

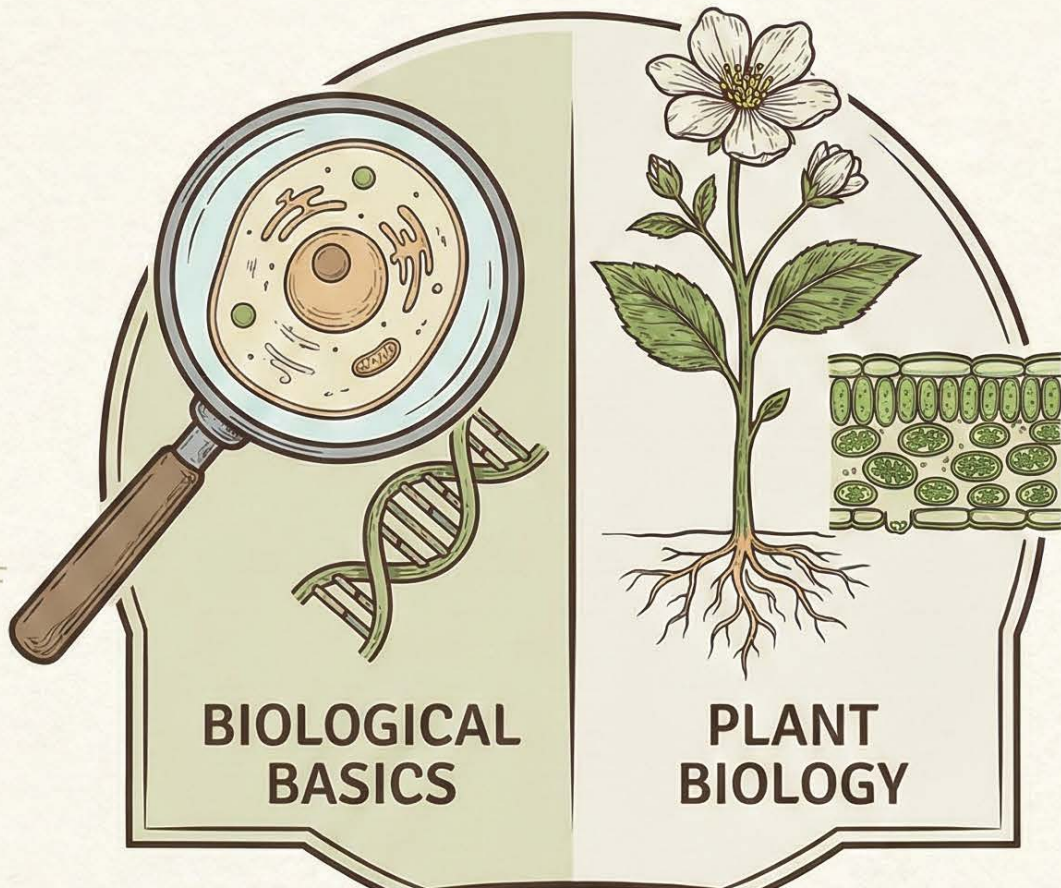
BASICS AND PLANTS

QUESTIONS BOOKLET

Dr. MOHAMED IBRAHIM



**TEAM
BIOCARDIA**

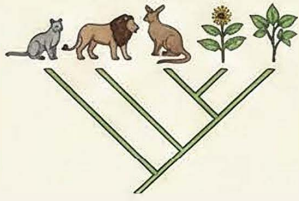


**BIOLOGICAL
BASICS**

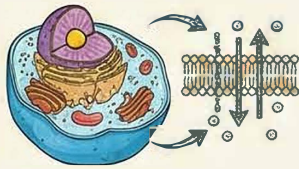
**PLANT
BIOLOGY**

**FUNDAMENTAL
KNOWLEDGE & INQUIRY**

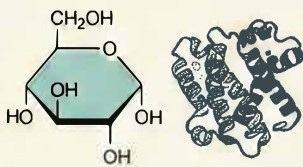
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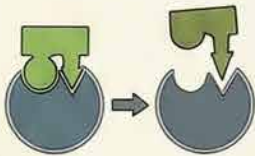
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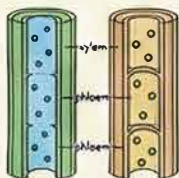
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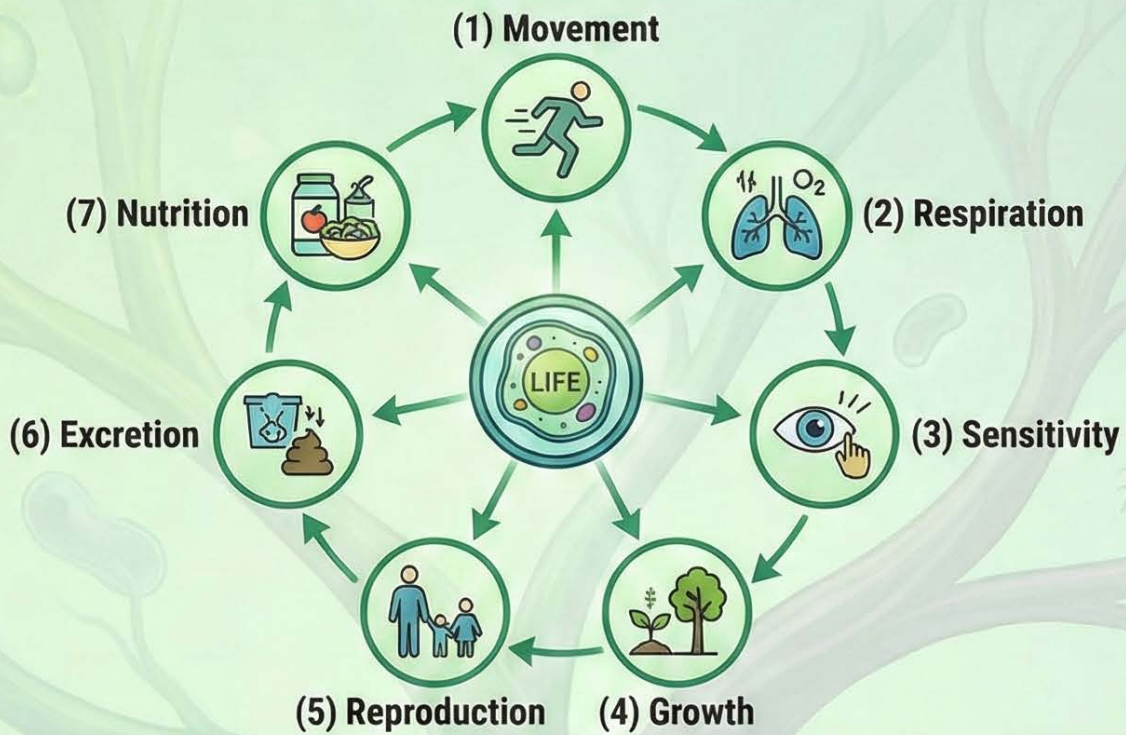


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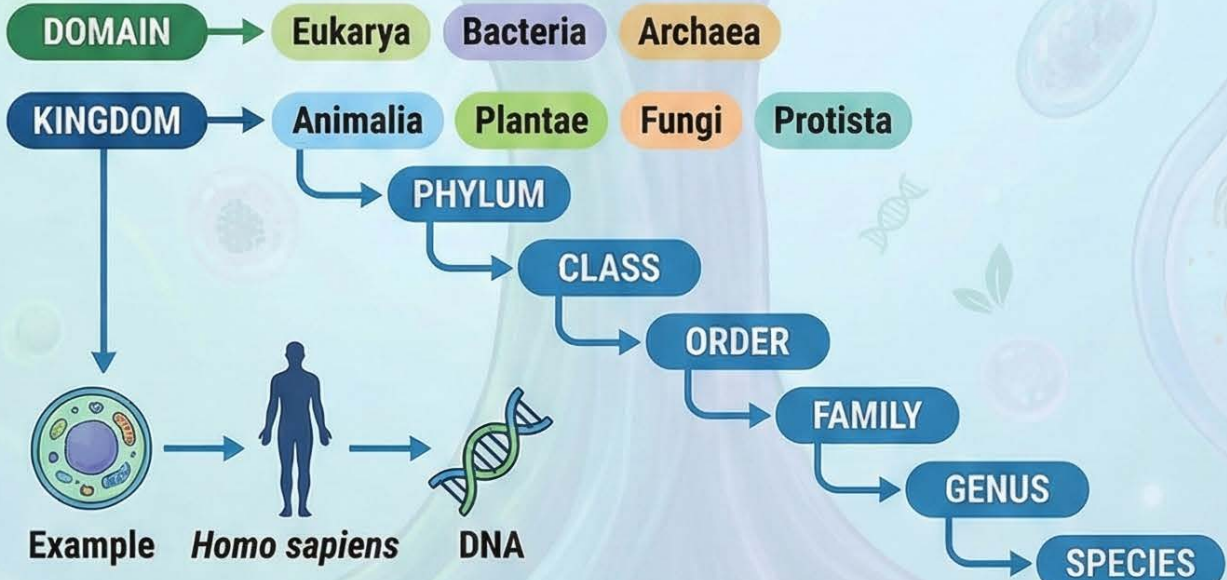
CHARACTERISTICS & CLASSIFICATION OF LIVING ORGANISMS

Exploring Life's Diversity and Order.

PART 1: CHARACTERISTICS OF LIFE



PART 2: CLASSIFICATION (TAXONOMY)



Characterstics & Classifications of LO

- (b) (i) A giant rat was discovered in a natural rainforest on Vangunu Island. Scientists wanted to determine if it was a new species.

Explain how scientists can use tissue samples to classify this rat.

.....
.....
.....
.....
..... [2]

- (ii) Giant rats eat coconuts.

Coconuts are grown as a monoculture for human consumption.

Suggest how monocultures of crop plants can result in the extinction of some animals.

.....
.....
.....
.....
.....
.....
.....
..... [3]

0610/43/O/N/20

[Total: 12]

- 1 (a) State **three** uses of energy in the human body.

1
2
3

0610/43/M/J/20

[3]

- (d) Sexual reproduction requires energy.

State **three** uses of energy in organisms **other than in reproduction**.

1
2
3

[3]

0610/41/M/J/20

1 (a) Sensitivity is one of the characteristics of life. The eye is one of the major sense organs of vertebrates.

(i) Define the term *sensitivity*.

.....

.....

.....

..... [2]

5 Bacteria are classified in the Prokaryote kingdom.

(a) State **two** features of animal **and** plant cells that are **not** found in prokaryotes.

1

2

[2]

5 Ciliates are classified in the kingdom Protocist. Bacteria are classified in the kingdom Prokaryote.

(a) State **two structural** features that distinguish the cells of a protocist from a prokaryote.

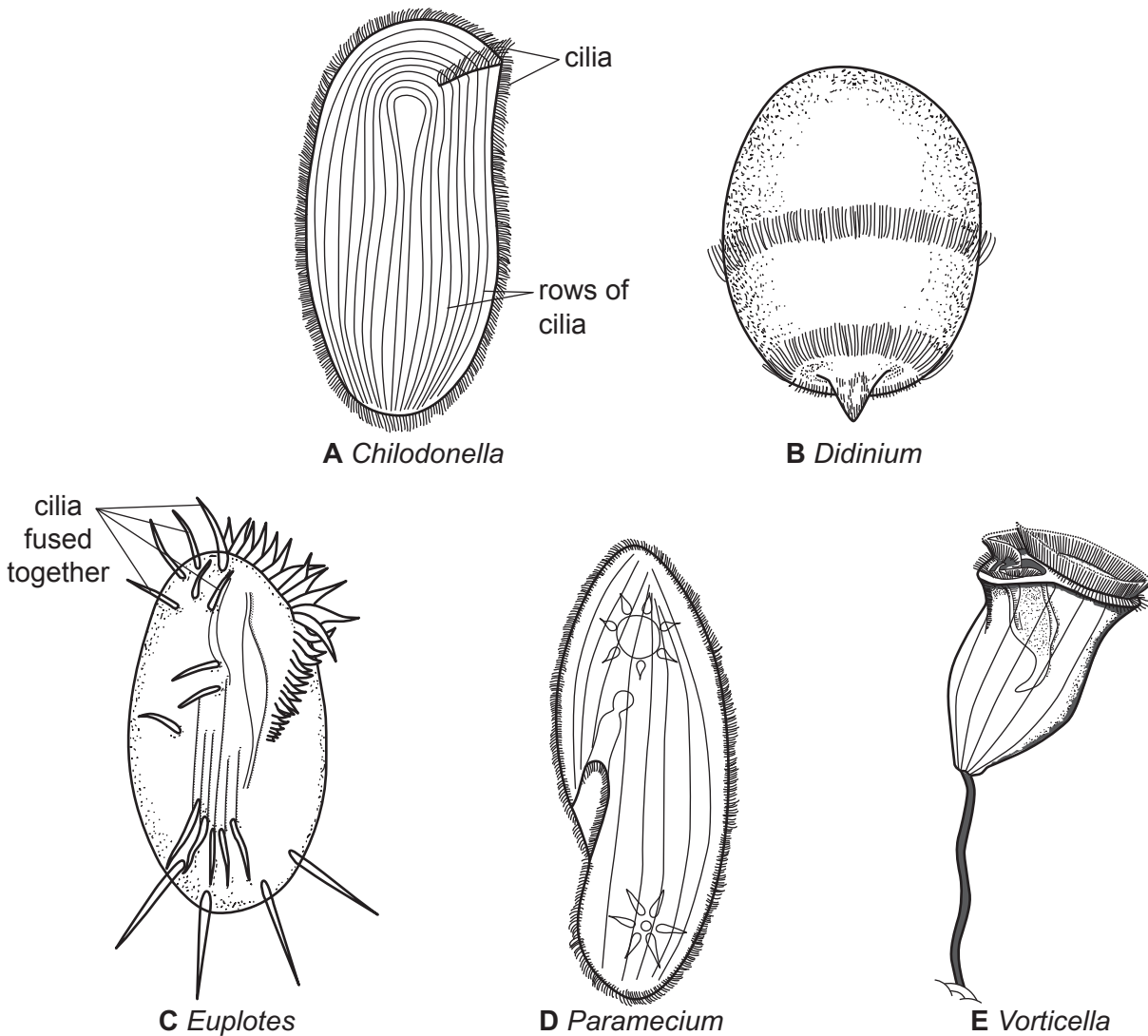
1

2

IN CELL STRUCTURE

[2]

(b) Fig. 5.1 shows five species of ciliate that are found in sewage treatment works.



not to scale

Fig. 5.1

5 The Galápagos Islands are a group of small islands in the Pacific Ocean.

In 1839 Charles Darwin published a book that described differences in a family of birds called finches.

Each species of Galápagos finch had:

- a different diet
- a different beak shape, as shown in Fig. 5.1.

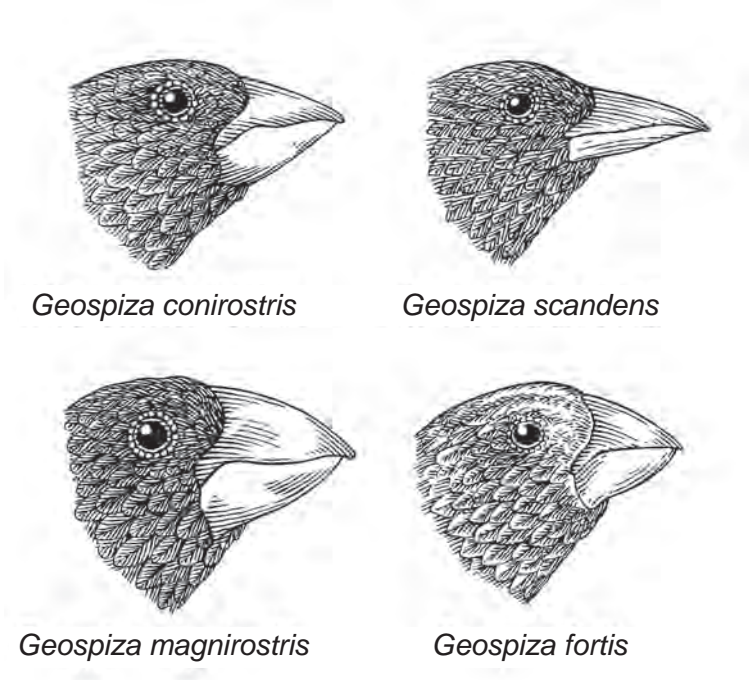


Fig. 5.1

(a) State the genus name for the Galápagos finches shown in Fig. 5.1.

