20-1

TUESDAY, 23 MAY 2023 – MORNING

BIOLOGY – AS UNIT 2

BIODIVERSITY AND PHYSIOLOGY OF BODY SYSTEMS

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.	11	
2.	14	
3.	13	
4.	12	
5.	10	
6.	11	
7.	9	
Total	**80**	

(Turn over)

ADDITIONAL MATERIALS

In addition to this paper, you will require 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.

IMAGE 1.1 shows a region of lowland heath on the Pembrokeshire coast.

Heathland is dominated by grasses and shrubs, such as heather and gorse, and supports a very diverse range of wildlife. Grazing by large herbivores, such as sheep and ponies, maintains this habitat.

continued on the next page . . .

Question 1 continued

However, if the area is not grazed, it develops into woodland.

Since the 19th century, more than 75% of lowland heaths in the UK have been lost with a resulting loss of biodiversity.

1. (a) State what is meant by biodiversity.

[1 mark]

Question 1 continued

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

In an investigation, an area of former heathland, which had developed into silver birch woodland, was cleared of trees to restore it to heathland.

Within this area, a 50 m × 50 m square was fenced off to prevent the entry of grazing animals.

continued on the next page . . .

Question 1 (b) continued

Native ponies and sheep were allowed to graze the remaining area. This is shown in IMAGE 1.2

The study area was left for THREE years, after which time conservation group used Simpson's Diversity Index to assess the impact of grazing on the heathland biodiversity.

continued on the next page . . .

Question 1 (b) continued

They used 1 m^2 quadrats to sample both the restored heathland and the fenced area within it and recorded which species of plants were present.

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

GRAPH 1.3 shows the results of preliminary work to decide how many times to use the quadrat.

continued on the next page . . .

Question 1 (b) continued

It was decided to use 11 quadrats at each site.

Explain the reasons for this decision.

[2 marks]

continued on the next page . . .

Question 1 continued

1. (c) Look at TABLE 1.4 for Question 1 (c) in the separate Diagram Booklet.

TABLE 1.4 shows the number of quadrats in which different species of plants were present.

(i) Name the genus to which bell heather belongs.

_____

_____

[1 mark]

continued on the next page . . .

Question 1 (c) continued

1. (c) (ii) Explain why the values in the table do not provide information about the actual number of organisms present.

[1 mark]

continued on the next page . . .

Question 1 (c) continued

1. (c) (iii) Look at TABLE 1.5 for Question 1 (c) (iii) in the separate Diagram Booklet.

The unfenced area had a Simpson's Diversity Index of 0.87

The results for the fenced area are shown in TABLE 1.5

continued on the next page . . .

Question 1 (c) (iii) continued

Calculate the Simpson's Diversity Index for this site.

$$D = 1 - \frac{\sum n(n-1)}{N(N-1)}$$

where;

n **= the number of quadrats where the species was present**

N **= the total number of quadrats where species were found**

$\sum$ **= sum of**

continued on the next page . . .

Question 1 (c) (iii) continued

Space for working:

D = _____

[3 marks]

continued on the next page . . .

Question 1 continued

1. (d) Use all the information provided to answer the following questions.

(i) Conclude the effect of grazing on heathland biodiversity.

_____

_____

_____

_____

[1 mark]

continued on the next page . . .

Question 1 (d) continued

1. (d) (ii) It was found that grazing increased the number of quadrats in which bell heather was found. Suggest an explanation for this.

[2 marks]

(Total for Question 1 = 11 marks)

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

IMAGE 2.1 shows a diagram of the blood supply to the cells of a body tissue.

(a) (i) Identify the structures labelled X and Y in IMAGE 2.1

X _____

Y _____

[2 marks]

continued on the next page . . .

Question 2 (a) continued

2. (a) (ii) DRAW AN ARROW on IMAGE 2.1 to show the direction of blood flow through the capillary network.

[1 mark]

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 the changes in the hydrostatic pressure and osmotic pressure of the blood flowing through the capillaries.

continued on the next page . . .

Question 2 (b) continued

2. (b) (i) Explain why the hydrostatic pressure decreases as the blood travels along the capillaries.

[2 marks]

Question 2 (b) continued

2. (b) (ii) Explain why the osmotic pressure remains constant as the blood travels along the capillaries.

[2 marks]

Question 2 (b) continued

2. (b) (iii) Use the information provided in GRAPH 2.2 to explain why structure Y in IMAGE 2.1 is necessary.

[2 marks]

Question 2 continued

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

Arterioles are responsible for the regulation of blood flow through a capillary network. IMAGE 2.3 shows a section through an arteriole.

Explain how the structure of the wall of the arteriole, shown in IMAGE 2.3, can reduce blood flow to a capillary network.

[2 marks]

continued on the next page . . .

Question 2 continued

2. (d) Look at TABLE 2.4 for Question 2 (d) in the separate Diagram Booklet.

Arterioles are also responsible for the distribution of blood around the body. TABLE 2.4 shows the blood flow in the human body at rest and during vigorous exercise.

continued on the next page . . .

Question 2 (d) continued

2. (d) (i) Calculate the percentage increase in blood flow to the skin during vigorous exercise.

Space for working:

Percentage = _____

[2 marks]

continued on the next page . . .

Question 2 (d) continued

2. (d) (ii) Suggest the significance of increased blood flow to the skin during exercise.

[1 mark]

(Total for Question 2 = 14 marks)

3. Look at IMAGE 3.1 for Question 3 in the separate Diagram Booklet.

IMAGE 3.1 shows the surface view of stomata found on the lower surface of Kalanchoe (KALANCHOE SP.) leaves and an enlarged view of one of the stomata. Kalanchoe is a xerophyte.

(a) (i) Identify the cells labelled A and B in IMAGE 3.1

A _____

B _____

[1 mark]

continued on the next page . . .

Question 3 (a) continued

3. (a) (ii) Describe the mechanism that causes stomata to open.

[4 marks]

continued on the next page . . .

Question 3 (a) continued

3. (a) (iii) Suggest an advantage to Kalanchoe of being able to close stomata.

[1 mark]

continued on the next page . . .

Question 3 continued

3. (b) In the 1990s, researchers investigated the effect of CO_2 concentration on stomatal density in a tree species known as GINKGO BILOBA using the following method:

- **One group of 40 young trees were grown in a greenhouse at atmospheric CO_2 concentrations (350 ppm).**

continued on the next page . . .

Question 3 (b) continued

- **A second group of 40 young trees were grown in a different greenhouse at a higher CO_2 concentration (560 ppm).**

  All other conditions were constant for the two groups.
- **After three years growth, the mean number of stomata per mm^2 was calculated for both groups of trees.**

continued on the next page . . .

Question 3 (b) continued

Look at GRAPH 3.2 for Question 3 (b) in the separate Diagram Booklet. The results of the investigation are shown in GRAPH 3.2

continued on the next page . . .

Question 3 (b) continued

3. (b) (i) State TWO variables that should have been controlled to maintain constant conditions.

I. _____

_____

_____

II. _____

_____

[1 mark]

continued on the next page . . .

Question 3 (b) continued

3. (b) (ii) State ONE conclusion that can be drawn from this investigation.

[1 mark]

continued on the next page . . .

Question 3 (b) continued

3. (b) (iii) Using your knowledge of the functions of stomata, explain the results of this investigation.

[3 marks]

continued on the next page . . .

Question 3 continued

3. (c) Darwin described GINKGO BILOBA as a 'living fossil', as fossils of the genus GINKGO have been found in rocks from the Mesozoic era (252 to 66 million years ago). Stomata can be seen on the surface of fossilised leaves.

continued on the next page . . .

Question 3 (c) continued

3. (c) Look at GRAPH 3.3 for Question 3 (c) in the separate Diagram Booklet. GRAPH 3.3 shows the number of stomata per mm^2 from three different species of the genus GINKGO.

Using the information in GRAPH 3.2 and GRAPH 3.3, suggest what conclusions could be made about the concentration of CO_2 during the Mesozoic era.

_____

_____

[2 marks]

(Total for Question 3 = 13 marks)

4. Look at IMAGE 4.1 and IMAGE 4.2 for Question 4 in the separate Diagram Booklet.

Emphysema is a disease of the lungs that results in the breakdown of the walls between adjacent alveoli.

IMAGE 4.1 and IMAGE 4.2 show sections of lung tissue from an adult with healthy lungs and an adult with emphysema.

continued on the next page . . .

Question 4 continued

4. (a) (i) Using IMAGE 4.1 and your own knowledge, describe AND explain TWO adaptations of the lungs for gas exchange.

[2 marks]

4. (a) (ii) Using IMAGE 4.2, explain why the person with emphysema would have a lower oxygen saturation of haemoglobin than an adult with healthy lungs.

[2 marks]

continued on the next page . . .

Question 4 continued

4. (b) The health of the lungs can be assessed by using a device called a spirometer, which measures the rate and depth of inspiration and expiration.

(i) Describe the process of inspiration.

(Turn over)

[4 marks]

continued on the next page . . .

Question 4 (b) continued

4. (b) (ii) Look at IMAGE 4.3, IMAGE 4.4 and key for Question 4 (b) (ii) in the separate Diagram Booklet.

During an investigation an adult with healthy lungs and an adult with emphysema were asked to:

- **breathe normally for three breaths**
- **then to take a very deep breath to fill their lungs, known as a forced inspiration**

continued on the next page . . .

Question 4 (b) (ii) continued

- **then to expire as completely and as rapidly as possible, known as a forced expiration.**

IMAGE 4.3 and IMAGE 4.4 show the spirometry traces produced.

Look at TABLE 4.5 and Emphysema fact file for Question 4 (b) (ii) in the separate Diagram Booklet.

continued on the next page . . .

Question 4 (b) (ii) continued

Complete TABLE 4.5 to state TWO differences between the two spirometry traces in IMAGE 4.3 and IMAGE 4.4 and use the information from the fact file to explain these differences.

[4 marks]

(Total for Question 4 = 12 marks)

5. Some heterotrophic organisms are also saprotrophic. Fungi are examples of saprotrophic organisms.

(a) (i) State the meaning of the term heterotrophic organism.

[1 mark]

Question 5 (a) continued

5. (a) (ii) Describe the process of saprotrophic nutrition in fungi.

[3 marks]

continued on the next page . . .

Question 5 continued

5. (b) Look at IMAGE 5.1 and IMAGE 5.2 for Question 5 (b) in the separate Diagram Booklet.

AMOEBA and HYDRA are also heterotrophic organisms. IMAGE 5.1 and IMAGE 5.2 show AMOEBA and HYDRA feeding. The images also show food which has previously been taken into the organisms.

continued on the next page . . .

Question 5 (b) continued

Use IMAGE 5.1, IMAGE 5.2 and your knowledge of digestion to describe ONE similarity and TWO differences between the adaptations of AMOEBA and HYDRA for obtaining their nutrition.

Similarity:

continued on the next page . . .

Difference I:

Difference II:

[3 marks]

continued on the next page . . .

Question 5 continued

5. (c) A student used an eyepiece graticule to measure the length of an AMOEBA on a microscope slide at a magnification of × 40

In order to calculate the actual size of the AMOEBA, the student had to calibrate the eyepiece graticule. She used a 1 mm stage micrometer slide which had 100 divisions.

continued on the next page . . .

Question 5 (c) continued

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

IMAGE 5.3 shows the field of view from a microscope with the eyepiece graticule and stage micrometer labelled.

continued on the next page . . .

Question 5 (c) continued

5. (c) (i) Use IMAGE 5.3 to calculate the length of ONE eyepiece unit in micrometres.

Space for working:

One eyepiece unit = _____ µm

[2 marks]

continued on the next page . . .

Question 5 (c) continued

5. (c) (ii) The AMOEBA at × 40 magnification measured 27 eyepiece units (epu). Calculate the actual length of the AMOEBA in micrometres.

Space for working:

Question 5 (c) (ii) continued

AMOEBA length = _____ µm

[1 mark]

(Total for Question 5 = 10 marks)

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

IMAGE 6.1 shows a transverse section through a root.

(a) Use the letters (A – E) from IMAGE 6.1 to identify the following:

I. the tissue responsible for transporting organic solutes

_____

II. the tissue where root hair cells are located

_____

continued on the next page . . .

Question 6 (a) continued

III. the tissue containing the Casparian strip

_____

[2 marks]

continued on the next page . . .

Question 6 continued

6. (b) Water can be transported across the tissue labelled B by the apoplast and symplast pathways.

Describe these TWO pathways.

[2 marks]

continued on the next page . . .

Question 6 continued

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

IMAGE 6.2 shows an experiment to demonstrate root pressure.

The stem of a well – watered plant is cut 3 cm above the level of the soil. The cut stem is inserted into a glass tube and secured with rubber tubing to ensure a watertight seal.

continued on the next page . . .

Question 6 (c) continued

A small volume of water is poured into the glass tube and its level marked.

After several hours the water level in the tube rises.

6. (c) (i) Explain the role of structure C, in IMAGE 6.1, in the uptake of water into the xylem vessels and in the generation of root pressure.

(Turn over)

[4 marks]

continued on the next page . . .

Question 6 (c) continued

6. (c) (ii) If the same experiment is repeated with cyanide added to the soil, the water level in the tube remains constant. Explain this observation.

[3 marks]

(Total for Question 6 = 11 marks)

7. **Look at IMAGE 7.1, IMAGE 7.2 and IMAGE 7.3 for Question 7 in the separate Diagram Booklet.**

IMAGE 7.1, IMAGE 7.2 and IMAGE 7.3 show the skulls and dentition from three different mammals and information regarding their classification and diet.

Describe and explain how the dentition of the white – tailed deer, the grey wolf and North American black bear is adapted to their respective diets.

_____

_____

(Turn over)

(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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GCE AS/A LEVEL

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TUESDAY, 23 MAY 2023 – MORNING

BIOLOGY – AS UNIT 2

BIODIVERSITY AND PHYSIOLOGY OF BODY SYSTEMS

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)

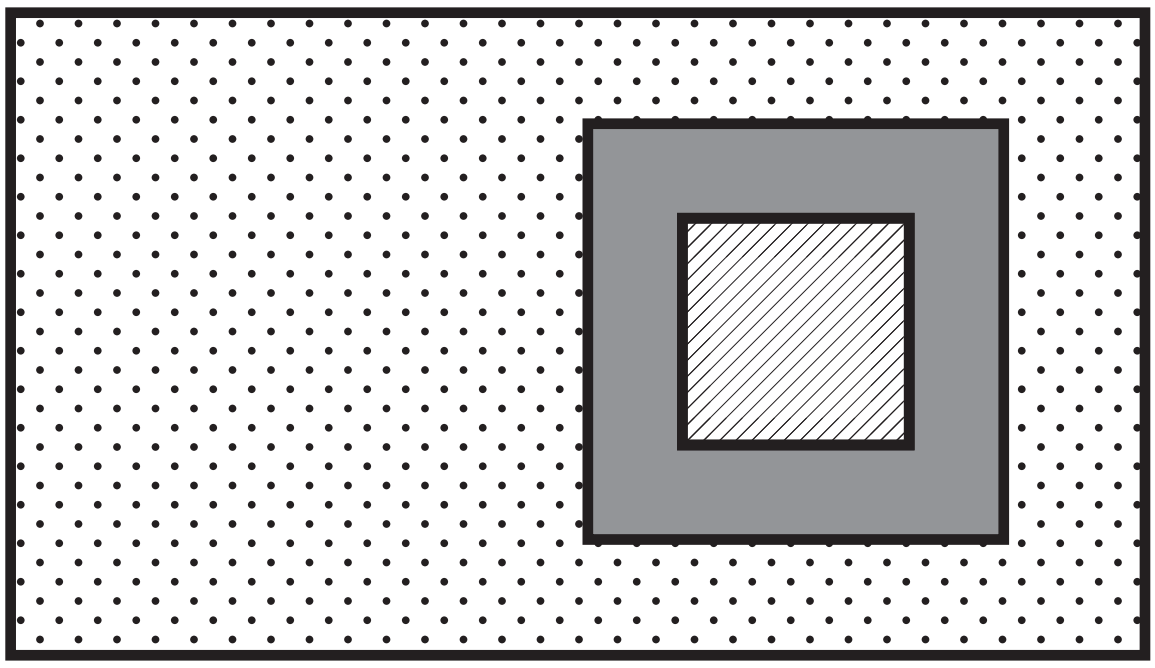
IMAGE 1.2

Key:

= woodland

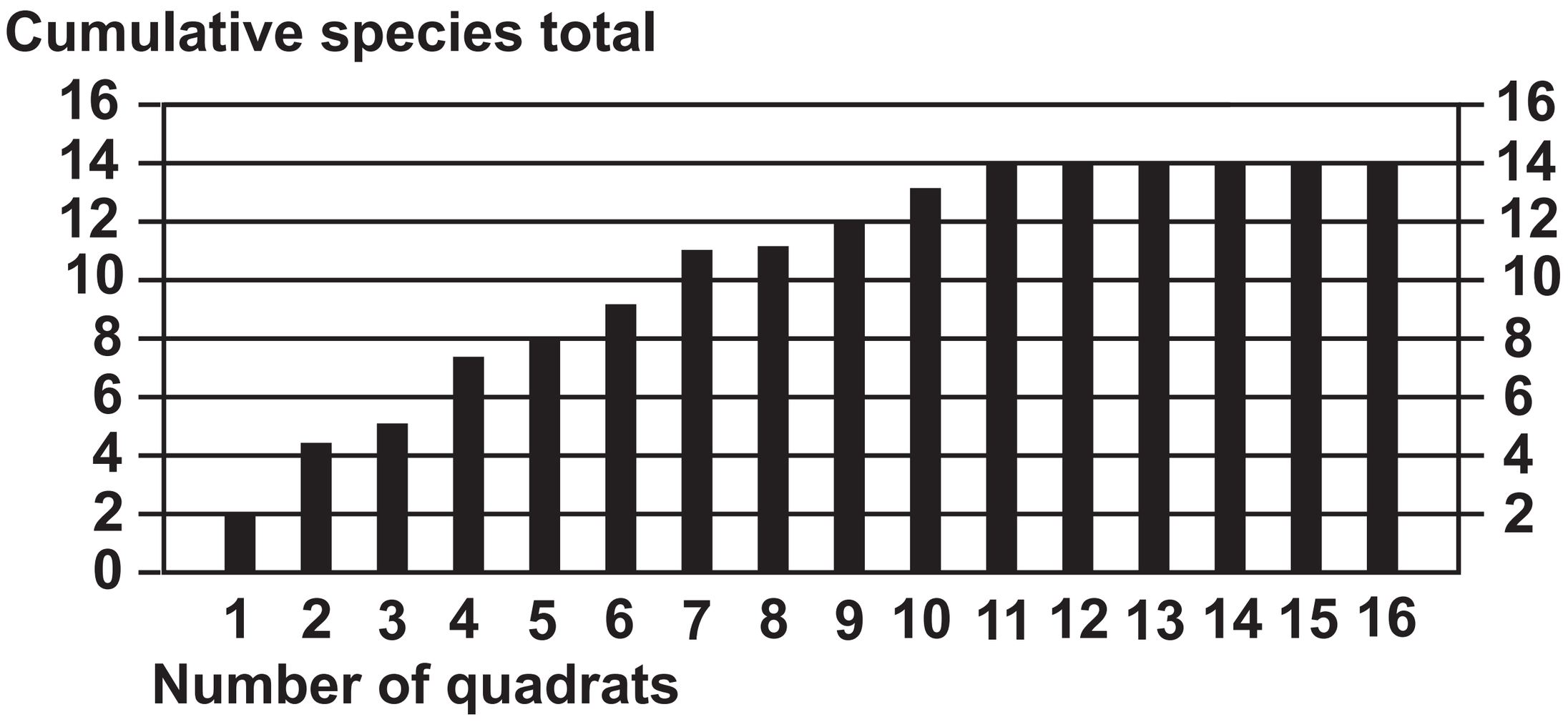
= restored heathland
unfenced
grazers present

= restored heathland
fenced
grazers absent



Question 1 (b)

GRAPH 1.3



Question 1 (c)

TABLE 1.4

Common name	Scientific name	Relative height of plant	Number of quadrats in which the species was present	
			Fenced area	Unfenced area
Common bent grass	AGROSTIS CAPILLARIS	short	1	7
Sweet vernal grass	ANTHOXANTHUM ODORATUM	short	1	4
Sedge	CAREX PILULIFERA	short	1	3
Gorse	ULEX EUROPAEUS	medium	11	5
Bramble	RUBUS FRUTICOSUS	medium	8	3
Silver birch	BETULA PENDULA	tall	10	1
Ling heather	CALLUNA VULGARIS	short	1	9
Bell heather	ERICA CINEREA	short	1	8