..... [1]

Characteristics & Classifications of LO

Fig. 5.2 is a dichotomous key to identify the ciliates shown in Fig. 5.1.

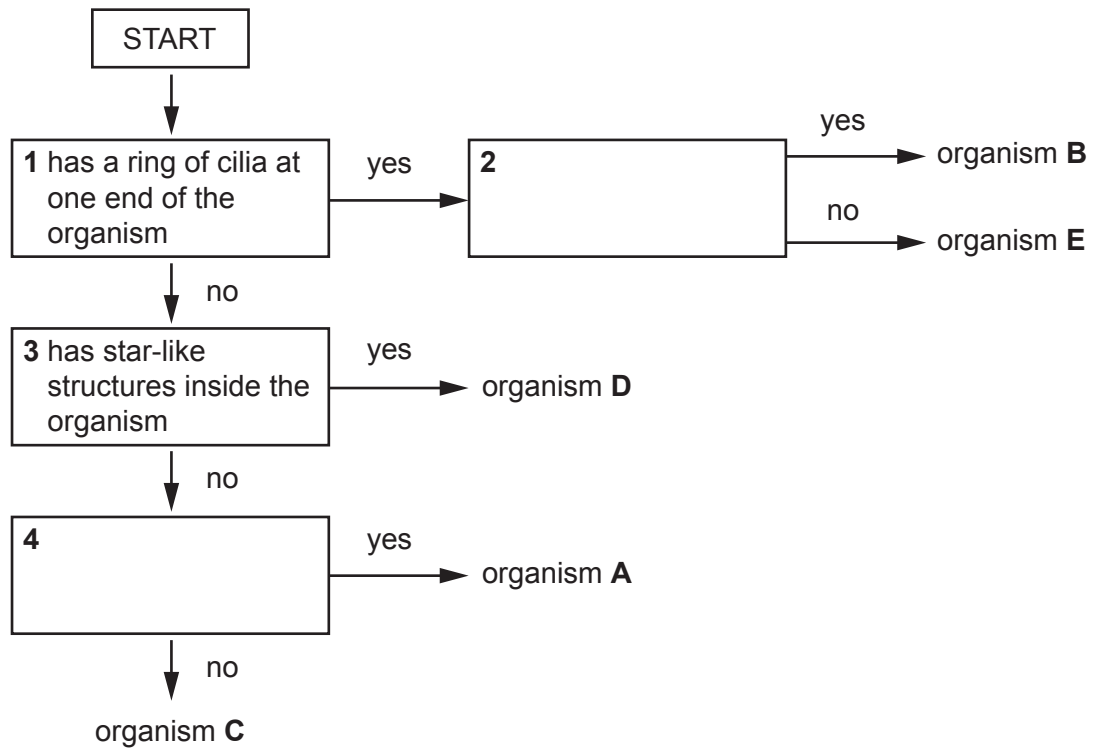


Fig. 5.2

Complete the key in Fig. 5.2 by writing suitable statements:

- for box 2 to distinguish species **B** and **E**
- for box 4 to distinguish species **A** and **C**.

text for box 2

.....

.....

text for box 4

.....

.....

[2]

Characteristics & Classifications of LO

(c) *Didinium* is a predatory ciliate. A video recording was made of one *Didinium* feeding on a *Paramecium*. Fig. 5.3 shows a sequence of still photographs taken from the video.

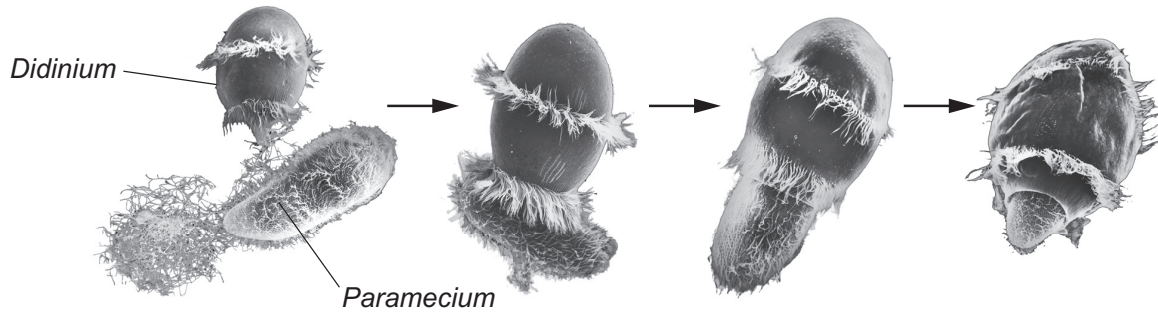


Fig. 5.3

Complete the table by putting a tick (✓) by each characteristic of life that can be seen in the still photographs from the video in Fig. 5.3.

excretion		nutrition	
growth		reproduction	
movement		respiration	

[1]

0610/41/M/J/20

1 (a) The ant mimic jumping spider, *Myrmarachne formicaria*, is shown in Fig. 1.1.

The common name of this species describes its behaviour. It is an arachnid that tricks its prey because it looks like the insects that it eats.



Fig. 1.1

(i) Suggest which trophic level in a food chain *M. formicaria* could belong to.

..... [1]

(ii) State the genus of the spider shown in Fig. 1.1.

..... [1]

(iii) Some keys use paired choices of features to identify species such as the ant mimic jumping spider.

State the name of this type of key.

..... [1]

Characteristics & Classifications of LO

3

(b) Spiders are classified as arachnids. Arachnids are one of the main groups of arthropods.

Fig. 1.2 shows diagrams of six arthropods, four of which are arachnids.

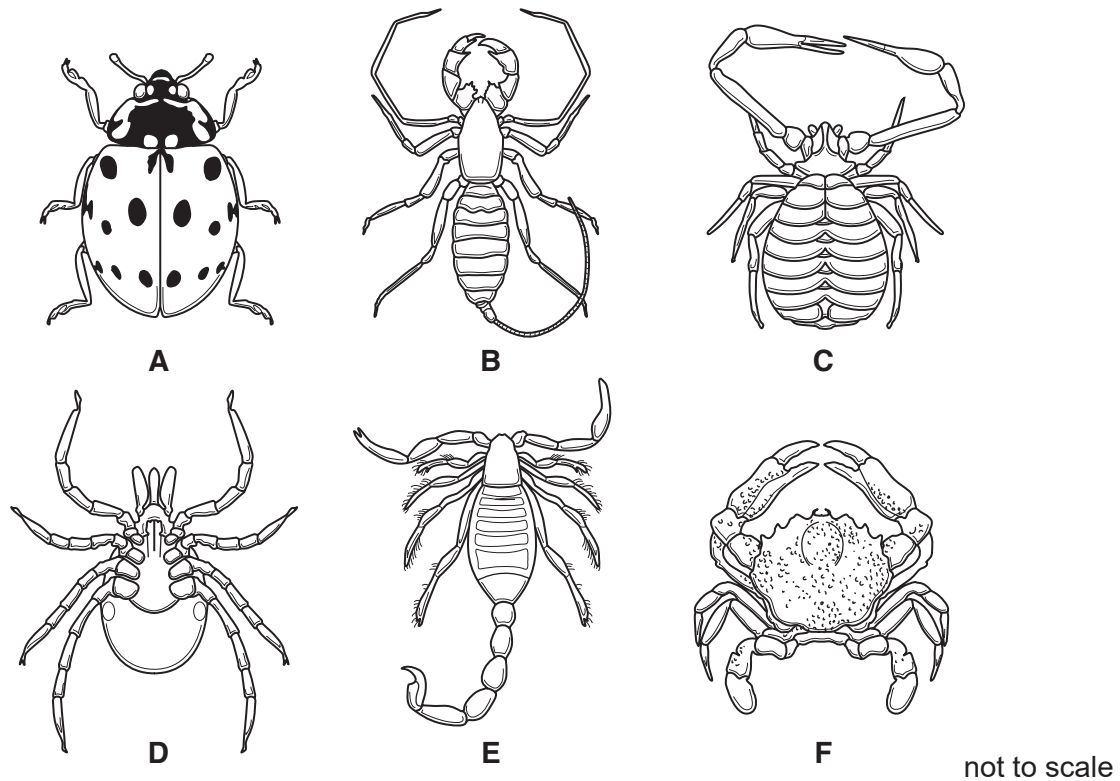


Fig. 1.2

(i) State **two** common features of all the arthropods, visible in Fig. 1.2.

- 1
- 2 [2]

(ii) State **two** common features of all arachnids that can be used to distinguish them from other arthropods.

- 1
- 2 [2]

(iii) State the letters of the **four** arachnids shown in Fig. 1.2.

..... [2]

(c) The features shown in Fig. 1.2 are morphological features. Many traditional methods of classification used morphology.

State the name of one **other** type of feature that can also be used in classification.

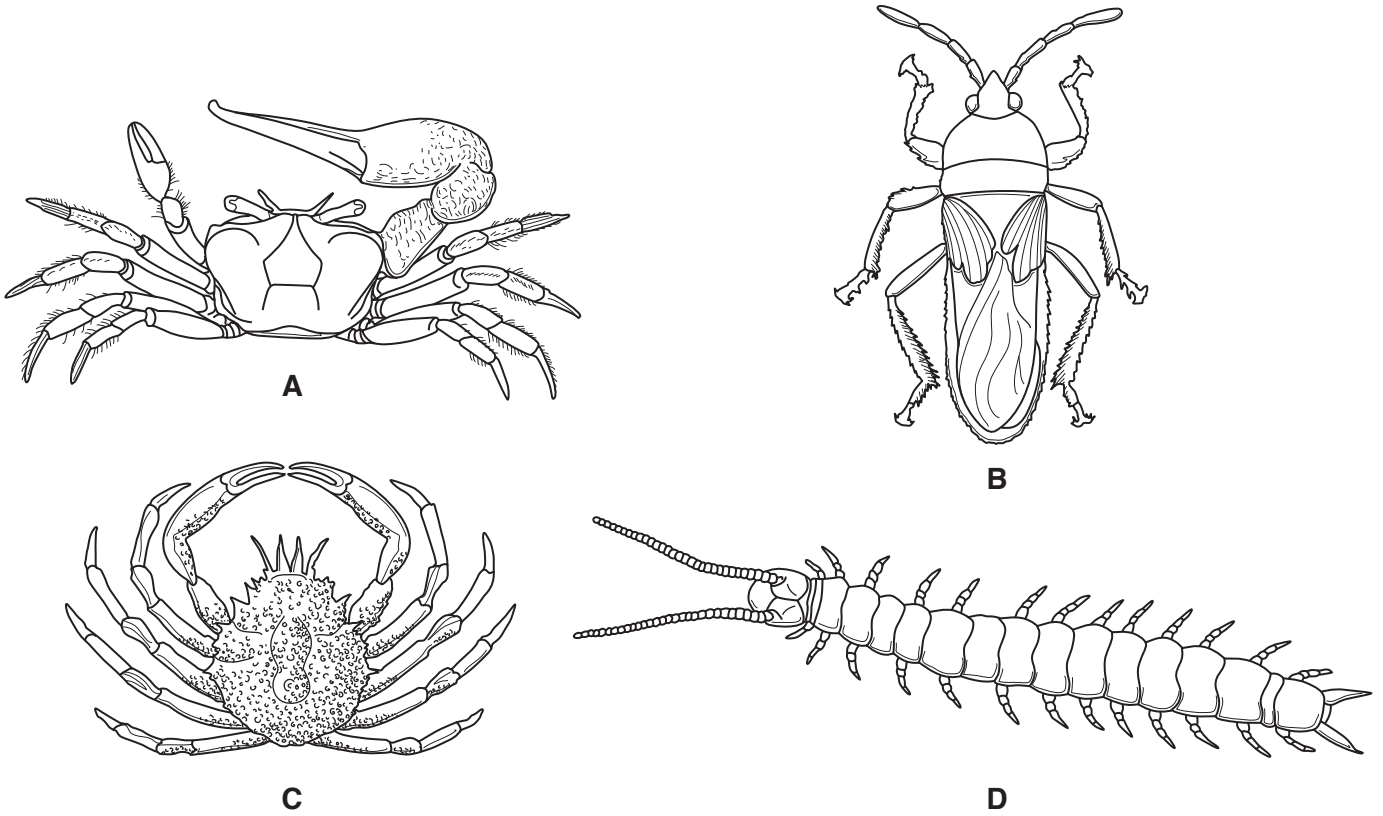
..... [1]

[Total 10]

Characterstics & Classifications of LO

2

1 (a) Fig. 1.1 shows four arthropods.



not to scale

Fig. 1.1

(i) State **two** features, visible in Fig. 1.1, that are common to all arthropods.

- 1
- 2

[2]

Characterstics & Classifications of LO

3

(ii) Fig. 1.2 is a dichotomous key for the arthropods shown in Fig. 1.1.

Complete Fig. 1.2 by writing suitable statements in:

- box 2 to identify species **B**
- box 3 to separate species **C** and **A**.

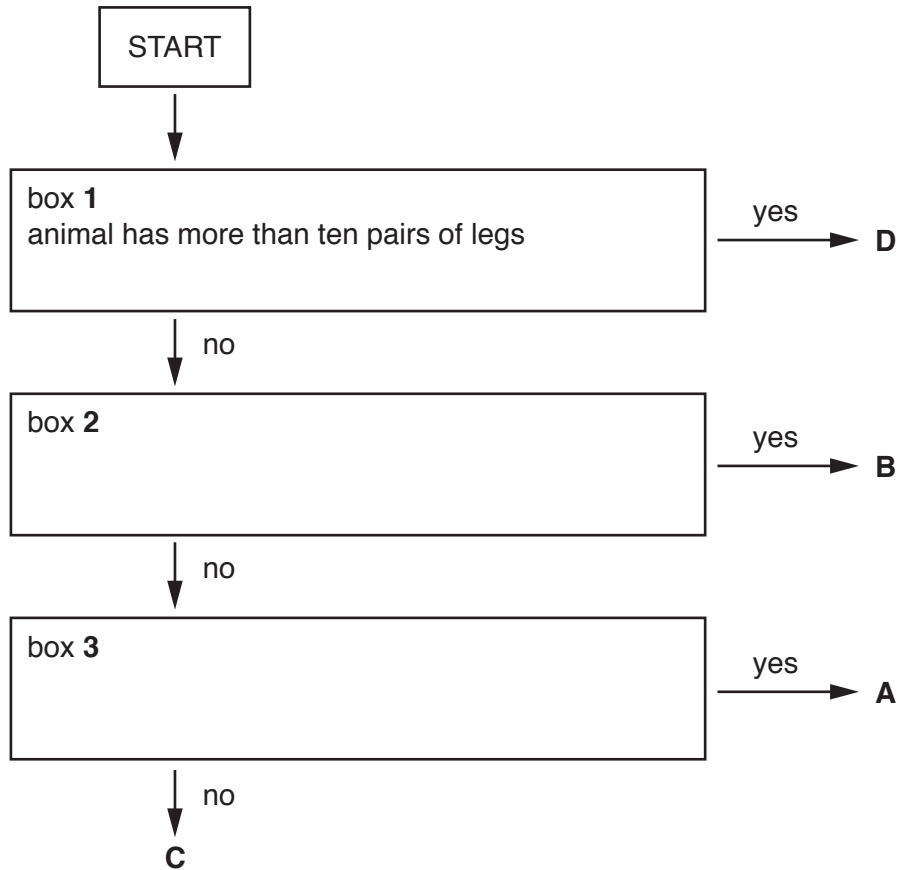


Fig. 1.2

[2]

Characterstics & Classifications of LO

4

- (b) The Hawaiian happy-face spider, *Theridion grallator*, is found on several of the Hawaiian islands. Some of the spiders have a very distinctive pattern on their bodies as shown in Fig. 1.3.



Fig. 1.3

- (i) State **one** feature, visible in Fig. 1.3, that identifies *T. grallator* as an arachnid.

..... [1]

- (ii) Scientists think that the pattern on the bodies of the spiders is an adaptive feature.

Explain the term *adaptive feature* with reference to this pattern.

.....
.....
.....
.....
.....
.....
.....
.....
..... [3]

Characterstics & Classifications of LO

5

- (c) DNA can be extracted from the webs of spiders. This DNA can be used to identify the species of spider that made the web, and the species of prey caught in the web.

Explain how DNA extracted from spider webs can be used to identify different species.

.....

.....

.....

.....

..... [2]

0610/42/O/N/19

-
- (e) Wheat plants are monocotyledons.

State **one** feature of monocotyledons that can be used to distinguish them from dicotyledons.

..... [1]

0610/42/O/N/19

1 All living organisms are placed into groups according to their features. Myriapods are one of the main groups of arthropods.

(a) State **two** features of myriapods that can be used to distinguish them from other arthropods.

1

2

[2]

Fig. 1.1 shows that there are four main groups of arthropods.

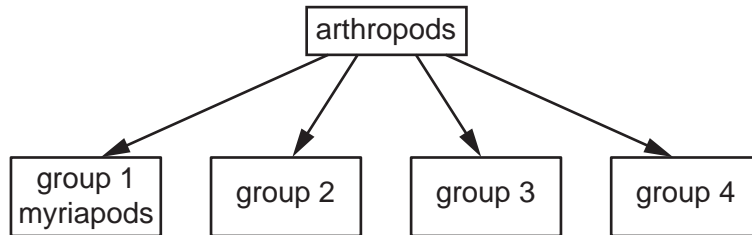


Fig. 1.1

(b) State the names of **two** of the other groups of arthropods in Fig. 1.1.

1

2

[2]

(c) Myriapods can be classified into four classes, **1, 2, 3** and **4**.

Fig. 1.2 is a dichotomous key that can be used to distinguish the four classes of myriapods.

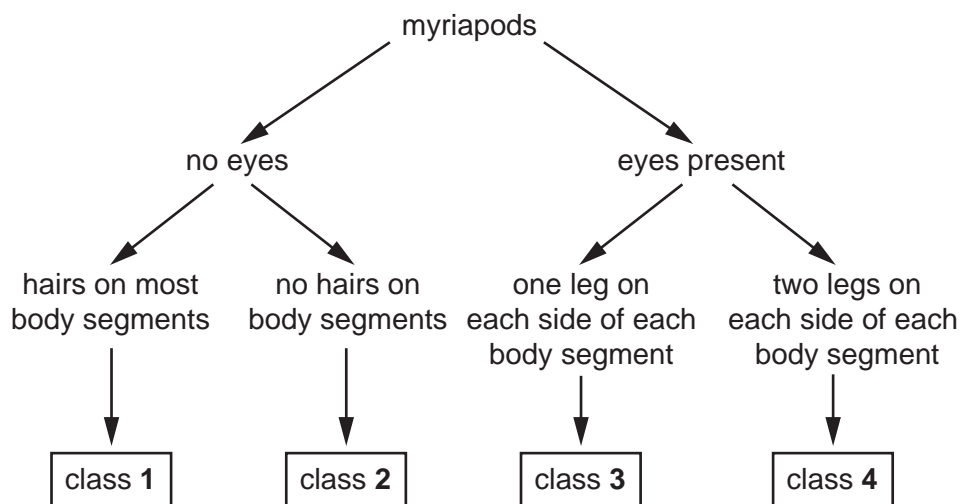


Fig. 1.2

3

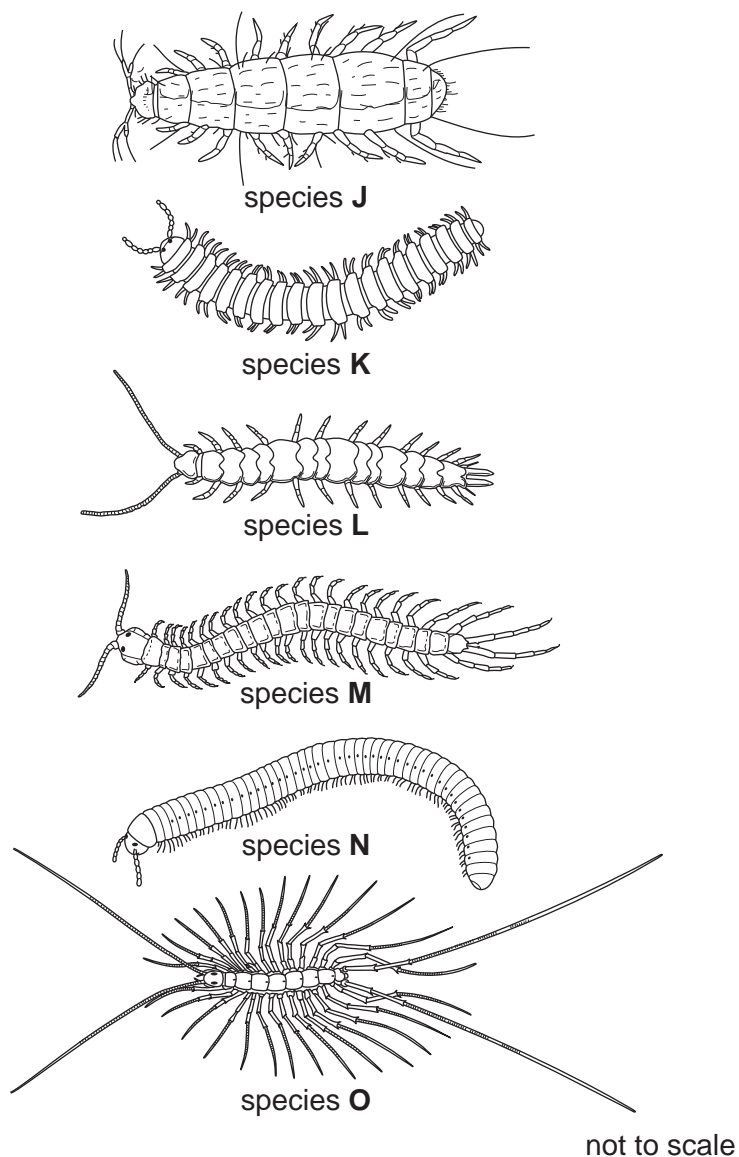


Fig. 1.3

Complete Table 1.1 by using the key in Fig. 1.2 to classify the six myriapods in Fig. 1.3 into the four classes.

Table 1.1

class	letter(s) of species from Fig. 1.3 in each class
1	
2	
3	
4	

[3]

(d) Fig. 1.4 is a photograph of the myriapod, *Apheloria virginiensis*.



Fig. 1.4

(i) State the genus name and kingdom name for the myriapod shown in Fig. 1.4.

genus

kingdom

[2]

(ii) *A. virginiensis* releases the poison cyanide when it is attacked by predators. Cyanide stops enzymes in the mitochondria from functioning.

Suggest why cells die if the mitochondria do not function.

.....
.....
..... [1]

[Total: 10]

1 Bacteria are classified in the Prokaryote kingdom.

(a) State **two** features of animal cells that are **not** found in bacteria.

1

2

[2]

(b) Some people who have sickle-cell anaemia have parents who do not have sickle-cell anaemia.

(c) Sickle-cell anaemia is most common in areas of the world where the infectious disease malaria is found.

Some species of the genus *Plasmodium* cause malaria in humans.

(i) Define the term *species*.

.....
.....
.....
.....
..... [2]

Characterstics & Classifications of LO

3

1 All commercial breeds of sheep belong to the species *Ovis aries*.

(a) Define the term *species*.

.....

.....

.....

.....

..... [2]

The Merino is a breed of sheep that is farmed mainly for its wool. The wool is very thick and is made of lots of very thin hairs.

Fig. 1.1 shows a female Merino sheep with her newborn lamb.



Fig. 1.1

(b) The presence of hair is a feature that is only found in mammals.

State **two other** features that distinguish mammals from all other vertebrates.

1

2

[2]

6 Fig. 6.1 shows the alapagos iguana, *Amblyrhynchus cristatus*.



Fig. 6.1

(a) (i) State **two** features that are used to classify animals, such as the alapagos iguana, as reptiles.

1

2

[2]

(ii) State **two** features that are present in plant cells that are **not** present in the cells of reptiles.

1

2

[2]

Characterstics & Classifications of LO

4

- 2 Fig. 2.1 shows an Arctic wolf, *Canis lupus*. These wolves are one of the few mammals adapted to the extreme cold of the tundra in the Canadian Arctic and in Alaska.



Fig. 2.1

- (a) (i) State **two** features, **visible** in Fig. 2.1, that identify Arctic wolves as mammals.

1

2

[2]

- (ii) Arctic wolves show many adaptive features to a cold environment.

Explain what is meant by the term *adaptive feature*.

.....
.....
.....
.....
.....
.....
.....[3]

Characterstics & Classifications of LO

5 (a) State the balanced chemical equation for aerobic respiration.

.....[2]

(b) Students investigated the rate of respiration of crickets (a type of insect) using a carbon dioxide sensor and laptop as shown in Fig. 5.1. The sensor was fitted inside an airtight glass jar. The apparatus was set up in a room with a constant temperature of 17 °C.



Fig. 5.1

The students found that the concentration of carbon dioxide inside the jar increased by 50 ppm in 120 seconds.

Calculate the rate of carbon dioxide production as ppm per second.

Show your working and express your answer to two significant figures.

..... ppm s⁻¹ [1]

(c) After 10 minutes, the students opened the jar by removing the sensor. They left the jar open for 5 minutes but made sure that the crickets remained in the jar. They then replaced the sensor and took more readings for another 10 minutes.

State **and** explain one reason for opening the jar after 10 minutes.

.....
.....
.....
.....
.....[2]

Characterstics & Classifications of LO

- (d) During the investigation the temperature inside the jar increased. The temperature outside the jar remained constant.

Explain why the temperature inside the jar increased.

.....

.....

.....

.....[2]

- (e) Researchers in Chile also investigated the rate of respiration in crickets.

They investigated the effect of temperature and body mass on the rate of respiration. They measured the rate of oxygen consumption in crickets with different body masses, at different temperatures.

The researchers results are shown in Fig. 5.2.

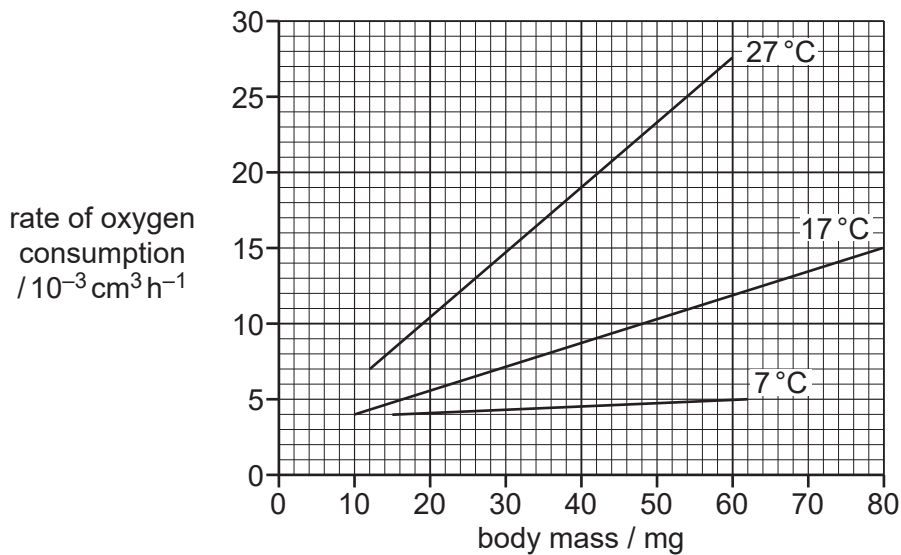


Fig. 5.2

State **two** conclusions that can be made from the data in Fig. 5.2 **and** support each conclusion with evidence from the graph.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

5 Fig. 5.1 shows an adult fly, *Chrysomya megacephala*.



Fig. 5.1

(a) State **three** visible features from Fig. 5.1 that could be used to distinguish adult insects from other arthropods.

- 1
- 2
- 3 [3]

(b) Fly larvae are immature insects that are often used in experiments on respiration.

Give the balanced chemical equation for aerobic respiration.

..... [2]

Characterstics & Classifications of LO

5 (a) State the balanced chemical equation for aerobic respiration.

.....[2]

(b) Researchers in the Czech Republic investigated oxygen consumption in horses. They measured the oxygen consumption of the horses while they were exercising at four different paces: walking, trotting, cantering and galloping.

The results are shown in Fig. 5.1.

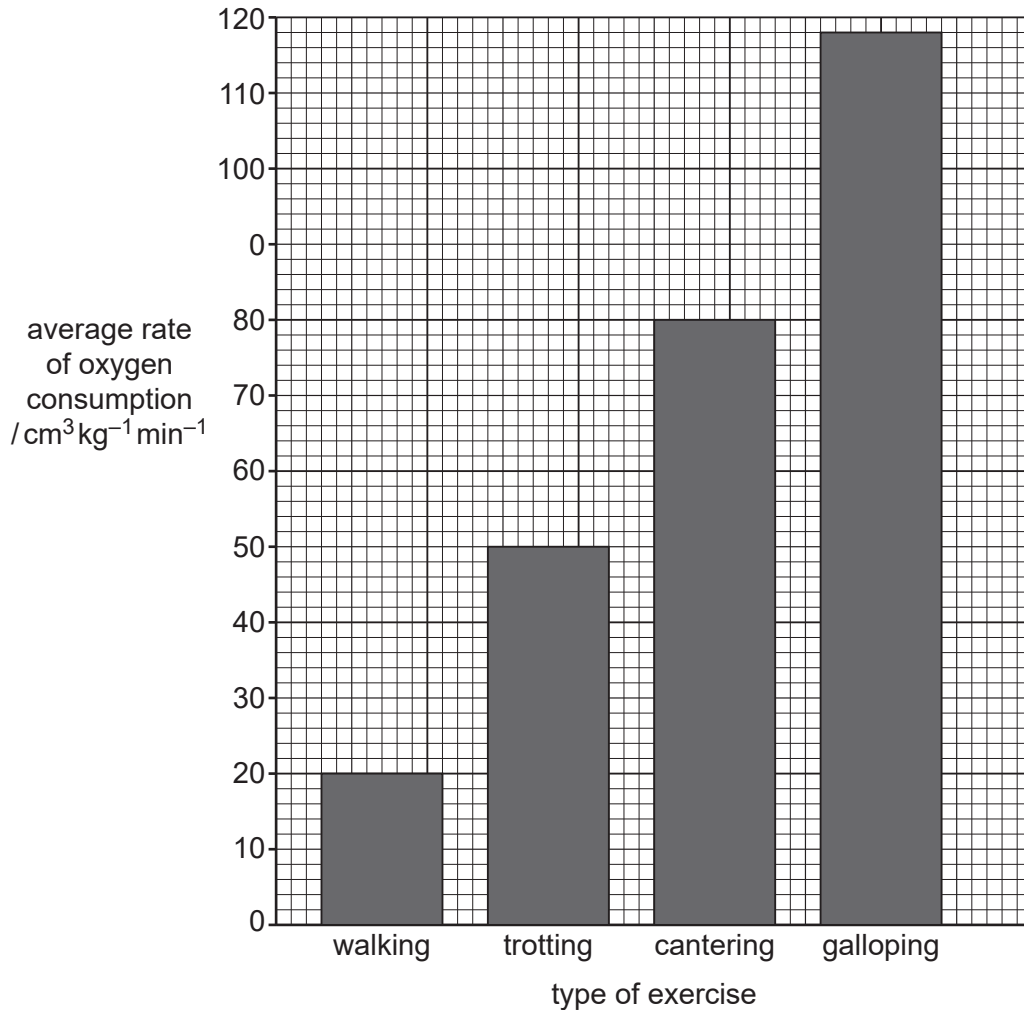


Fig. 5.1

Calculate the percentage increase in the average rate of oxygen consumption as the horses change from walking to trotting.

Show your working.

..... %
[2]

Characteristics & Classifications of LO

2

1 (a) (i) Fig. 1.1 is a branching key used to identify different species of bacteria.