Question 1 (c) (iii)

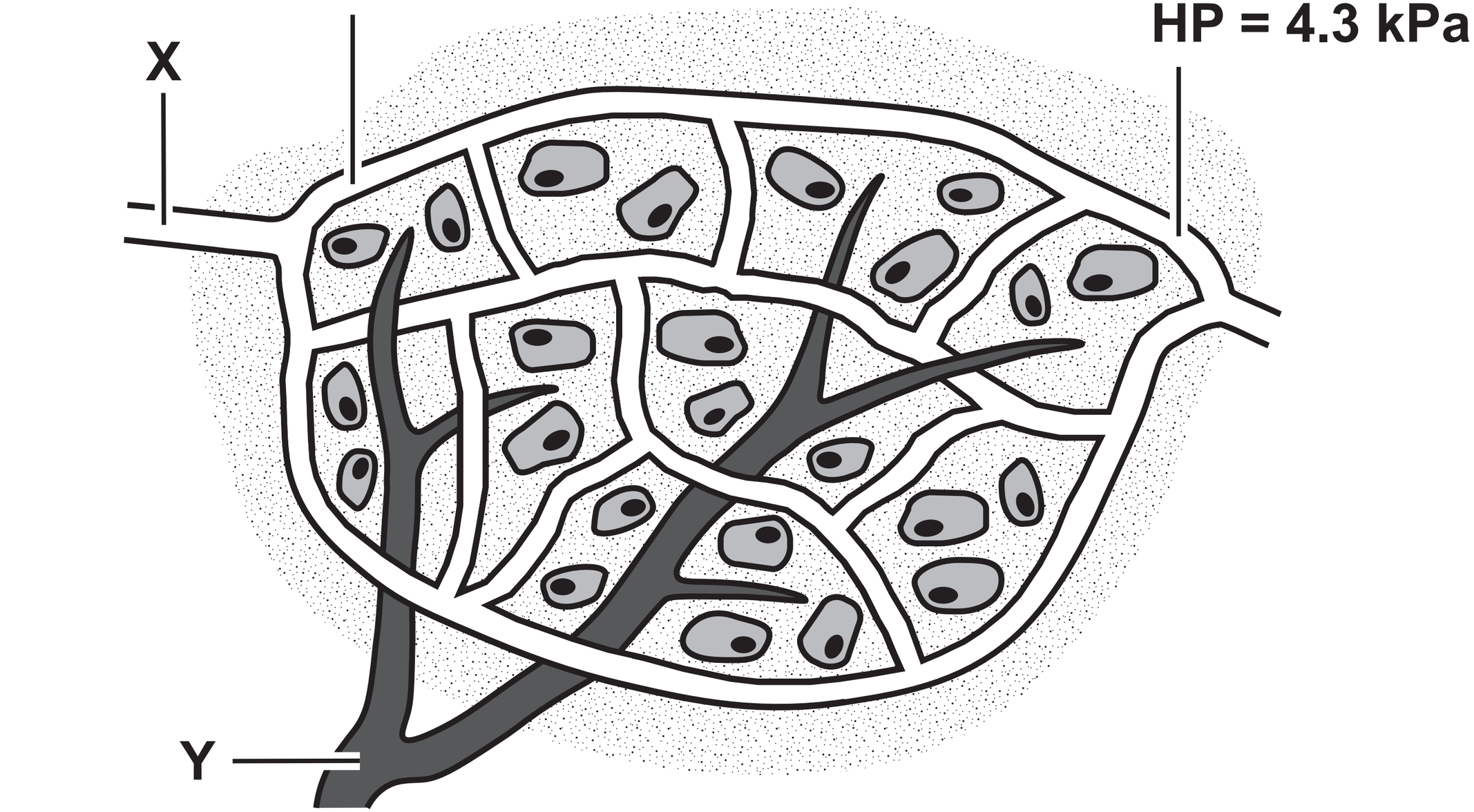
TABLE 1.5

Common name	n	$(n-1)$	$n(n-1)$
Common bent grass	1		
Sweet vernal grass	1		
Sedge	1		
Gorse	11		
Bramble	8		
Silver birch	10		
Ling heather	1		
Bell heather	1		
$N =$		$\sum n(n-1) =$	
$N(N-1) =$			

Question 2

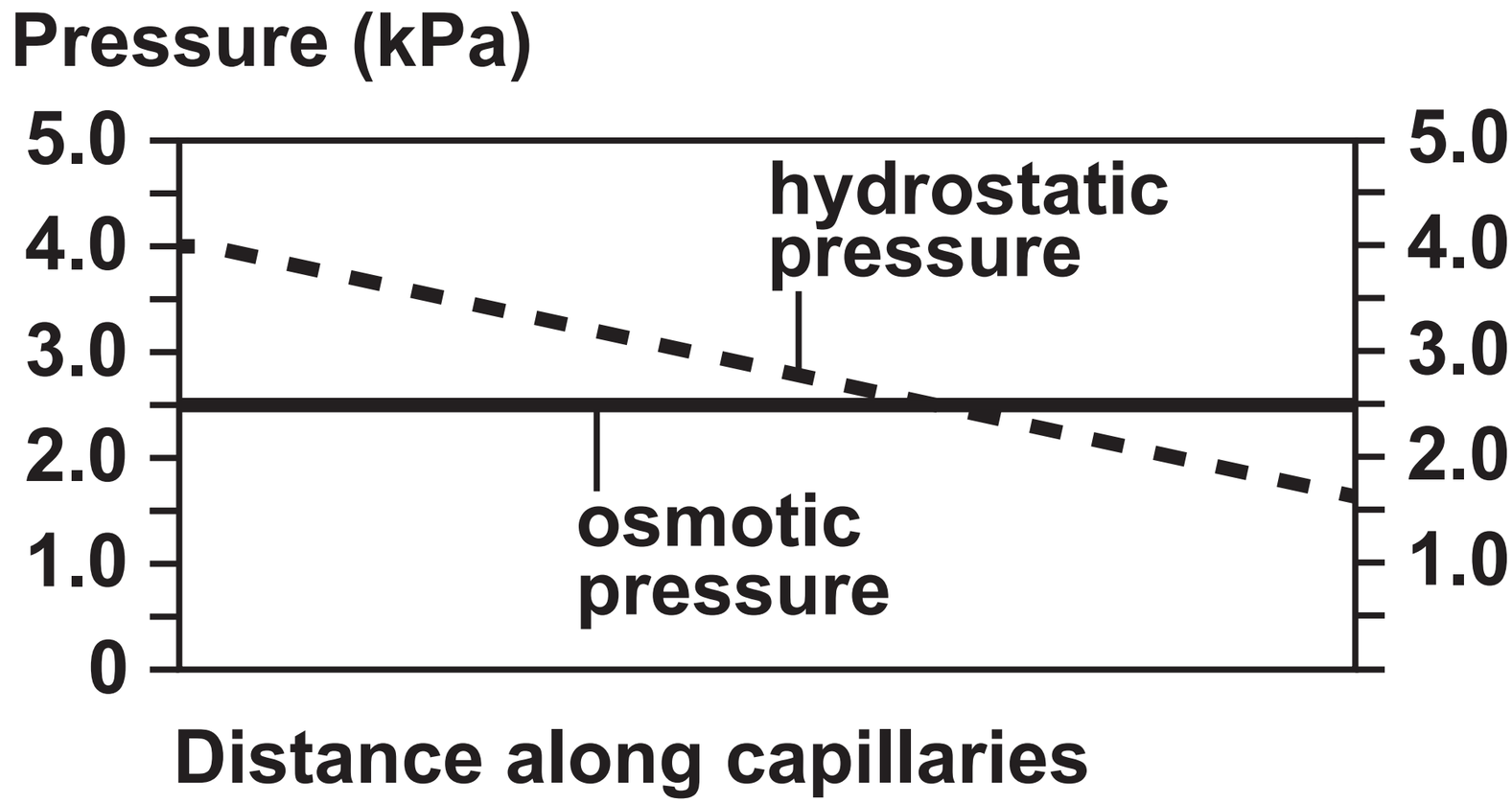
IMAGE 2.1

HP = hydrostatic pressure



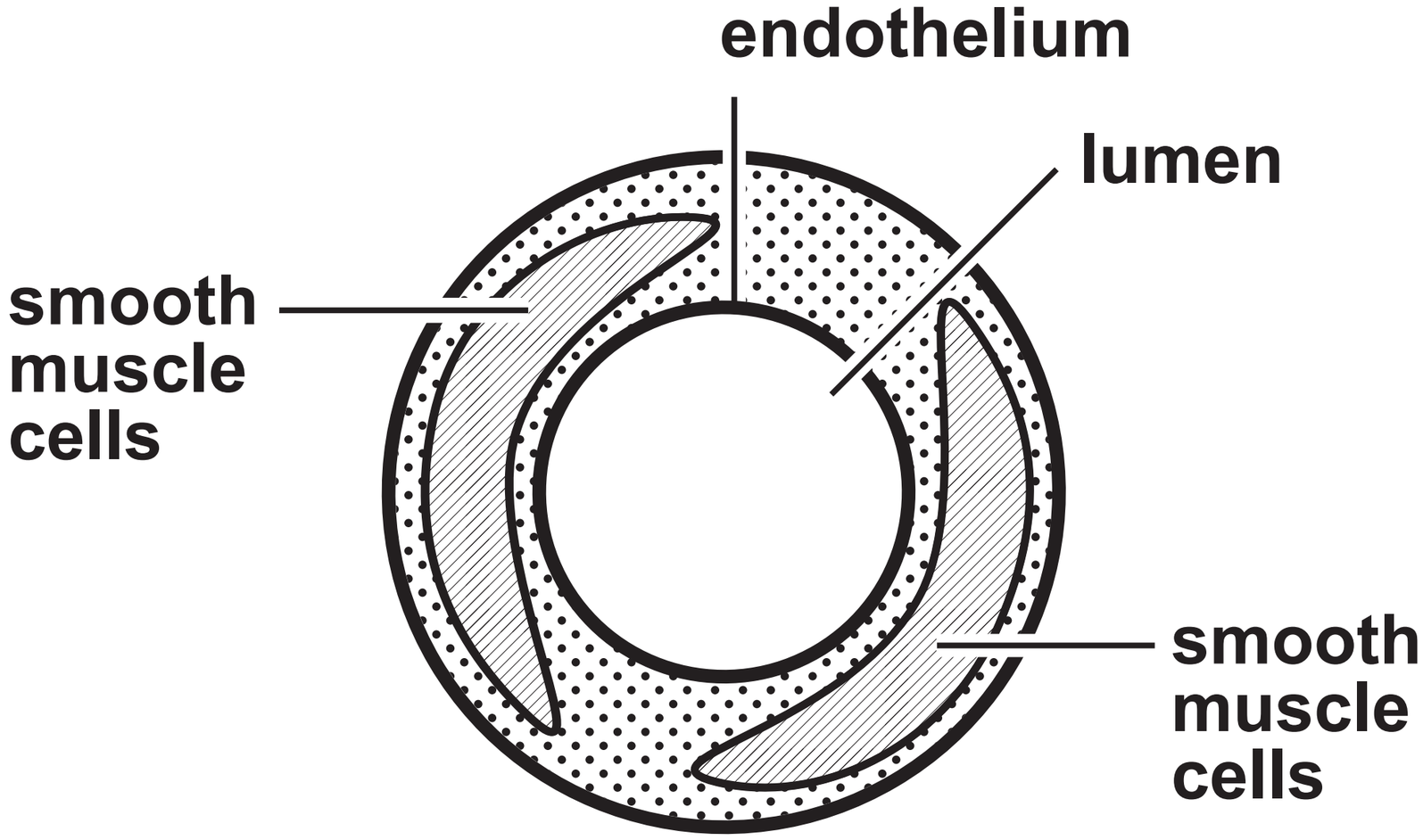
Question 2 (b)

GRAPH 2.2



Question 2 (c)

IMAGE 2.3



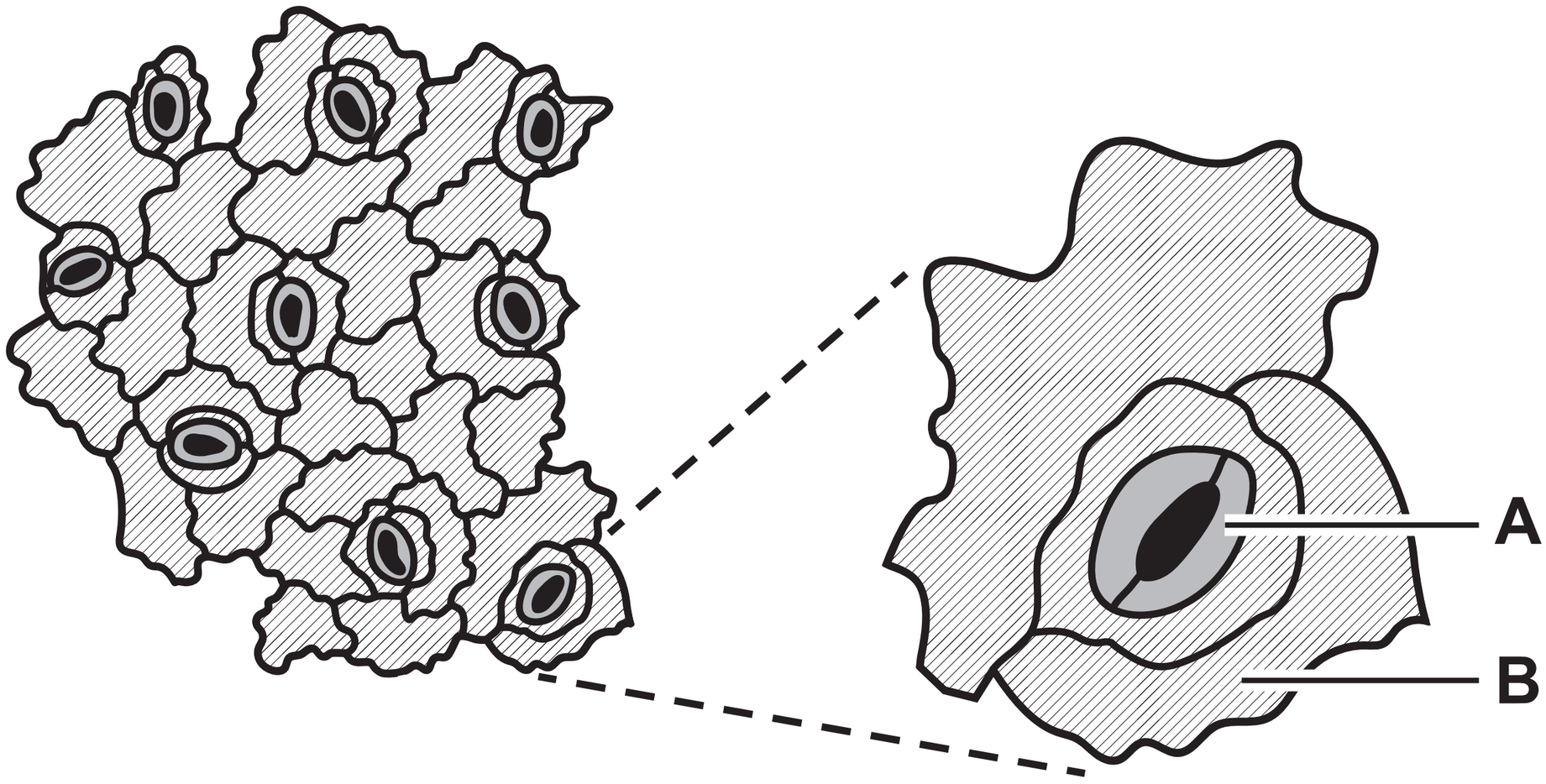
Question 2 (d)

TABLE 2.4

Body structure	Blood flow / $cm^3\ min^{-1}$	
	At rest	During vigorous exercise
skeletal muscles	1000	125 000
skin	400	1900
stomach & intestines	1400	600
brain	750	750
other	2050	1750
Total	5600	130 000

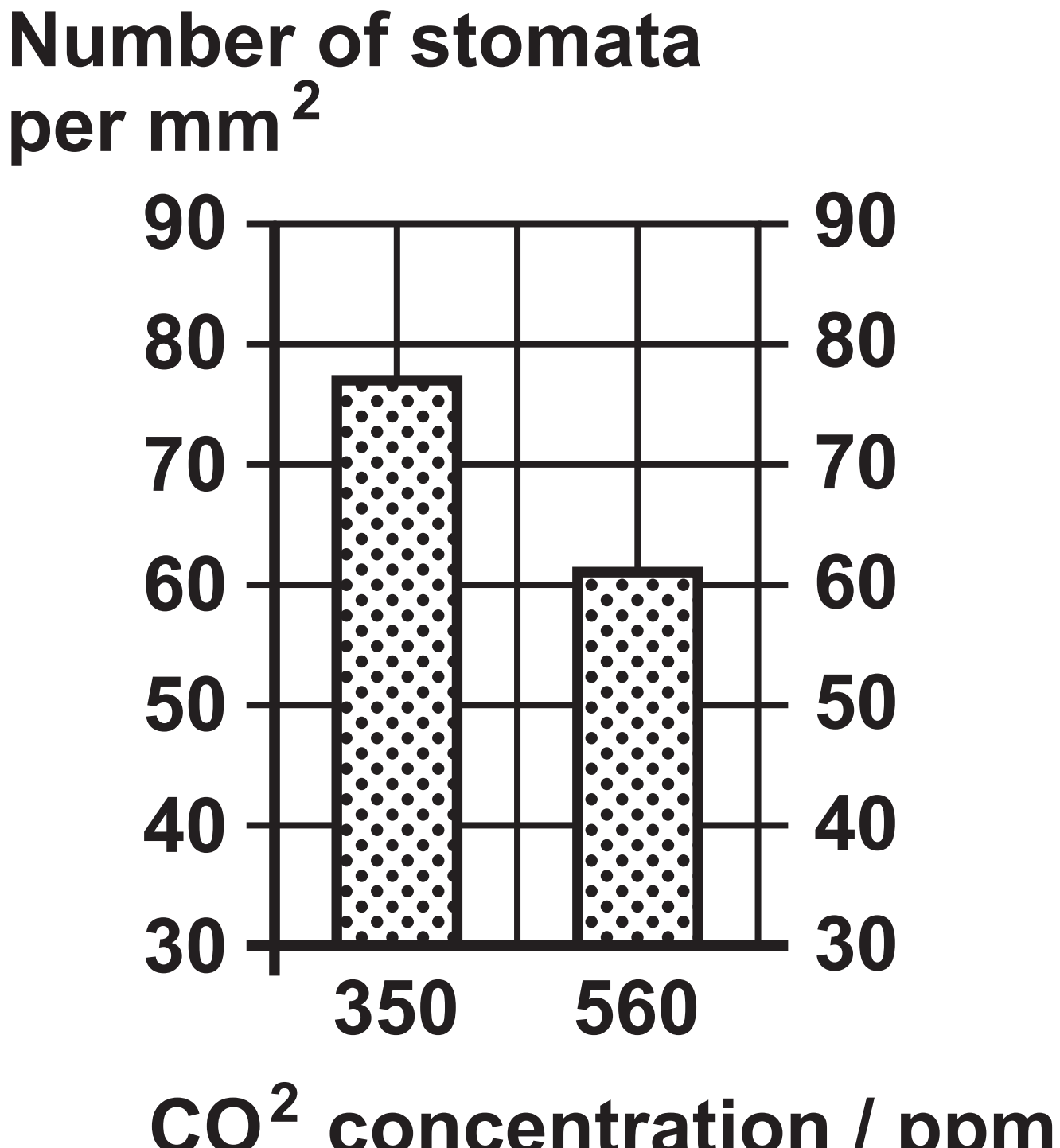
Question 3

IMAGE 3.1



Question 3 (b)