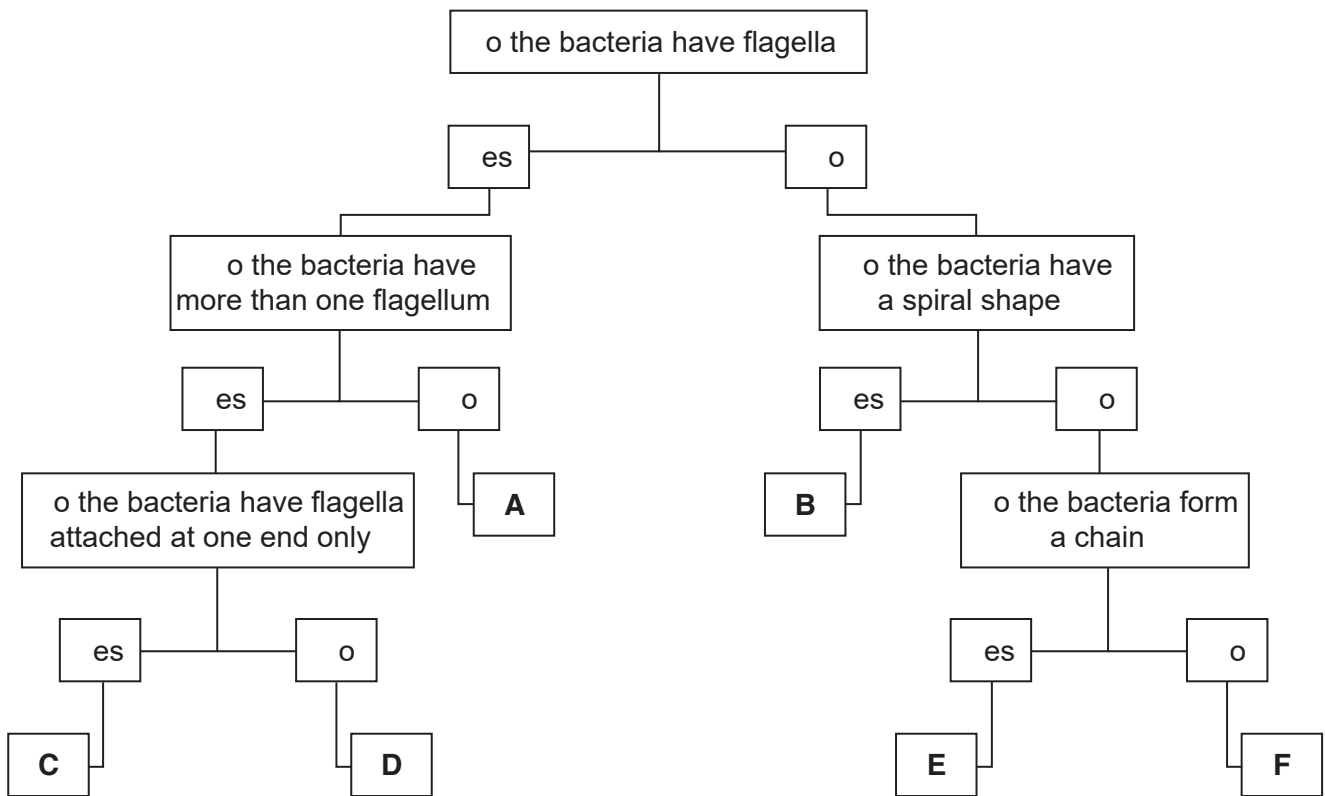


Fig. 1.1

Fig. 1.2 shows six different species of bacteria.

Use the key to identify the six different species of bacteria.

Write the letters on the lines in Fig. 1.2.

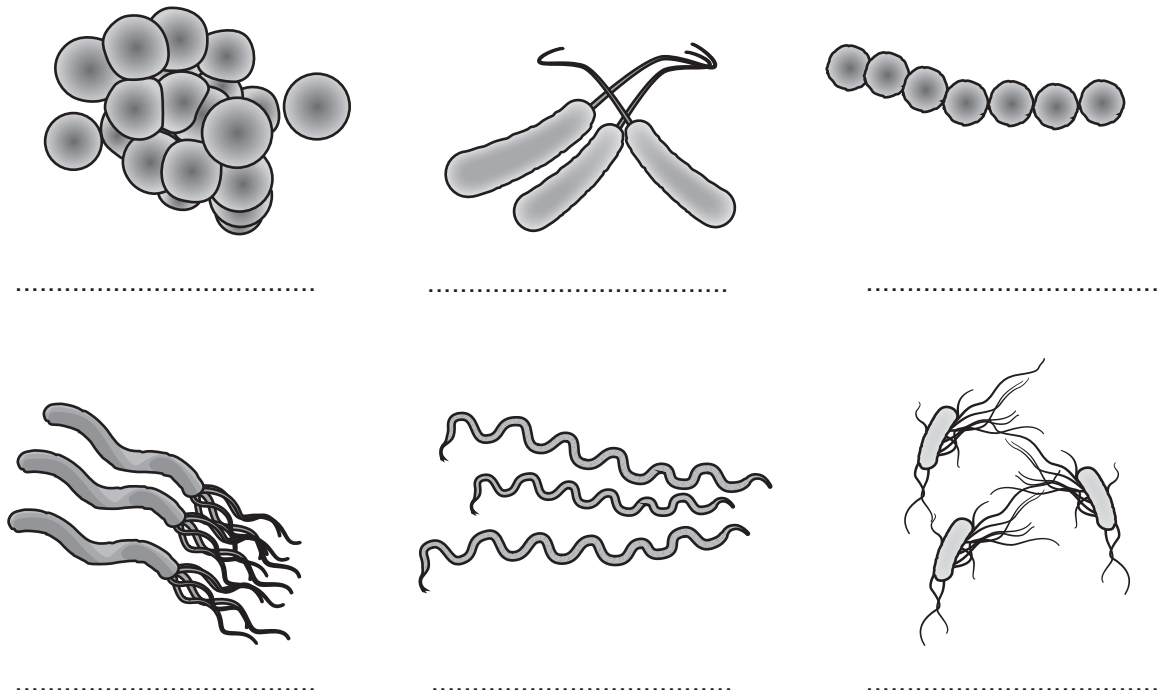


Fig. 1.2

0610/42/F/M/18

5 Fig. 5.1 shows the bacterium *Helicobacter pylori*, which is a human pathogen.



Fig. 5.1

(a) State the genus of *Helicobacter pylori*.

.....[1]

(b) *H. pylori* is placed in the prokaryote kingdom.

State **two** structural features that *H. pylori* shares with other prokaryotes.

1

2

[2]

- 4 Fig. 4.1 is a photograph of a yellow-shouldered Amazon, *Amazona barbadensis*, a species of parrot found along the Venezuelan coast of the Caribbean.



Fig. 4.1

- (a) State the vertebrate group that includes *A. barbadensis* and give **two** features that are used to classify animals into this group.

vertebrate group

feature 1

feature 2

[2]

2 Bacteria are classified as belonging to the Prokaryote kingdom.

(a) State **two** features of **all** prokaryotes.

1

2

[2]

MRSA is a type of bacterium that is resistant to antibiotics. The number of cases of MRSA identified in hospitals in the USA between 1995 and 2005 was recorded.

Fig. 2.1 shows these data.

DNA can be used to distinguish between different species of bacteria.

Molecular biologists compared the DNA sequences of the gene in mitochondria and six species of bacteria. They counted the number of differences.

Table 5.1 shows the number of differences between the DNA sequences.

Table 5.1

	mitochondria A	species B	species C	species D	species E	species F	species G
mitochondria A		29	26	34	25	3	23
species B			18	12	17	26	24
species C				19	10	19	14
species D					28	29	30
species E						19	6
species F							16
species G							

The most closely related species have:

- the least number of differences between their DNA sequences
- the shortest distance from a branching point on a classification tree.

- 6 (a) Name **one** feature of dicotyledonous leaves that distinguishes them from monocotyledonous leaves.

.....[1]

- (b) Explain why a leaf is an organ.

.....
.....[1]

- (c) Base sequences of the DNA of different species are compared to investigate how species are related to one another. The most closely related species have the shortest distance from a branching point on a classification tree.

Fig. 2.4 shows how six species of fungi are related to each other.

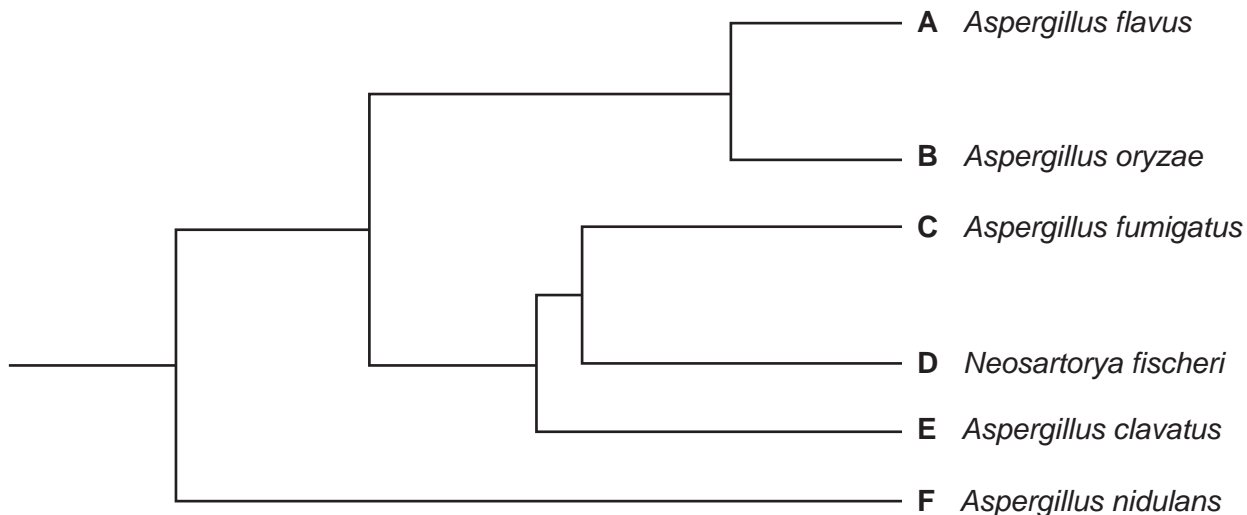


Fig. 2.4

- (i) Use the letters on Fig. 2.4 to state the two species that are most closely related.

..... [1]

- (ii) Use Fig. 2.4 to explain why *Aspergillus nidulans* is the most distantly related species from all of the other five species.

.....
.....
.....
.....
..... [2]

- (d) Modern methods of classification rely on the analysis and comparison of base sequences in DNA.

Describe the type of evidence that scientists used for classifying organisms before they were able to sequence DNA.

.....

.....

.....

.....

..... [2]

[Total: 10]

When molecules of DNA are used to classify species, only one of the two DNA strands is sequenced.

First the DNA sequence from one strand of a DNA molecule from each species is lined up against one strand from another species.

The bases of the DNA sequences from the same strand can then be compared with each other.

Fig. 6.2 shows a short section from the DNA sequences of eight plant species. There are ten differences between species **A** and species **B**. These differences are shown in Fig. 6.2.

Species **A**: CTCCTCGGGT GACGGCCTAG CCCGTTGACG AATCCCATTC CTAAACTTTT

Species **B**: CTCCTAGGGT GCAGGACTAG CCCGTTGACG AATCCCATTC CCAAGA

Species **C**: CTCATAGGGT GCAGGCCTAG CCCGTTGACG AATCACATTC CGATT

Species **D**: CTCATAGGGT GCAGGCCTAG CCCCTTGACG AATCCAATTC CGCTT

Species **E**: CTCATAGGGT GCAGGCCTAG CCCGTTGACG AATCCAATTC CGCTT

Species **F**: CTCCTAGGTT GCAGGCCTAG CCCTTTGAAG AATCACATTC CCCAA

Species **G**: CTCCTCGGGT GCAGGCATAG CCCTTTGACG AATCCCCTTC CGAAA

Species **H**: CTCCTAGGGT GCAGGCATAG CCCTTTGACG AATCCCCTTC CAAAAT

Fig. 6.2

(b) The number of differences between the DNA sequences of the eight species shown in Fig. 6.2 are recorded in Table 6.1.

Count the number of differences between the DNA sequences shown in Fig. 6.2 for:

- species **C** and species **D**
- species **G** and species **H**

Write your answers in Table 6.1.

[2]

Table 6.1

	species A	species B	species C	species D	species E	species F	species G	species H
species A		10	10	13	12	11	10	9
species B			7	8	7	7	7	6
species C					3	7	8	8
species D					1	9	9	8
species E						9	8	10
species F							6	7
species G								
species H								

(c) The most closely related species have the fewest differences between their DNA sequences.

State which **two** plant species shown in Table 6.1 are most **distantly related** to each other.

.....[1]

(d) The most closely related species have the shortest distance from a branching point on a classification tree.

Use the information in Table 6.1 to complete the classification tree in Fig. 6.3. Write the letter corresponding to species **B**, **C**, **D** and **G** in the box next to the correct branch of the classification tree. [3]

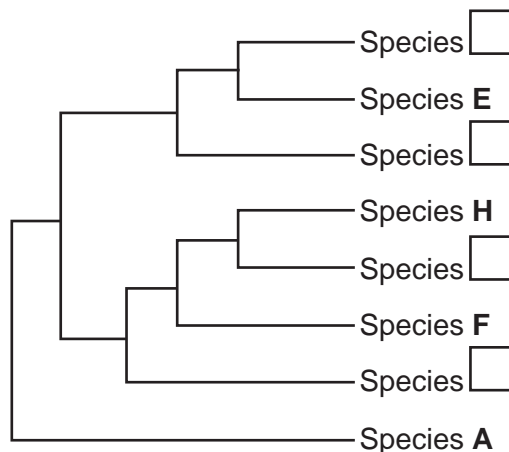


Fig. 6.3

2 Fig. 2.1 is an electron micrograph showing the bacteria, *Vibrio cholerae*.



Fig. 2.1

(a) (i) Bacteria are prokaryotes.

State **two** distinguishing features of all prokaryotes.

- 1
- 2

[2]

(ii) The bacteria shown in Fig. 2.1 each have a flagellum.

Suggest the function of the flagellum in bacteria.

-
-
-

[1]

- 6 A new species of frog was discovered in 2009 in the Amazon rainforest in Peru.

Fig. 6.1 shows this frog, *Osteocephalus castaneicola*.



Fig. 6.1

- (a) State the genus of this animal.

.....[1]

(ii) Describe how DNA can be used to classify organisms.

.....

.....

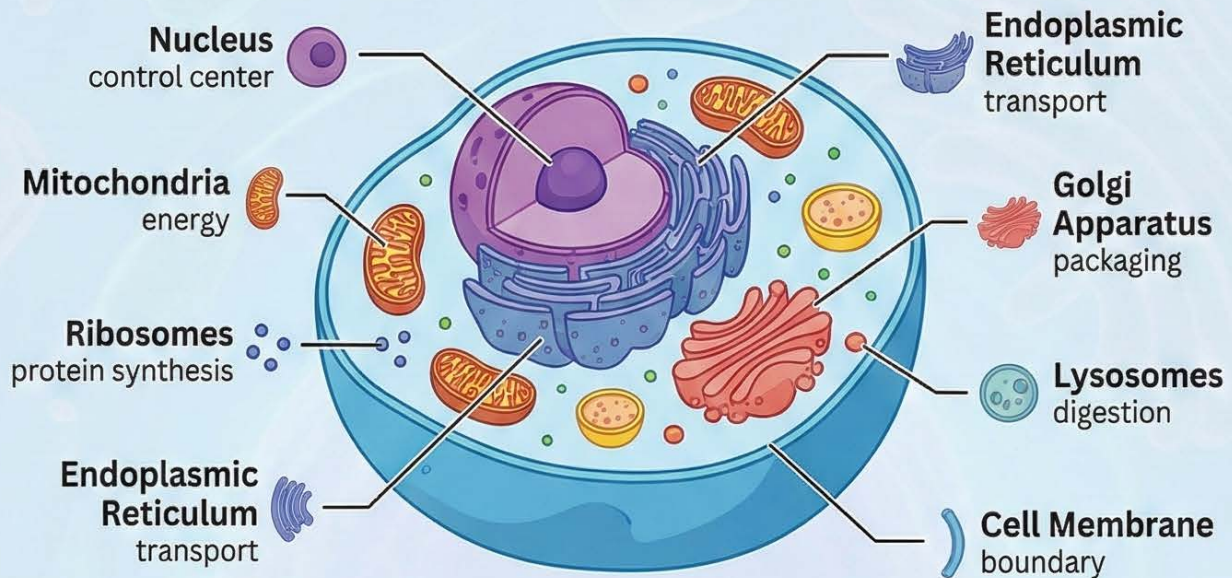
.....

.....[2]

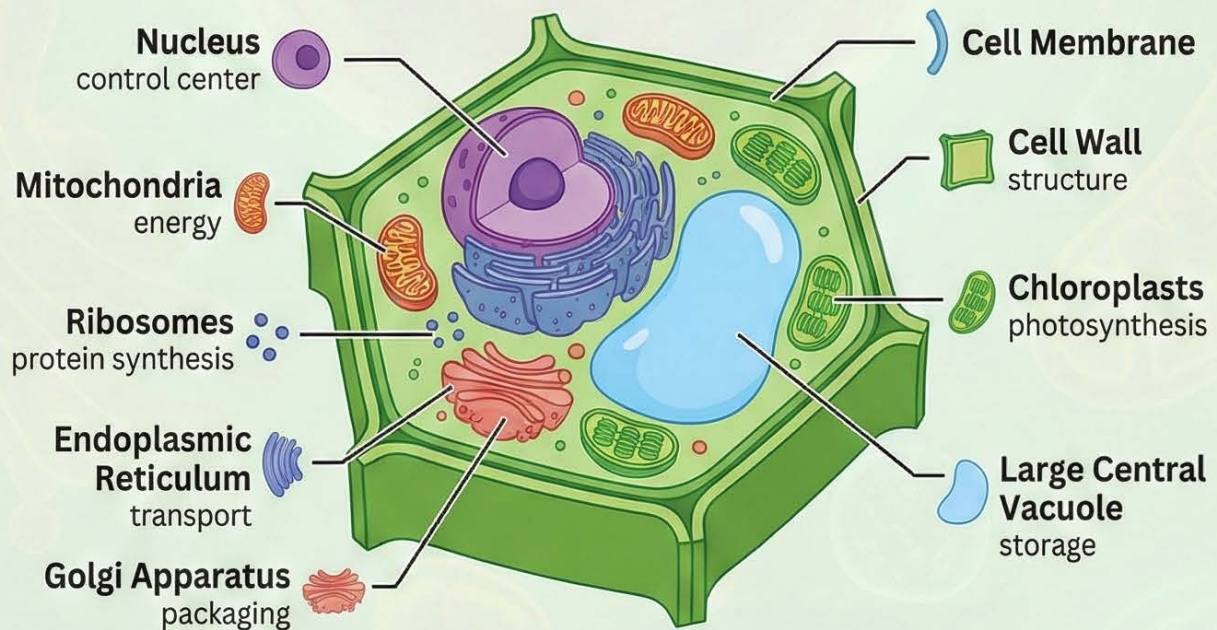
CELL STRUCTURE

The Basic Unit of Life: Organelles & Functions.

ANIMAL CELL



PLANT CELL



Understanding cell structure is fundamental to all biological sciences.

4 Yeast is an example of a single-celled fungus.

- (a) The population of yeast can be estimated by using a light microscope to view a small sample of yeast cells in a modified microscope slide.

There is a square chamber, with a specific volume, cut into the microscope slide and a grid to make it easier to count the number of cells.

Fig. 4.1 shows a diagram of the modified microscope slide. It also shows part of a light microscope with the modified microscope slide filled to the top with a sample of yeast cells.

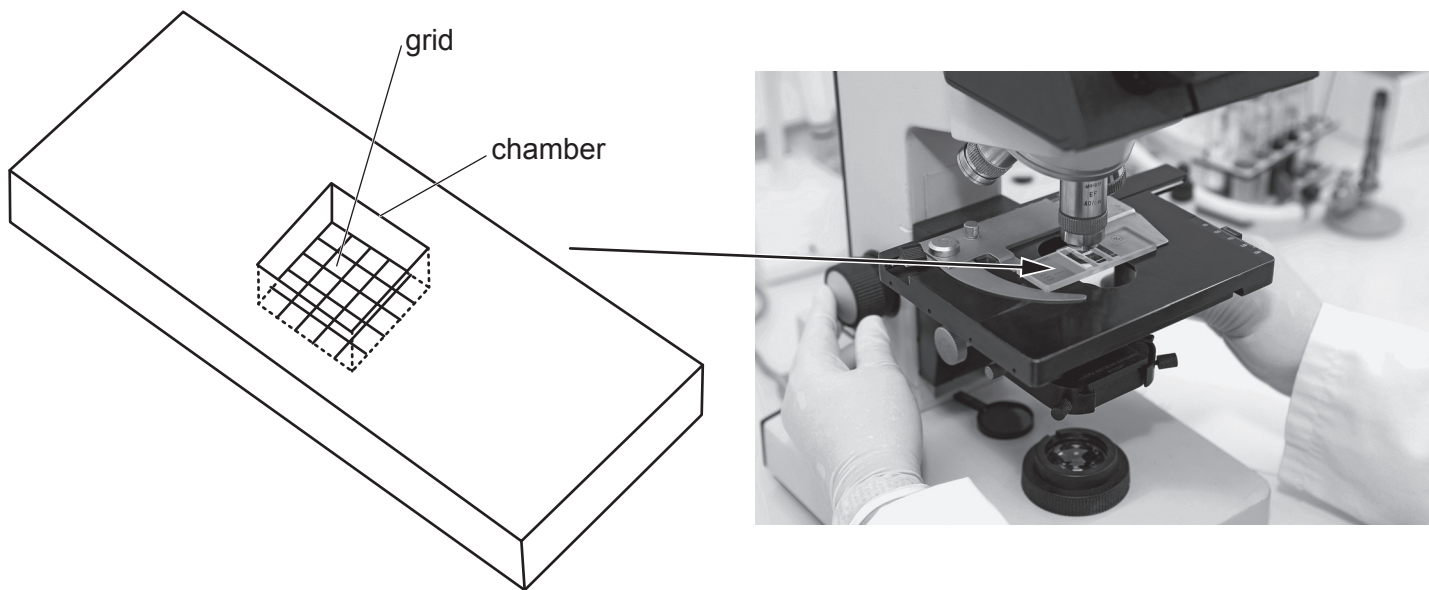


Fig. 4.1

The length of the sides of each small square in the grid in the modified microscope slide is $200\mu\text{m}$. The depth of the chamber is $100\mu\text{m}$. There is a total of 25 small squares in the grid.

Each small square in the grid has an average of 52 yeast cells.

Calculate the concentration of yeast cells per mm^3 .

Space for working.

..... cells per mm^3
[3]

- 4 (a) Yeast cells have many structures in common with a plant cell.

Fig. 4.1 is a drawing of a yeast cell.

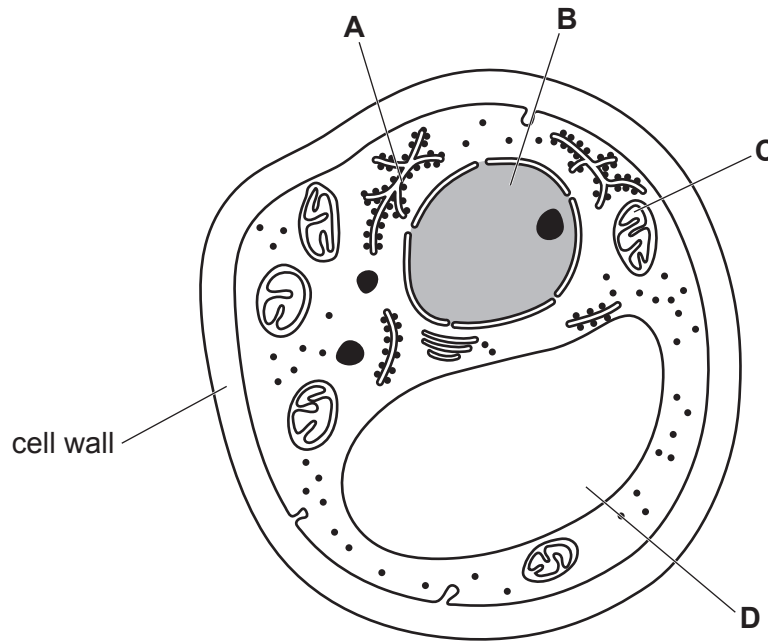


Fig. 4.1

- (i) State the names of the cell structures labelled **A** and **D** on Fig. 4.1.

A

D [2]

- (ii) State the functions of the cell structures labelled **B** and **C** on Fig. 4.1.

B

C [2]

- (iii) State the name of **one** structure that is found in plant cells but is absent in yeast cells.

..... [1]

- (b) A leaf cell was put into a solution. The water potential of the solution was lower than the water potential of the contents of the cell.

Fig. 1.1 is a sketch of the cell after three hours in the solution.

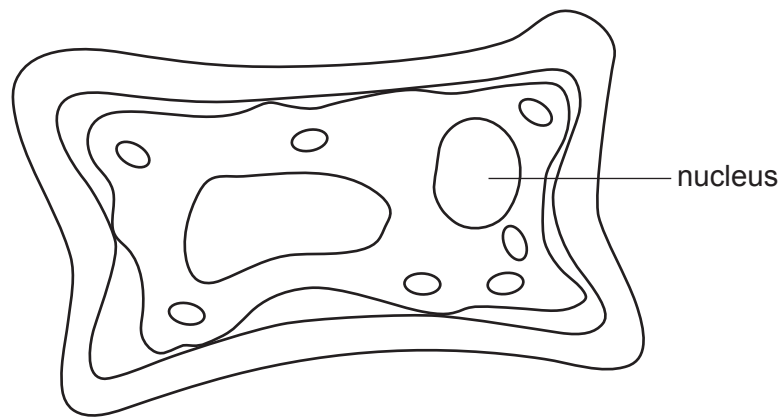


Fig. 1.1

The leaf cell was transferred into pure water.

Sketch the expected appearance of the cell after it had been in the pure water for three hours.

Draw **one** arrow on your sketch to show the direction of water movement.

(c) A plant was **not** watered for one week.

Fig. 1.2 shows a series of photographs of the plant during the week.



Fig. 1.2

Explain how the lack of water has affected the support of the leaves of the plant shown in Fig. 1.2.

Use the term *turgor pressure* in your answer.

.....
.....
.....
.....
.....
.....
..... [3]

[Total: 8]

3 All living organisms excrete waste products.

(a) Fig. 3.1 is a photomicrograph of *Naegleria fowleri*, a single-celled protocist that lives in watery environments.

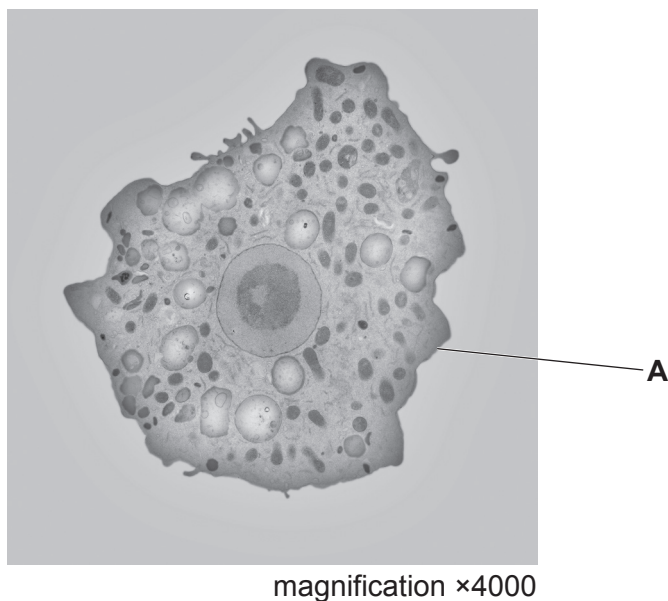


Fig. 3.1

(i) State a feature of *N. fowleri*, visible in Fig. 3.1, that distinguishes it from prokaryotes.

..... [1]

(ii) State the name and function of structure **A**.

structure

function

..... [2]

(iii) Suggest how *N. fowleri* excretes carbon dioxide.

.....

..... [1]

5 Bacteria are classified in the Prokaryote kingdom.

(a) State **two** features of animal **and** plant cells that are **not** found in prokaryotes.

1

2

[2]

Fig. 1.2 shows part of the gas exchange surface of a human.

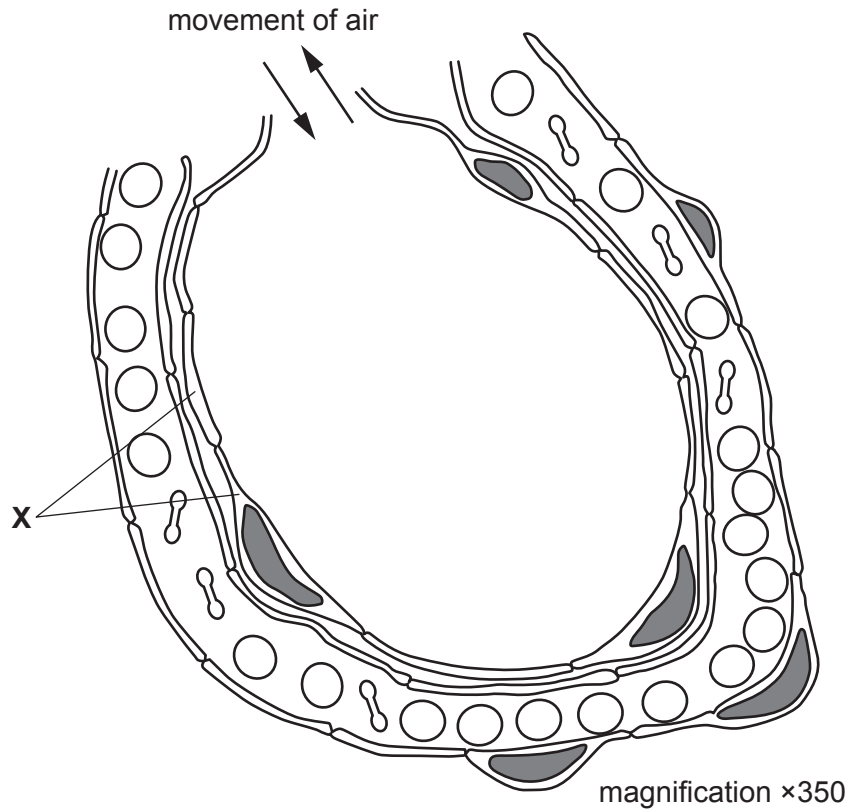


Fig. 1.2

(c) The cells labelled X on Fig. 1.2 form a tissue.

(i) Define the term *tissue*.

.....

.....

.....

.....

..... [2]

- 3 (a) Dialysis tubing is an artificial membrane, which is similar to the lining of the intestine.

A student investigated the diffusion of glucose through dialysis tubing by using the apparatus shown in Fig. 3.1.

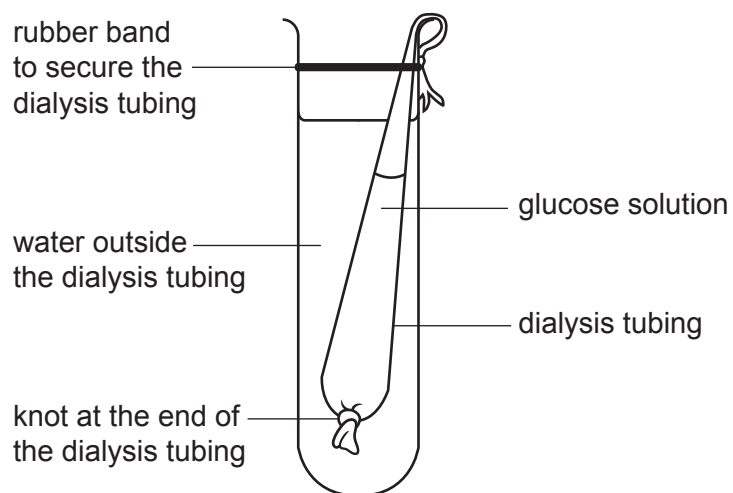


Fig. 3.1

The student took samples of the water outside the dialysis tubing at 5 minute intervals and tested the samples with Benedict’s solution.

The results are shown in Table 3.1.

Table 3.1

time / minutes	results of the Benedict’s tests on the water outside the dialysis tubing
0	blue
5	green
10	yellow
15	red

(i) Describe and explain the results shown in Table 3.1.

.....

.....

.....

.....

.....

.....

.....

..... [3]

(ii) The student repeated the investigation with a higher concentration of glucose in the dialysis tubing.

Predict the results that the student would observe.

.....

.....