GRAPH 3.2



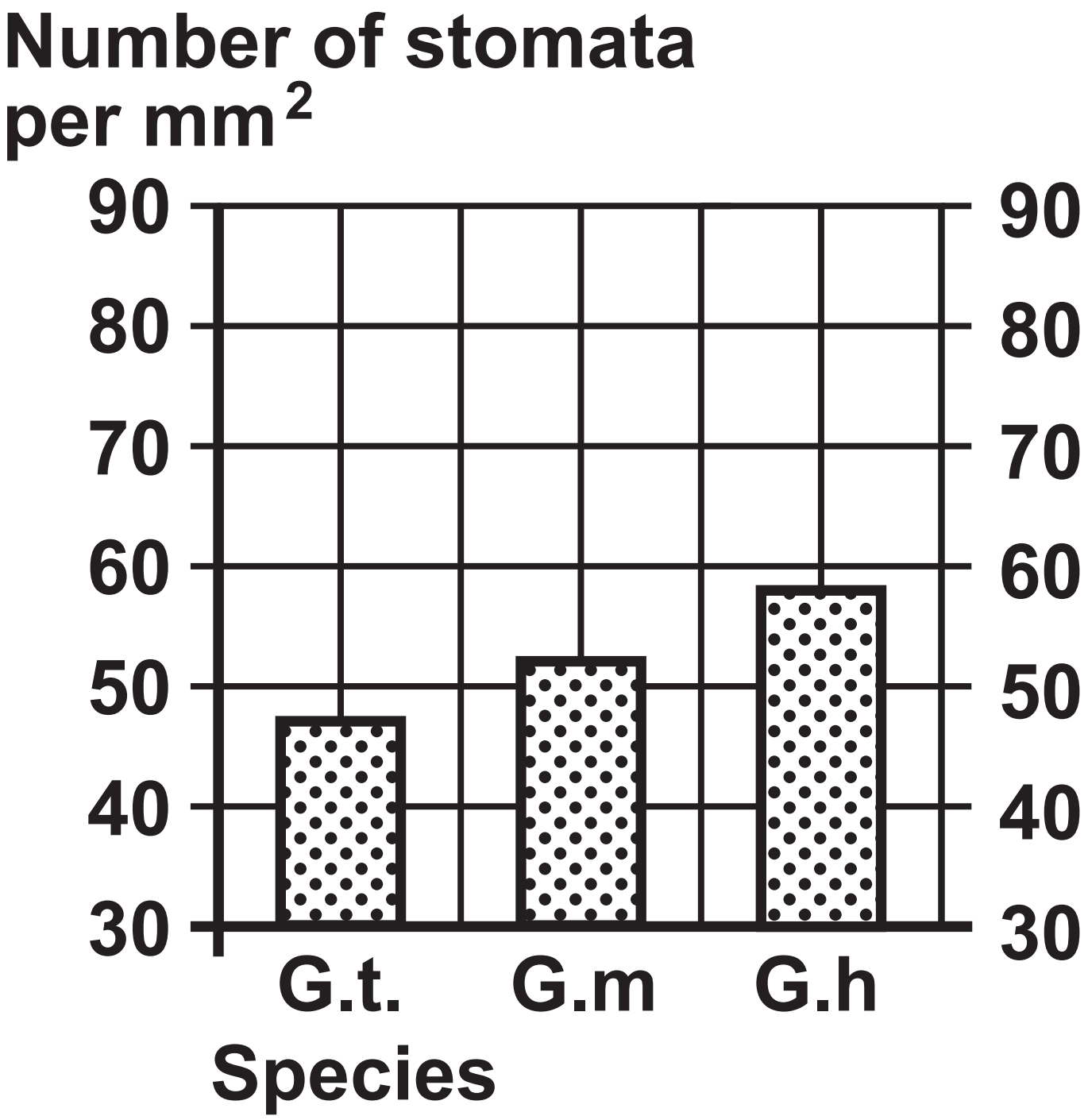
Question 3 (c)

GRAPH 3.3

Key:
G.t. = G. TROEDSSONNI
rocks 237 – 200 million years old

G.m. = G. MARGINATUS
rocks 200 – 174 million years old

G.h. = G. HUTTONII
rocks 174 – 163 million years old



Question 4

IMAGE 4.1
Lung tissue from an adult with healthy lungs

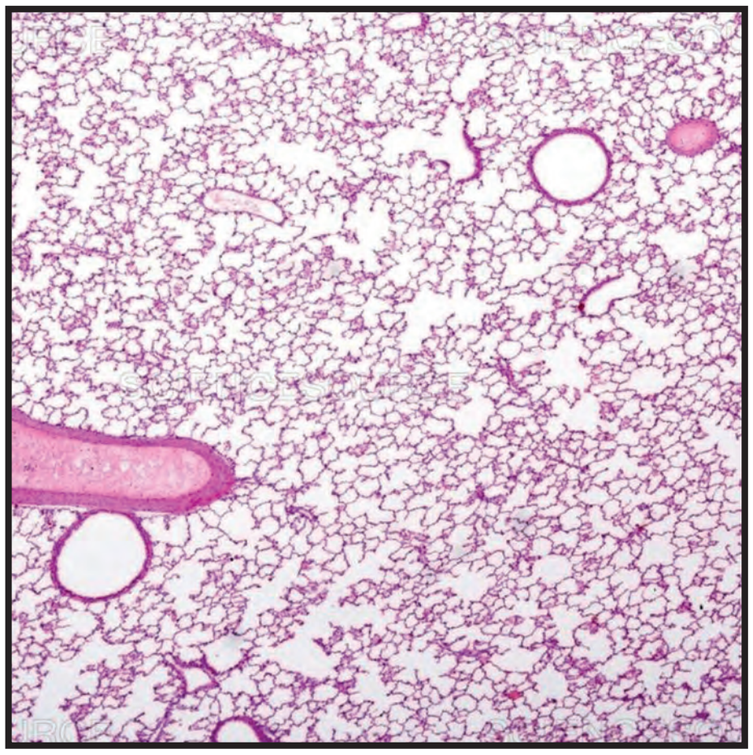
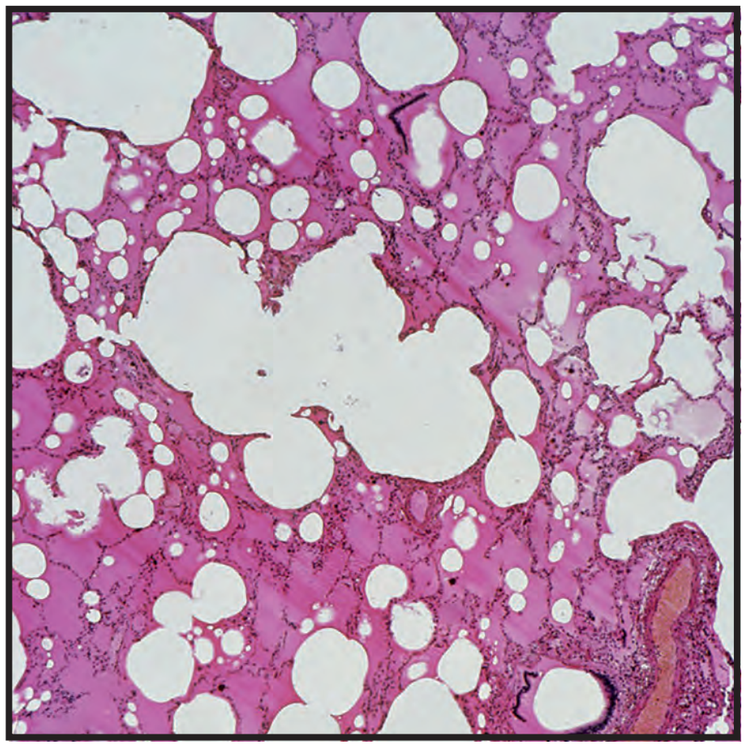


IMAGE 4.2
Lung tissue from an adult with emphysema



Question 4 (b) (ii)

Key

INSPIRATORY CAPACITY:	**Total volume of air that can be taken into the lungs during inspiration.**
FORCED VITAL CAPACITY:	**Total volume of air that can be forced out of the lungs following a forced inspiration.**
RESIDUAL VOLUME:	**Volume of air that cannot be removed from the lungs.**