..... [1]

5 Ciliates are classified in the kingdom Protocist. Bacteria are classified in the kingdom Prokaryote.

(a) State **two structural** features that distinguish the cells of a protocist from a prokaryote.

1

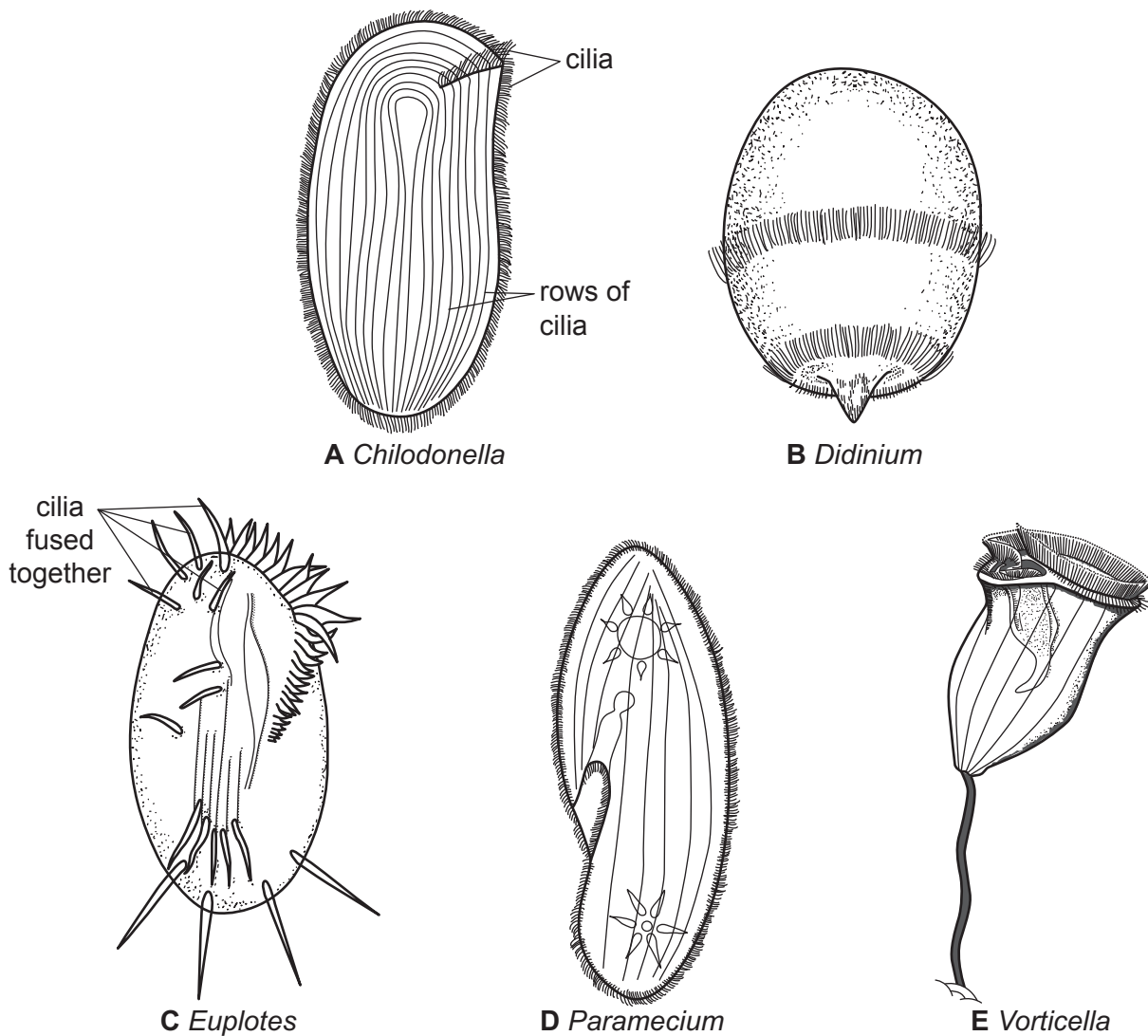
.....

2

.....

[2]

(b) Fig. 5.1 shows five species of ciliate that are found in sewage treatment works.



not to scale

Fig. 5.1

Fig. 5.2 is a dichotomous key to identify the ciliates shown in Fig. 5.1.

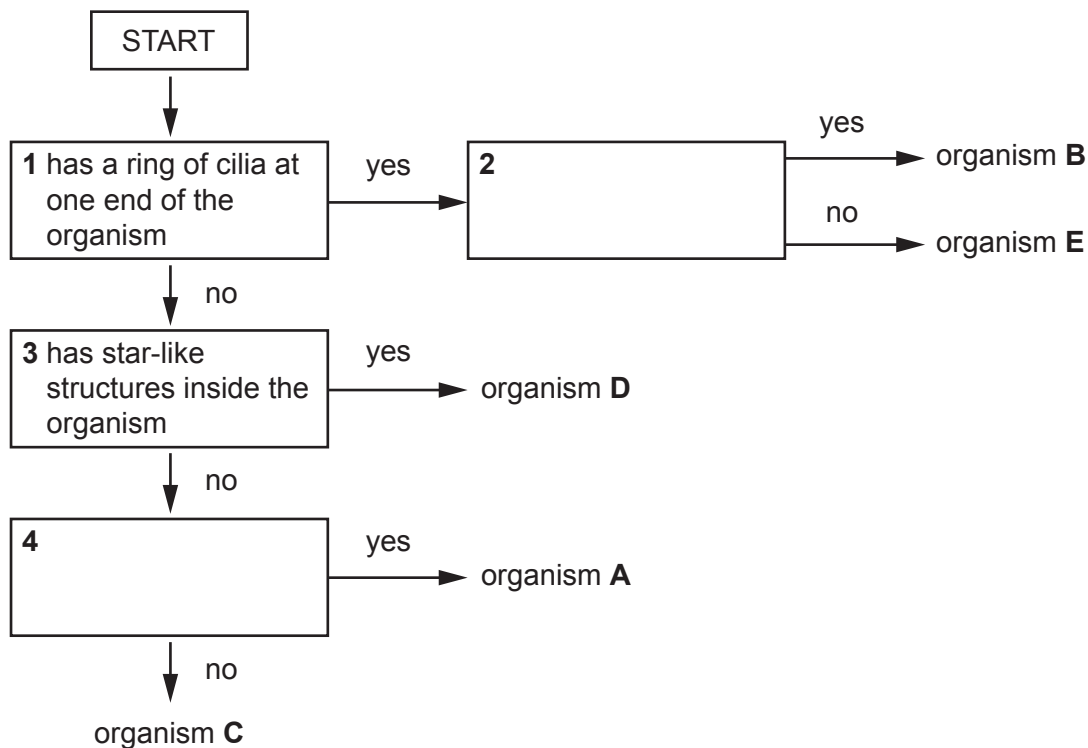


Fig. 5.2

Complete the key in Fig. 5.2 by writing suitable statements:

- for box 2 to distinguish species **B** and **E**
- for box 4 to distinguish species **A** and **C**.

text for box 2

.....

.....

text for box 4

.....

.....

[2]

- 6 Fig. 6.1 is a photomicrograph of part of a cell from the pancreas that produces enzymes that are released into the small intestine.

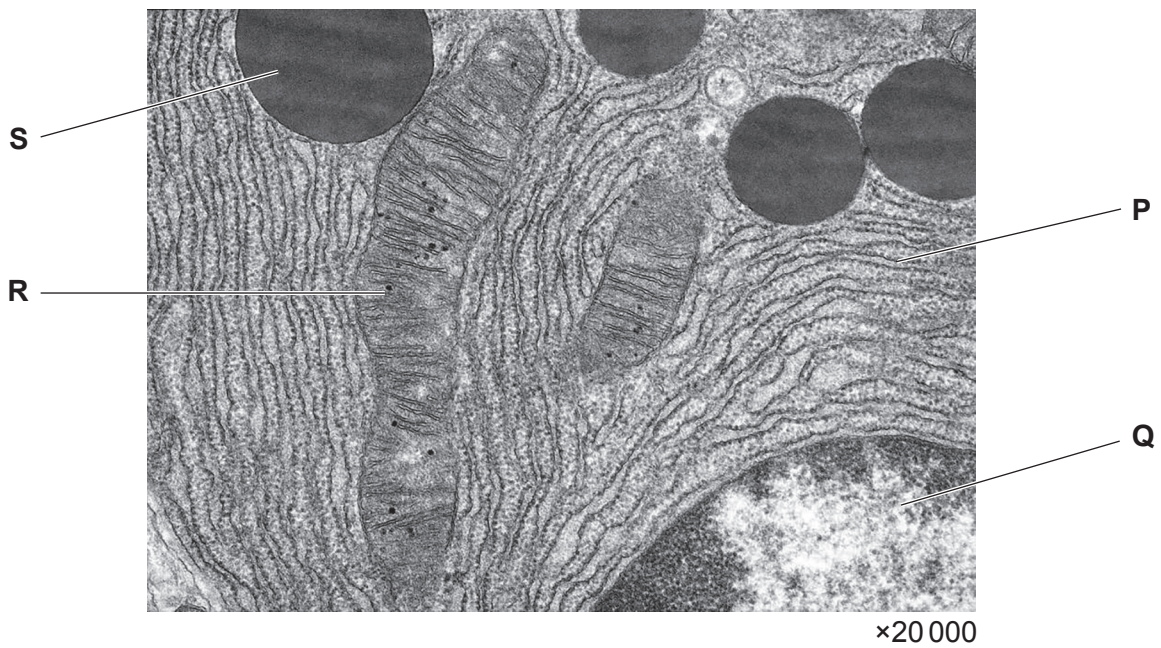


Fig. 6.1

(a) (i) Structure **Q** is part of the nucleus of the cell.

State **one** function of a nucleus.

.....
.....
..... [1]

(ii) State the names of the structures labelled **P** and **R** in Fig. 6.1.

P

R [2]

- 4 (a) Table 4.1 shows four structures associated with the human male reproductive system.

Complete Table 4.1 by identifying the level of organisation of each structure.

Choose your answers from the list.

cell **cell structure** **organ**
organ system **organism** **tissue**

Table 4.1

structure	level of organisation
epithelium	
nucleus	
sperm	
testis	

[4]

6 Fig. 6.1 shows some cells from the shoot tip of an onion, *Allium cepa*.

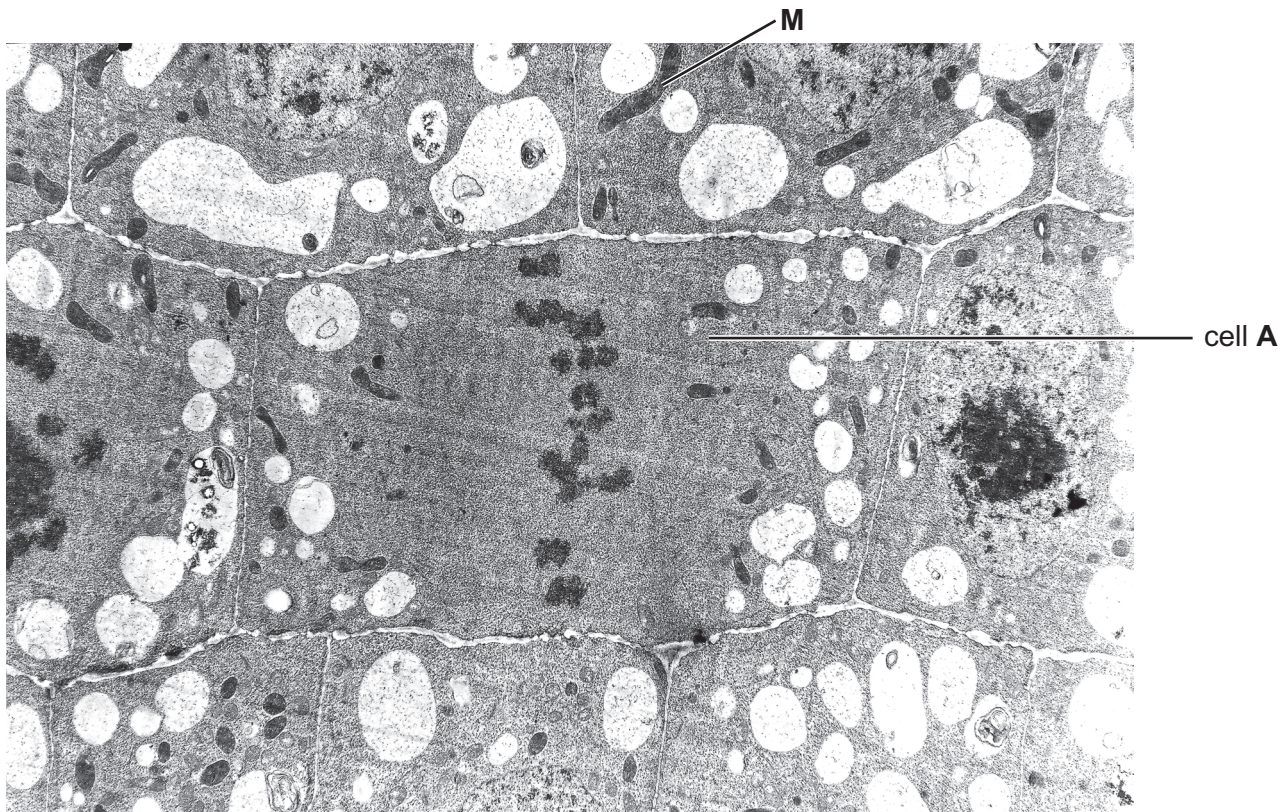


Fig. 6.1

(a) (i) State the evidence visible in Fig. 6.1 that identifies the cells of *A. cepa* as plant cells.

..... [1]

(ii) Cell A is dividing by mitosis.

State the role of mitosis in a shoot tip.

.....
.....
..... [1]

2 Mangrove trees are hydrophytes because they grow in water.

Fig. 2.1 shows a young mangrove tree.



Fig. 2.1

(a) An adaptive feature is a feature that increases the fitness of an organism.

(i) Define the term *fitness*.

.....
.....
..... [1]

(ii) Mangrove trees have many aerial roots and floating seeds.

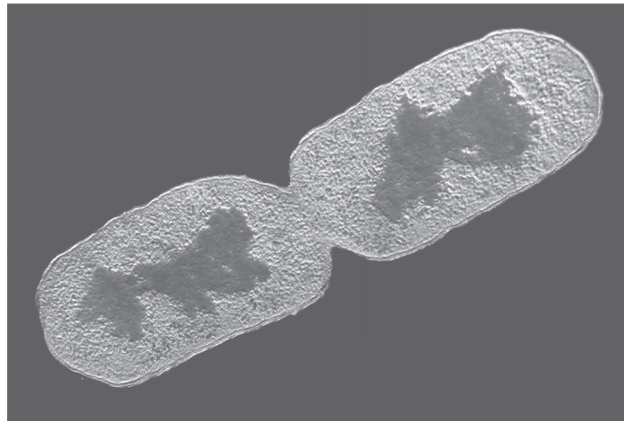
Suggest how these adaptive features allow mangrove trees to survive in water.

many aerial roots
.....
.....
floating seeds
.....
.....

[2]

6 Bacteria are useful in biotechnology and genetic engineering.

Fig. 6.1 shows a photomicrograph of a bacterium.



magnification $\times 27\,000$

Fig. 6.1

(a) State the name of the process that is taking place in Fig. 6.1.

..... [1]

(b) (i) Write the formula that would be used to calculate the actual width of the bacterium.

(ii) The actual width of the bacterium is 0.0008 mm. [1]

Convert this value to micrometres (μm).

Space for working.

..... μm [1]

- 3 A student cut a section of a root and made an outline drawing of the distribution of tissues as shown in Fig. 3.1.

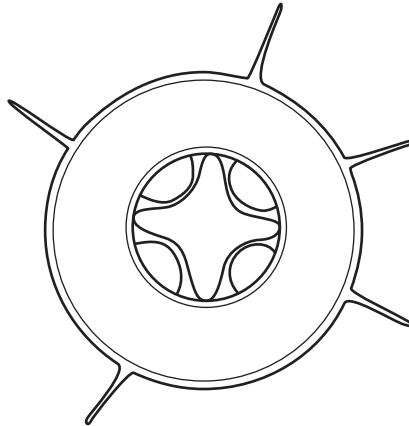


Fig. 3.1

- (a) (i) Identify the position of the xylem tissue by drawing a label line and the letter **X** on Fig. 3.1. [1]
- (ii) State why xylem is a tissue.