Question 4 (b) (ii)
Spirometry traces

IMAGE 4.3 Adult with healthy lungs

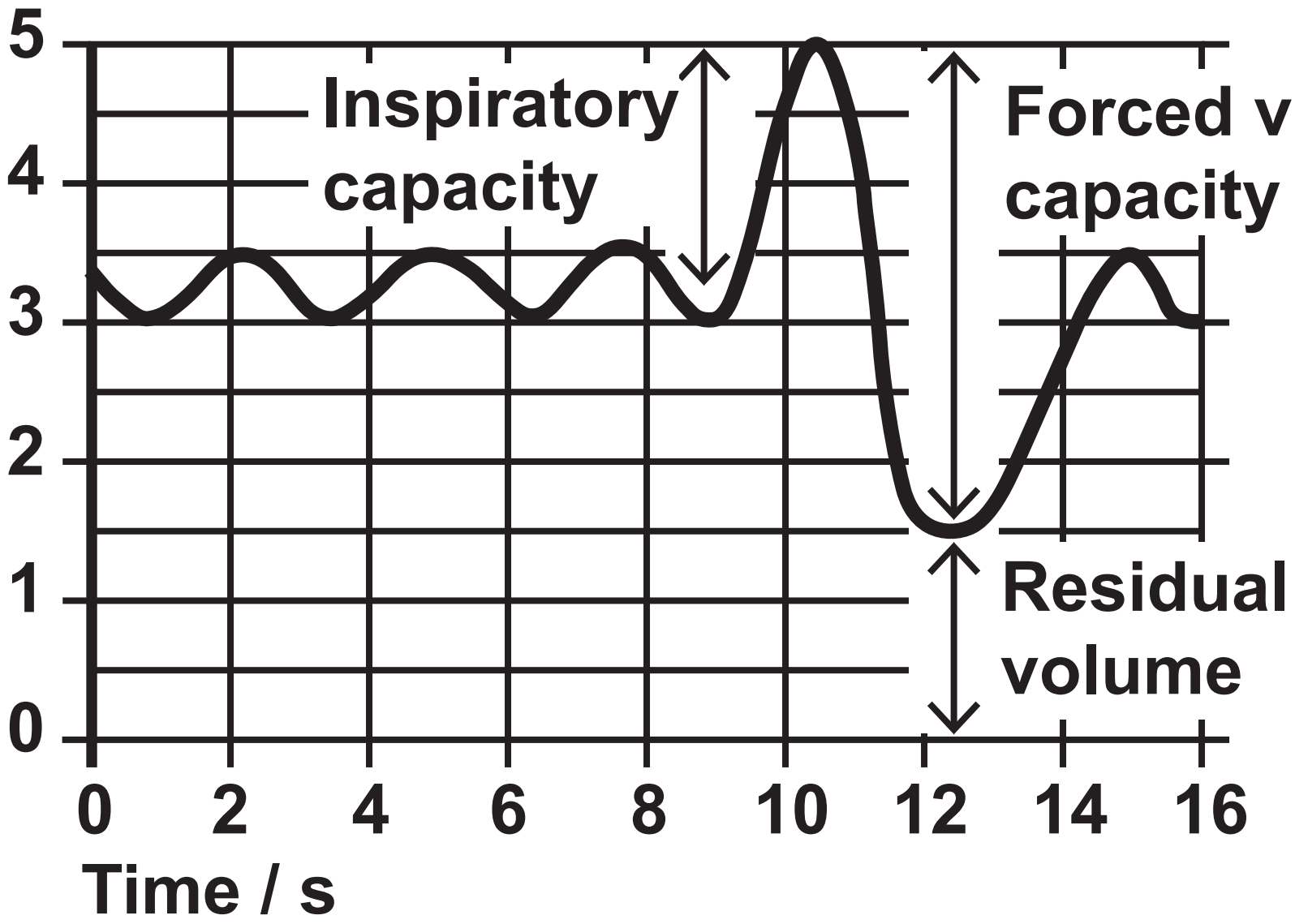
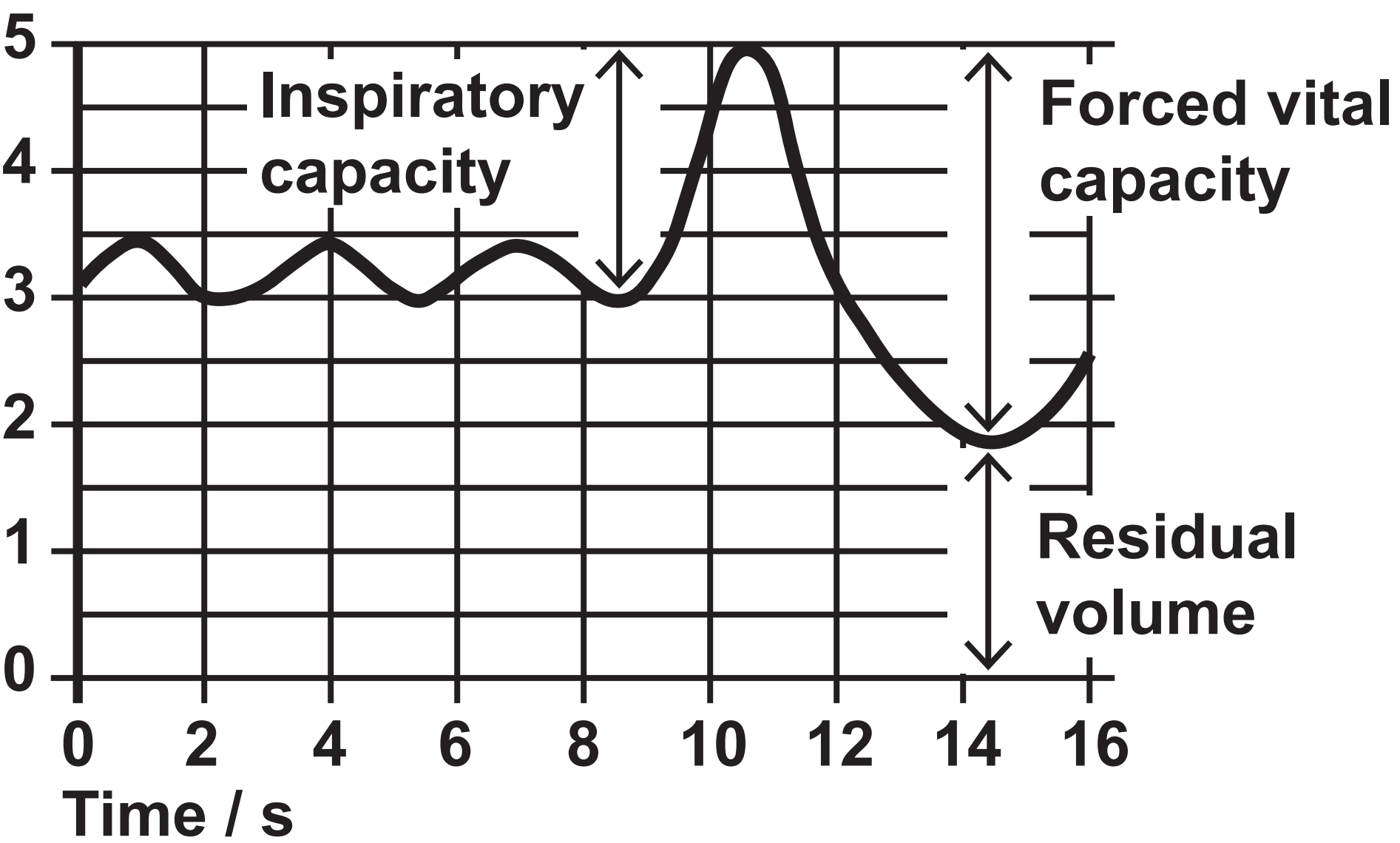


IMAGE 4.4 Adult with emphysema



Question 4 (b) (ii)

Emphysema fact file

Emphysema fact file

Emphysema causes the following physical effects on the lungs:

- **loss of elastic tissue from the lungs**
- **thickening of the walls of the bronchioles**
- **increased mucus production within the bronchioles.**

Question 4 (b) (ii)

TABLE 4.5

Difference	Explanation
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Question 5

IMAGE 5.1
AMOEBA feeding

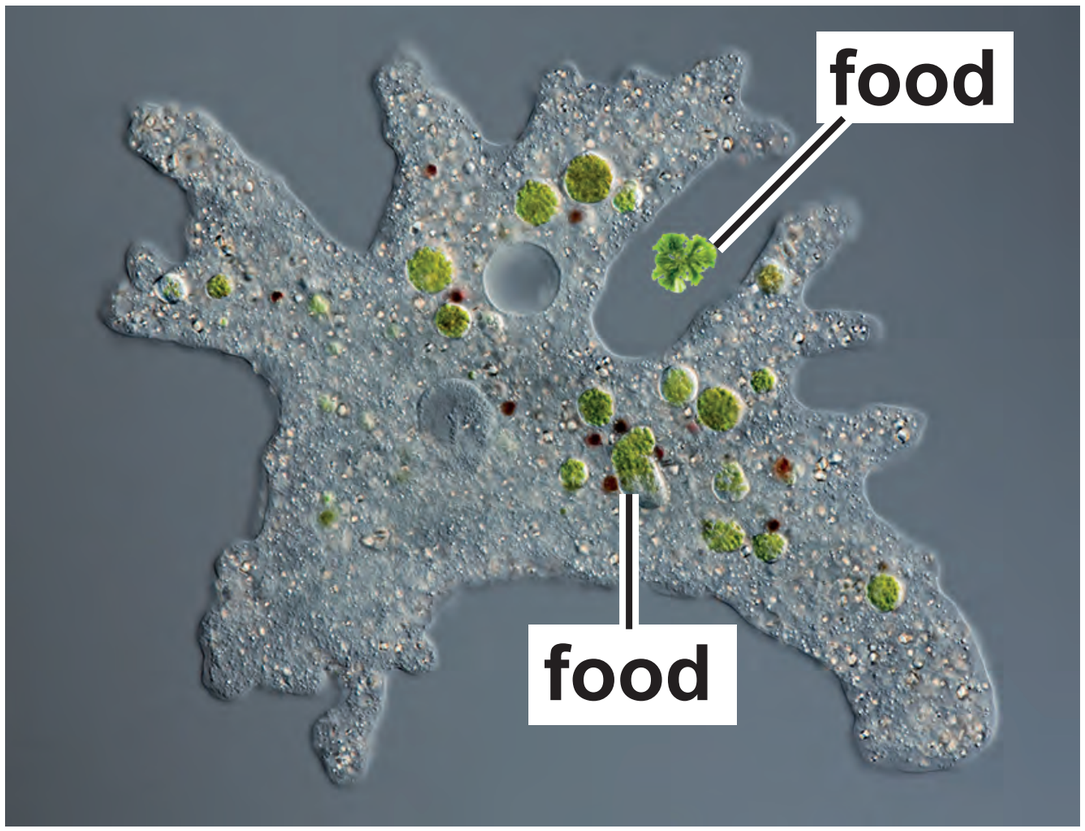
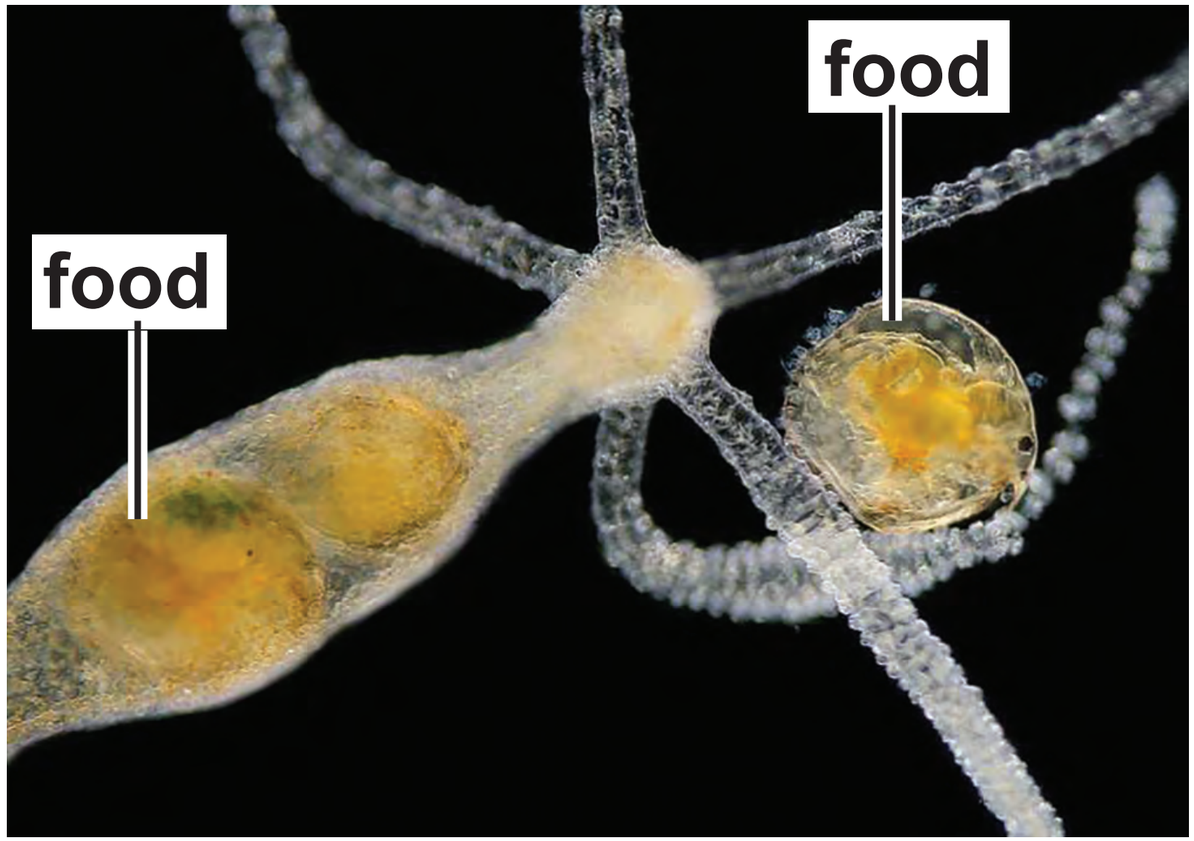
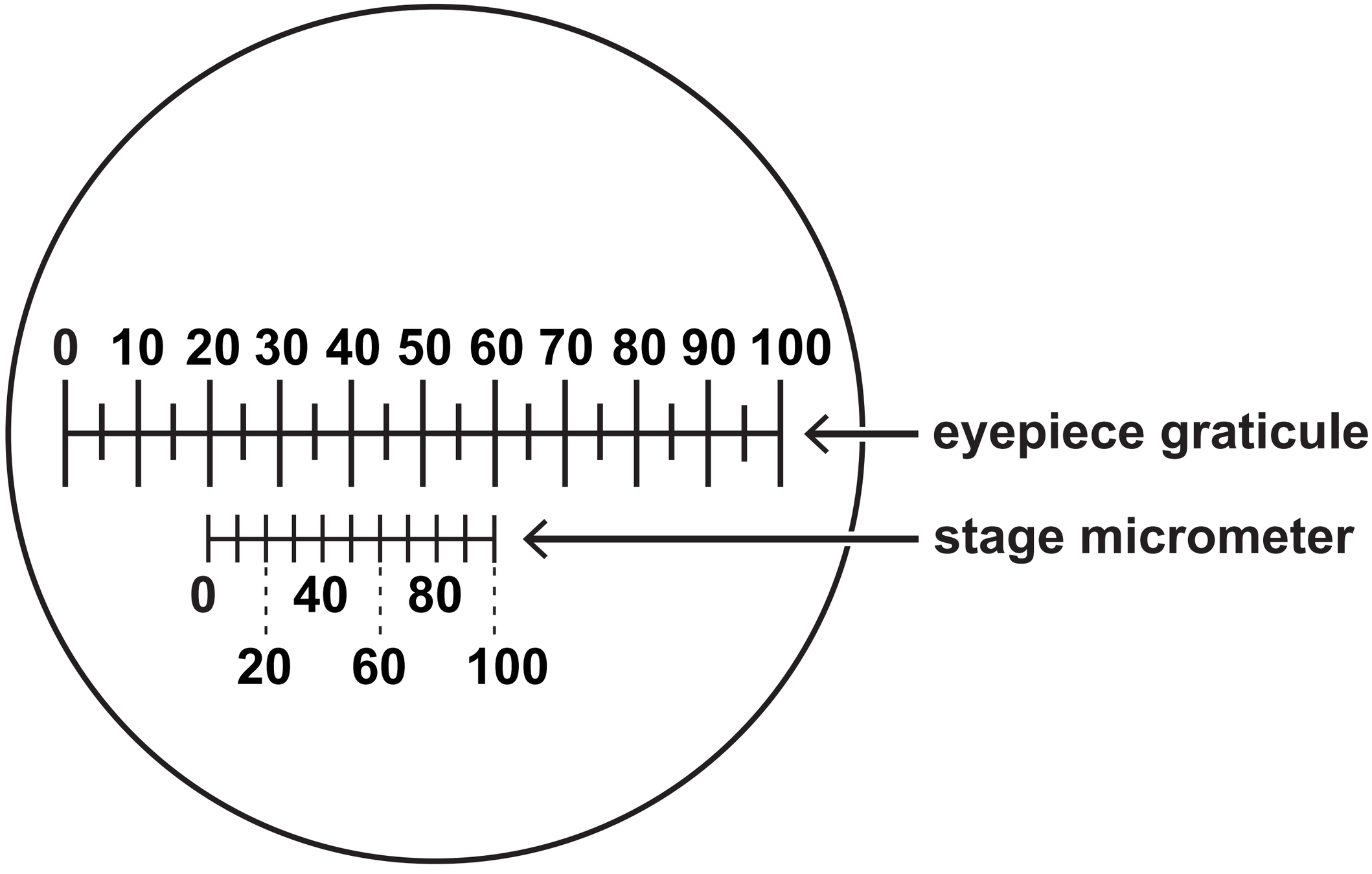