.....

.....

.....

..... [2]

(b) Fig. 6.2 is a diagram of a human sperm cell.

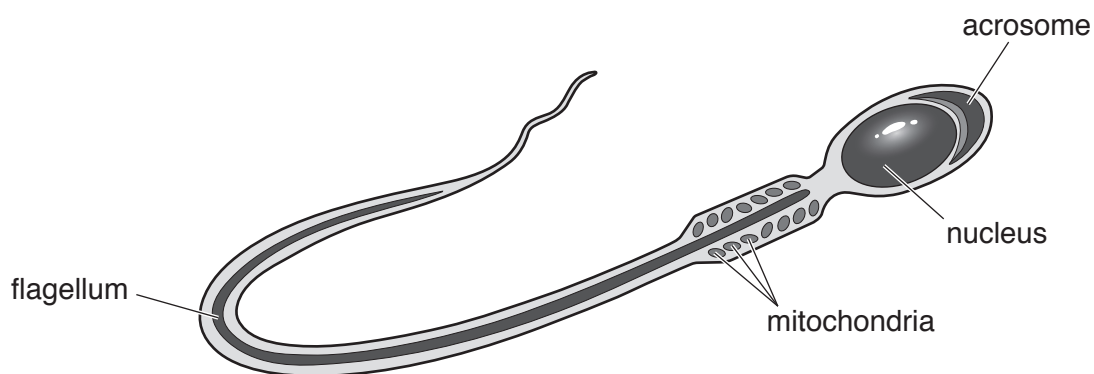


Fig. 6.2

(i) Write the formula that would be used to calculate the magnification of the diagram.

[1]

(ii) The actual length of the sperm cell in Fig. 6.2 is 0.055 mm.

Convert this value to micrometres (μm).

Space for working.

..... μm [1]

- (c) The filtrate which is formed from the blood in the kidneys contains many useful substances, which are reabsorbed into the blood.

Fig. 1.1 is a photomicrograph of a cross-section of some of the cells that carry out reabsorption.

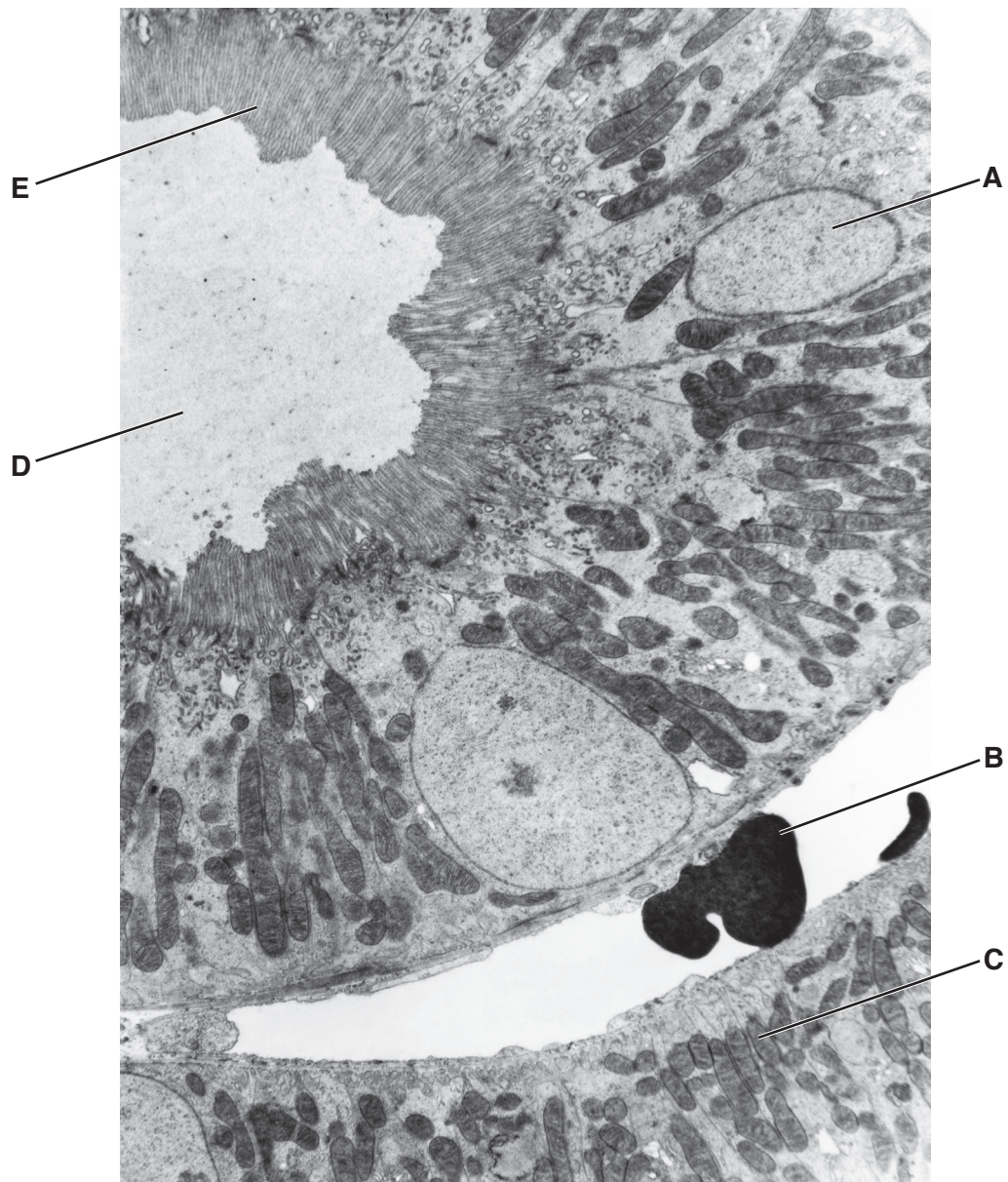


Fig. 1.1

- (i) Complete the table by stating the letter in Fig. 1.1 that identifies each structure.

structure	letter on Fig. 1.1
microvilli	
nucleus	
mitochondrion	

[3]

4 A neurone is a type of specialised animal cell.

(a) (i) Neurones develop from unspecialised cells.

State the name of these unspecialised cells.

.....[1]

(ii) All animal cells have some common features.

State **two** structural features common to all animal cells.

1

2

[2]

(iii) Most neurones are longer than other types of animal cell.

Suggest why most neurones are very long.

.....

.....[1]

3 Red blood cells in humans are produced from stem cells.

Fig. 3.1 shows how a red blood cell is produced and becomes specialised.

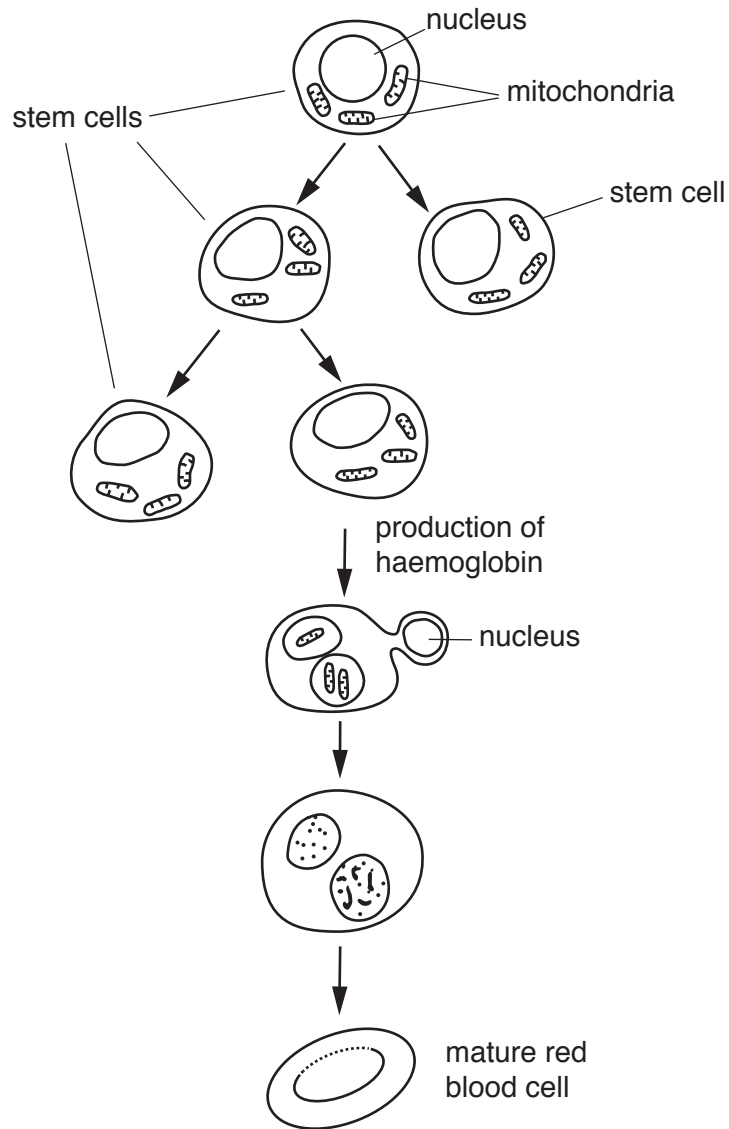


Fig. 3.1

(c) Fig. 2.1 is a diagram of a protein used to move ions across membranes in root hair cells.

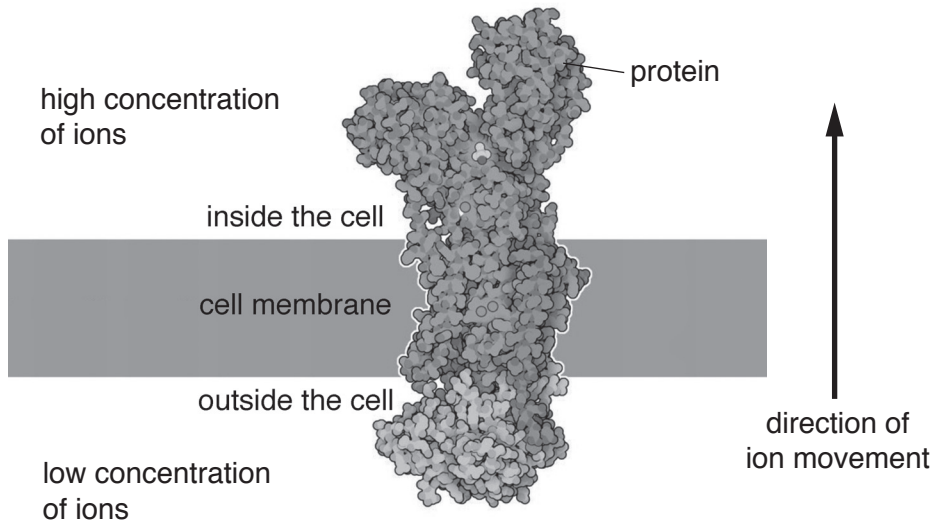


Fig. 2.1

(i) State the name of the process that moves mineral ions into root hair cells through cell membrane proteins.

.....[1]

(ii) Explain how protein molecules move ions across a membrane during this process.

.....
.....
.....
.....
.....
.....
.....
.....[3]

6 Fig. 6.1 is a flow diagram that shows what happens at the start of a bacterial infection.

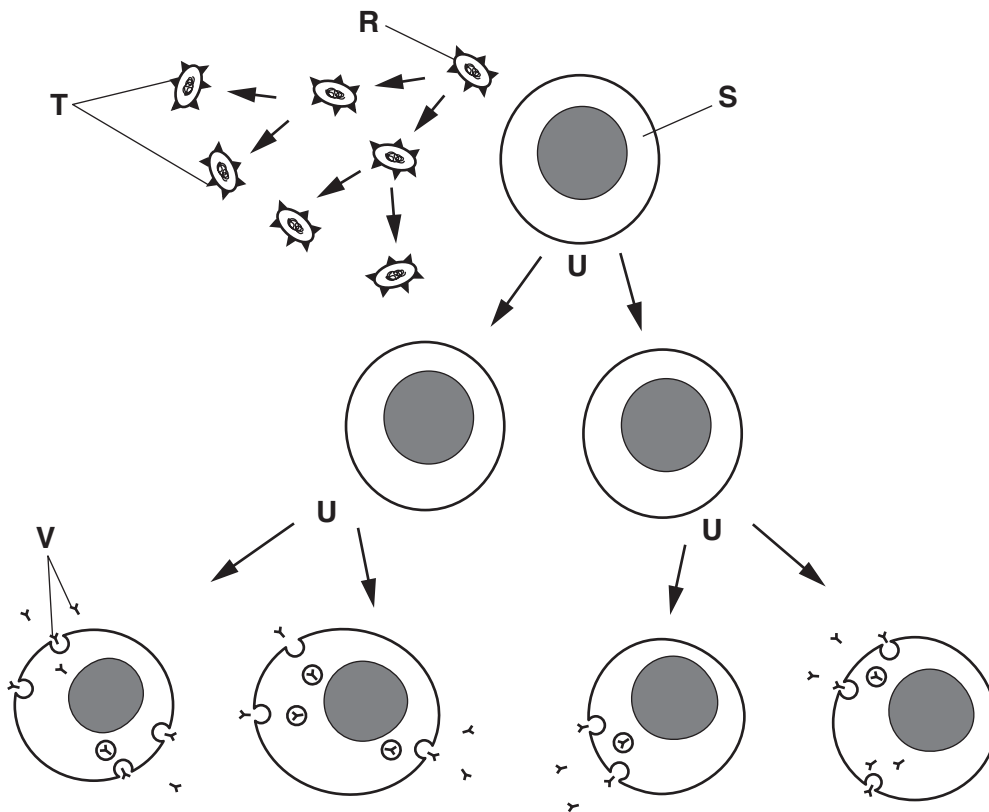


Fig. 6.1

(a) Cell R is a prokaryote and cell S is a lymphocyte.

(i) State the names of **two** cellular structures that would be found in **both** prokaryotes and white blood cells.

1

2

[2]

(ii) Describe how the cellular structure of white blood cells differs from the cellular structure of prokaryotes.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....[3]

(c) Fig. 2.1 is a drawing made from an electron micrograph of a lymphocyte that produces antibodies.

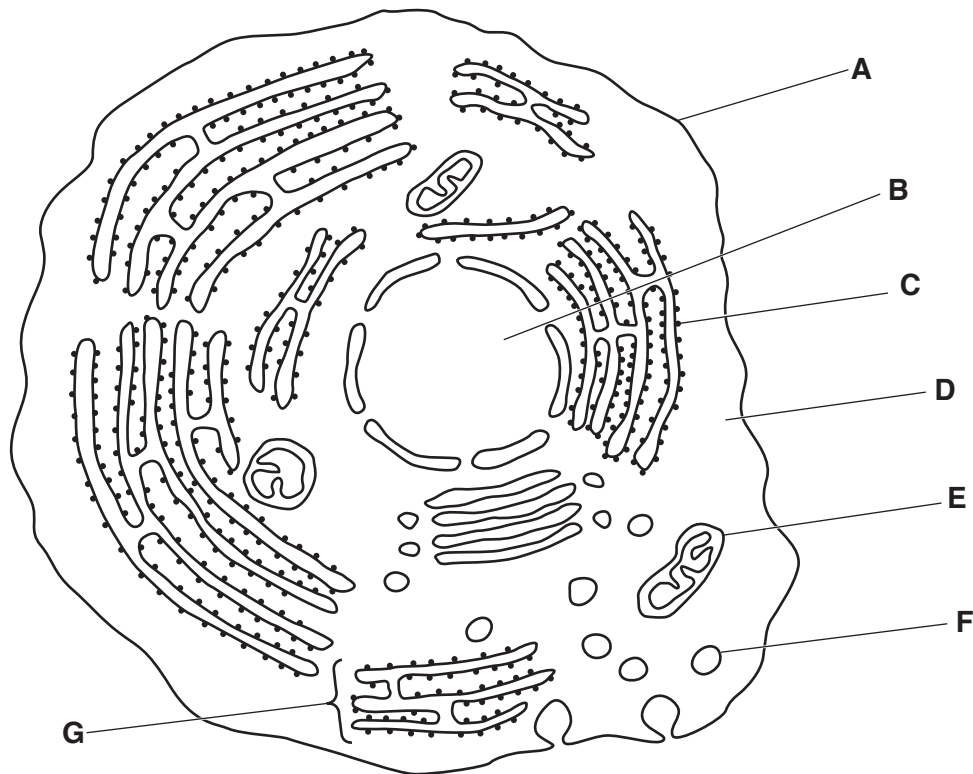


Fig. 2.1

Table 2.1 contains statements about the structures visible in Fig. 2.1.