IMAGE 5.2
HYDRA feeding



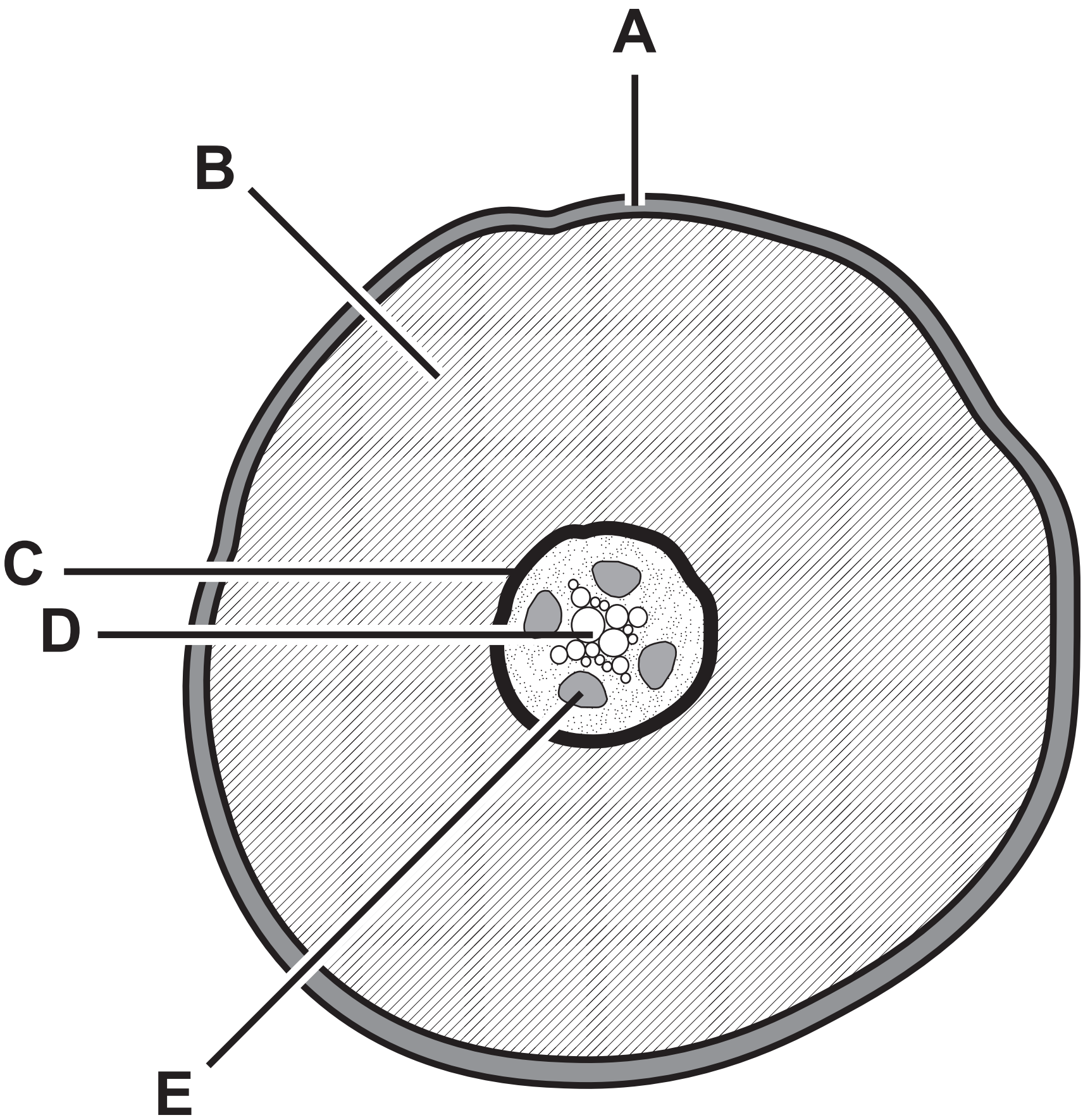
Question 5 (c)

IMAGE 5.3



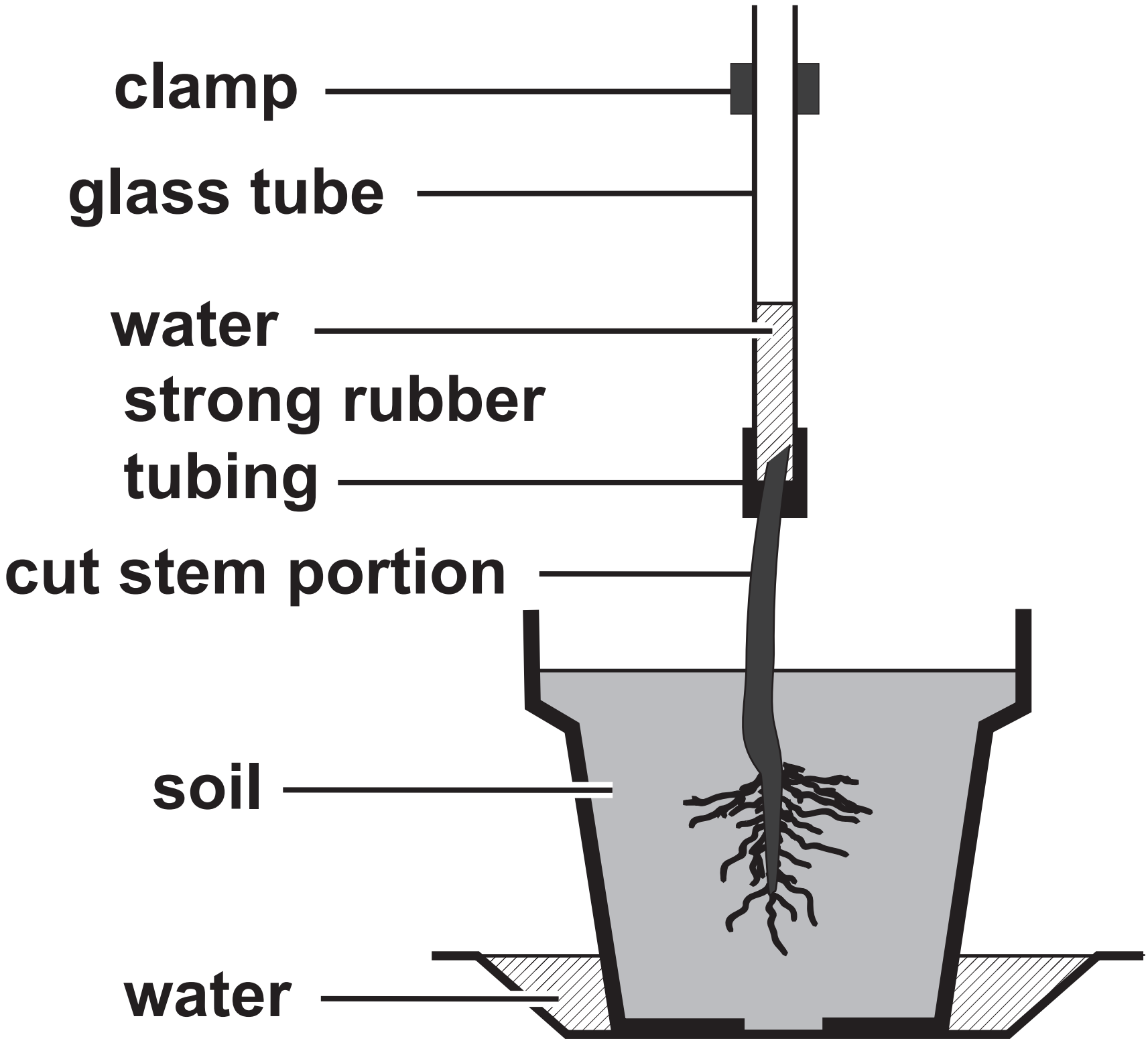
Question 6

IMAGE 6.1



Question 6 (c)

IMAGE 6.2



Question 7

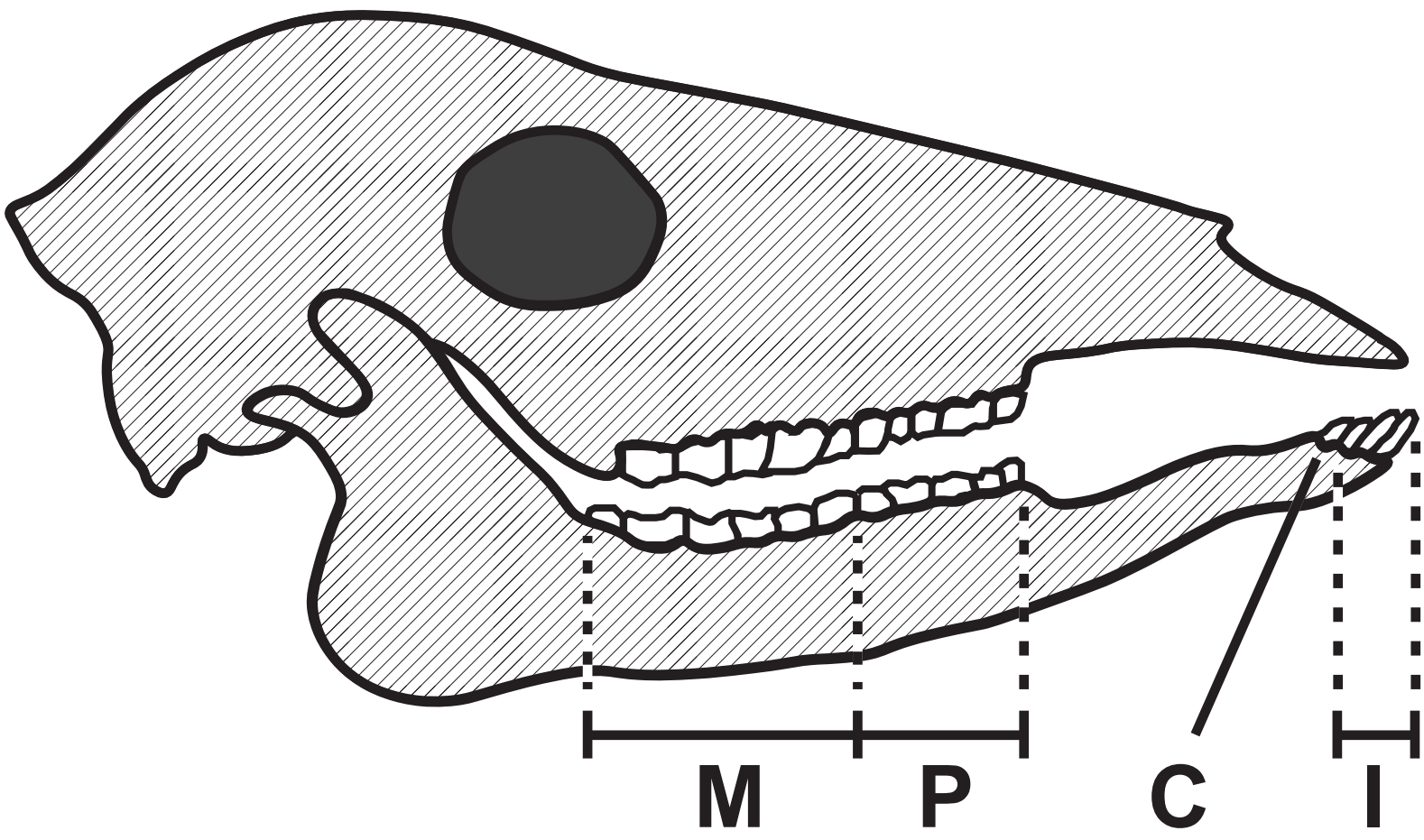
IMAGE 7.1

The skull and dentition of a WHITE-TAILED DEER (Order: Artiodactyla)

Key:

M = molars
P = premolars
C = canine
I = incisors

DIET:
Plants including grasses, leaves, twigs, fruits and nuts.



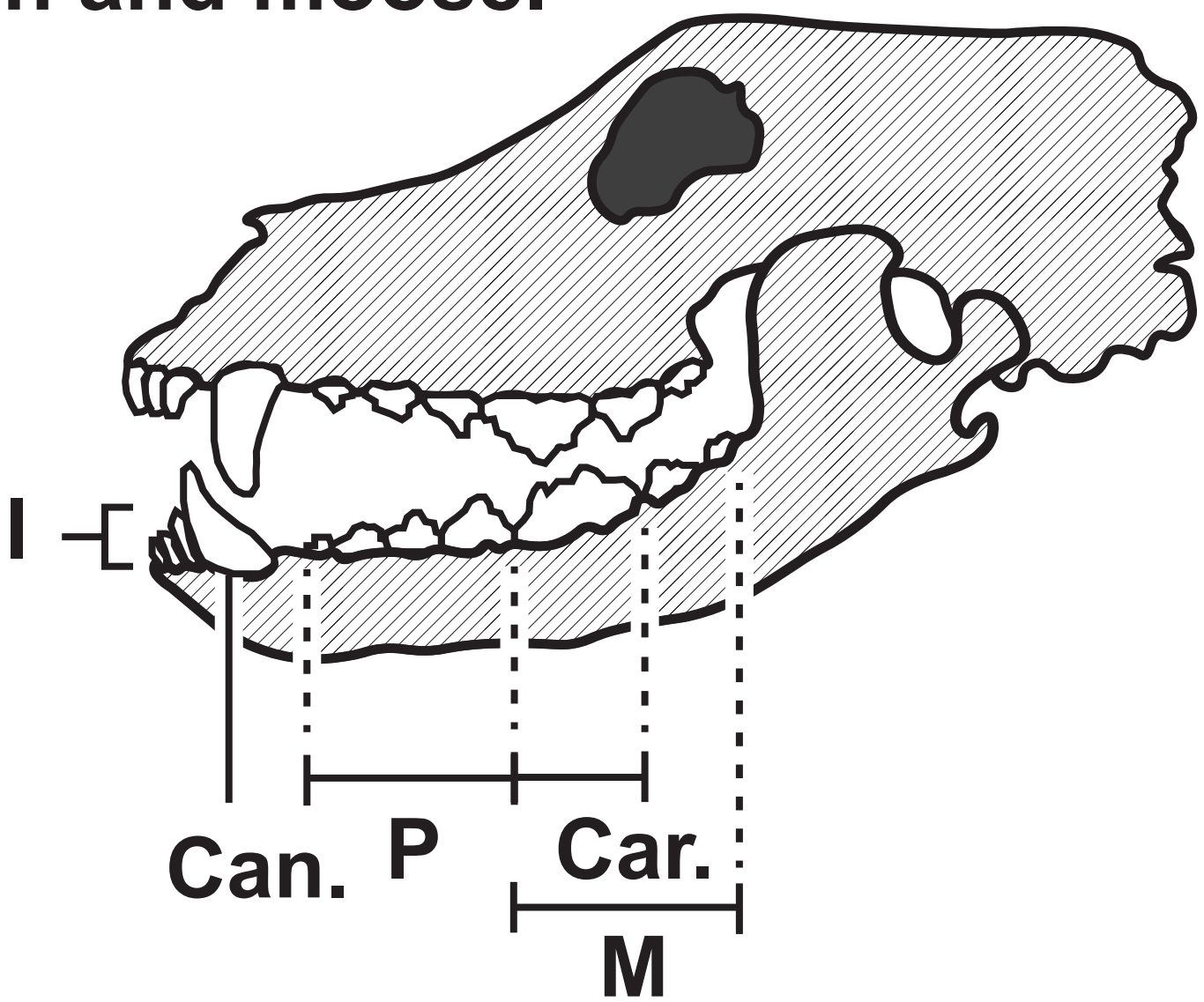
Question 7

IMAGE 7.2

The skull and dentition of a GREY WOLF (Order: Carnivora)

Key:
I = incisors
Can. = canines
P = premolars
Car. = carnassial
M = molars

DIET:
Hunt mainly for large-hoofed mammals such as deer, elk, bison and moose.



Question 7

IMAGE 7.3

The skull and dentition of a NORTH AMERICAN BLACK BEAR (Order: Carnivora)

DIET:

Plants, fruits, nuts, insects, honey, salmon, small mammals.
It will occasionally kill small deer.