Complete Table 2.1 by

- naming the structure
- identifying the letter that labels the structure.

The first one has been done for you.

Table 2.1

function	name of structure	letter from Fig. 2.1
absorption of amino acids used in making antibodies	cell membrane	A
stores genetic information as DNA		
provides energy for making antibodies		
site of production of antibodies		
transport of antibody molecules for release into blood		

[4]

(b) Molecular biologists identified a gene found in all species of bacteria and in mitochondria.

State the function of mitochondria.

.....
..... [2]

(c) Some scientists think that mitochondria evolved from bacteria because they are similar in size and structure. Bacteria belong to the Prokaryote kingdom.

Give **two** features of all prokaryotes.

1
2 [2]

- 6 (a) Name **one** feature of dicotyledonous leaves that distinguishes them from monocotyledonous leaves.

.....[1]

- (b) Explain why a leaf is an organ.

.....
.....[1]

(c) Fig. 4.2 shows a section through the leaf of a water lily.

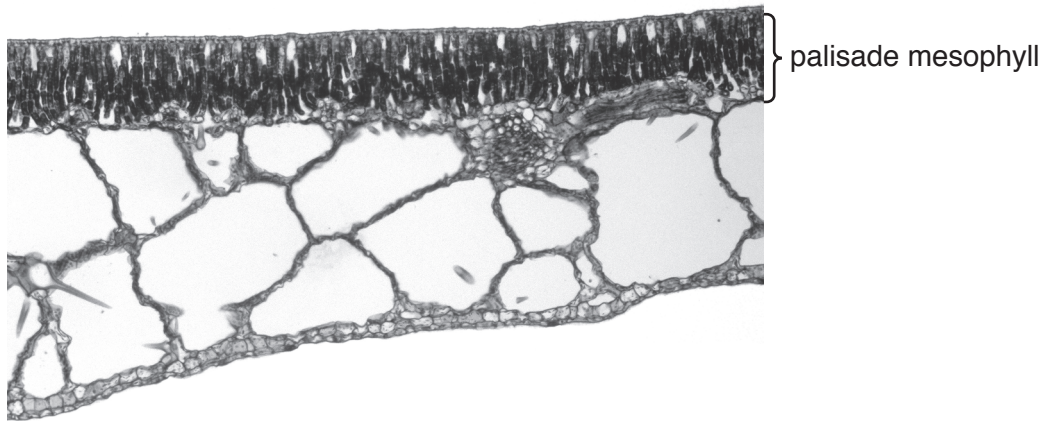


Fig. 4.2

(i) State why the palisade mesophyll is a tissue.

.....
..... [1]

(d) The large air spaces are an adaptation of water lily leaves. Suggest why.

.....
.....
.....
.....
..... [2]

(e) Hydrophytes are adapted to aquatic habitats.

State the name used for plants that are adapted to dry habitats.

..... [1]

- 4 A student investigated the diffusion of substances through Visking tubing, an artificial membrane which has some of the properties of cell membranes.

The student made a bag of Visking tubing as shown in Fig. 4.1.

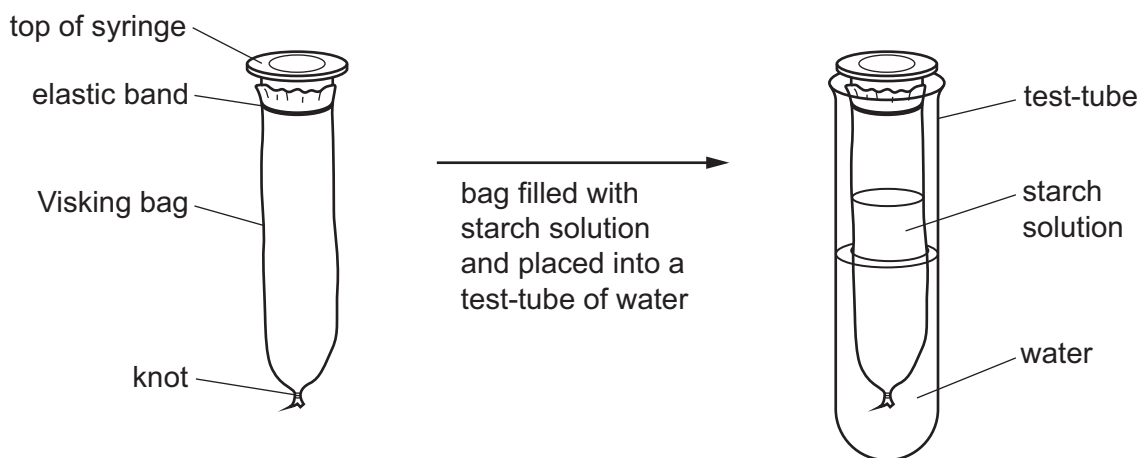


Fig. 4.1

The student added some iodine solution to the water in the test-tube.

After 30 minutes at room temperature, the contents of the Visking bag were stained blue-black, but the water outside remained a yellow colour.

- (a) (i) Explain these results.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[4]

(ii) State **three** factors that influence the movement of molecules through membranes.

1

2

3

[3]

(c) Many years ago scientists discovered that *V. cholerae* secretes a toxin. Fig. 2.2 shows the results of an experiment to measure the flow of chloride ions out of human cells with and without the toxin.

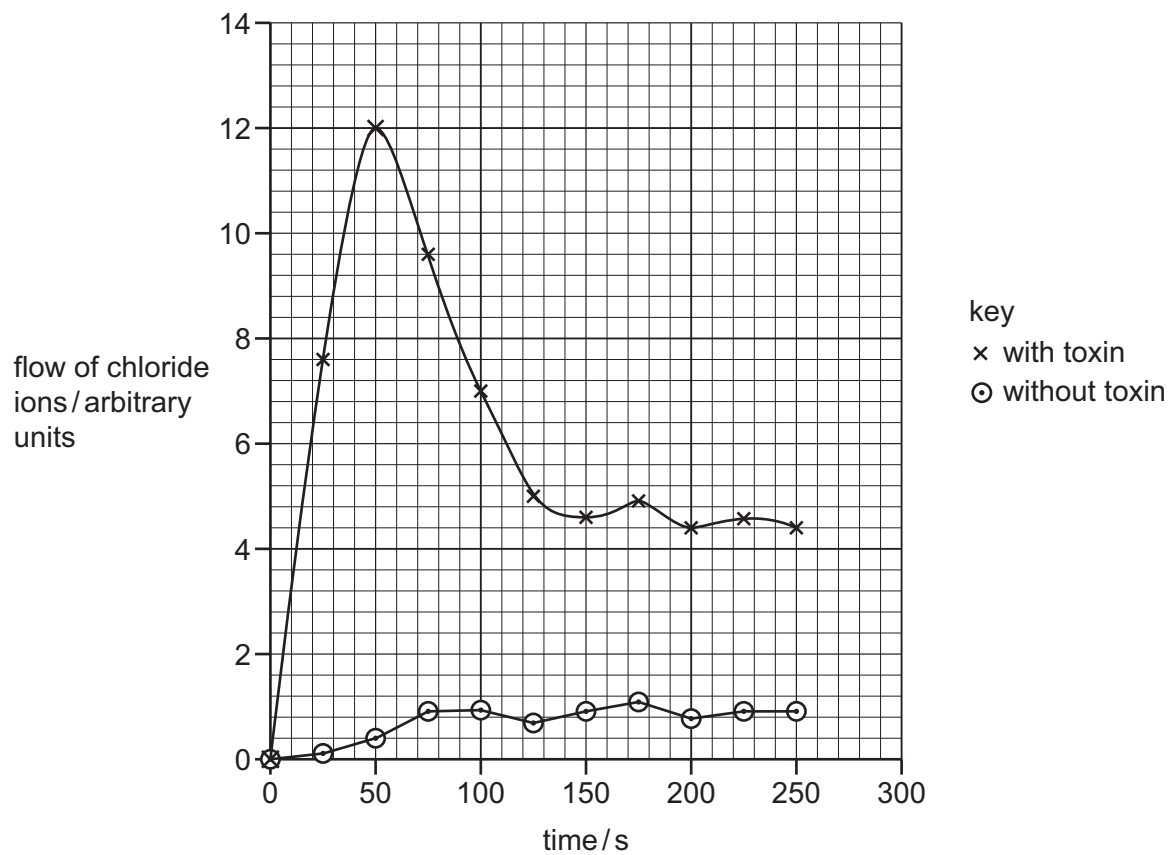


Fig. 2.2

- (i) Calculate the difference in flow of chloride ions between the cells with the toxin and the cells without the toxin at 50 seconds.

Show your working and state the units in your answer.

..... [2]

- (ii) Use the data in Fig. 2.2 to describe the effect of the toxin on the flow of chloride ions out of the cells.

.....
.....
.....
.....
.....
.....
.....
..... [3]

- (iii) Chloride ions cannot move out of cells by simple diffusion.

Suggest **and** describe how chloride ions could move out of cells.

.....
.....
.....
.....
.....
.....
..... [3]

4 Some students investigated osmosis in raw potato sticks.

(a) Define the term *osmosis*.

.....

.....

.....

.....

.....

.....

.....

.....

[3]

(b) The students measured the mass of four of the potato sticks using an electronic balance.

Fig. 4.1 shows an electronic balance.



Fig. 4.1

The students left each potato stick in one of four different liquids for 5 hours:

- distilled water
- 0.1 mol per dm³ sodium chloride solution
- 0.5 mol per dm³ sodium chloride solution
- 1.0 mol per dm³ sodium chloride solution.

After 5 hours they measured the mass again and calculated the change in mass.

(i) Predict which of the liquids would cause the largest decrease in mass of a potato stick.
..... [1]

(ii) The students dried the potato sticks with paper towels before putting them on the electronic balance.

Suggest why.

.....
.....
..... [1]

(c) After the experiment the students noticed that the potato stick with the lowest mass was soft and floppy.

Explain why the potato stick had become soft and floppy.

.....
.....
.....
.....
.....
.....
..... [3]

(d) The students followed the same experimental procedure with boiled potato sticks and found no overall change in mass in any of the solutions.

Suggest why the mass of the boiled potato sticks remained the same.

.....
.....
.....
.....
..... [2]

[Total: 10]

4 *Rhabdostyla* is a single-celled organism that has no cell wall and no chlorophyll.

(a) Gases are exchanged across the cell membrane of *Rhabdostyla*.

Name:

the gas produced by *Rhabdostyla*

the process that produces the gas

the method of removal of the gas

[3]

Rhabdostyla lives in freshwater habitats, such as ponds, lakes and rivers.

Freshwater has a very low concentration of solutes.

Rhabdostyla has a contractile vacuole that fills with water and empties at intervals as shown in Fig. 4.1. The contractile vacuole removes excess water.

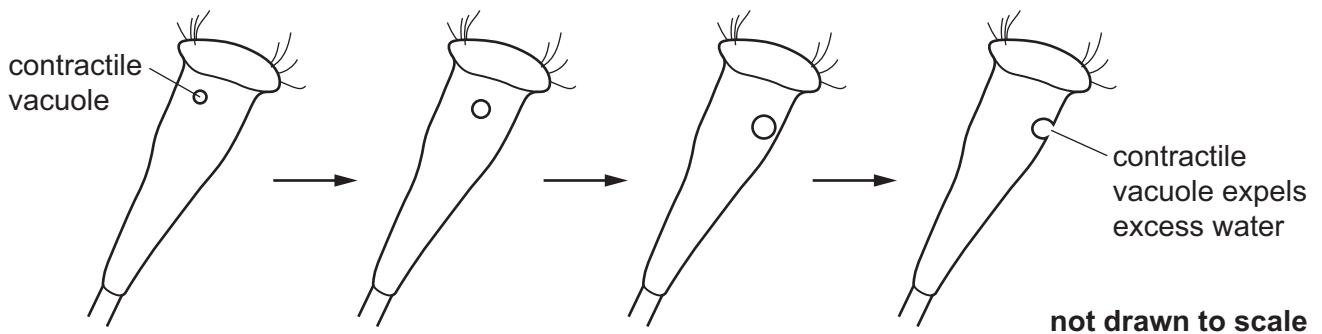


Fig. 4.1

(b) Explain, using the term **water potential**, why *Rhabdostyla* needs to remove excess water.

.....

.....

.....

.....

.....

.....

.....

.....

[3]

In an investigation, individual *Rhabdostyla* were placed into different concentrations of sea water. The rate of water excreted by the contractile vacuole of each organism was determined. The results are shown in Fig. 4.2.

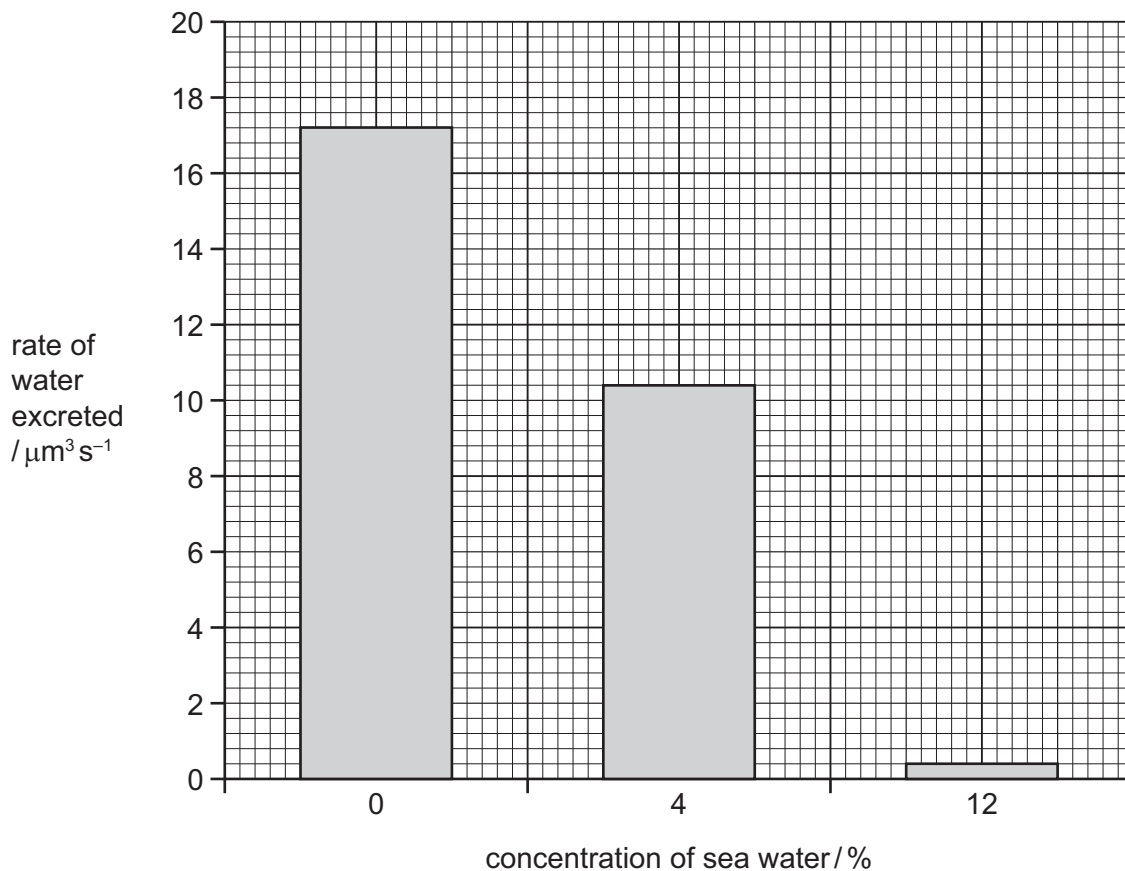


Fig. 4.2

(c) Explain the results shown in Fig. 4.2.

.....

.....

.....

.....

.....

.....

.....

.....

[3]

(d) Single-celled organisms with cell walls do not have contractile vacuoles. Suggest why.

.....

.....

.....

.....

.....

.....

.....

.....

.....

[3]

[Total: 12]

- 1 A researcher used a light microscope to observe epithelial cells from a human cheek. Fig. 1.1 is a photograph that the researcher made of these cells.

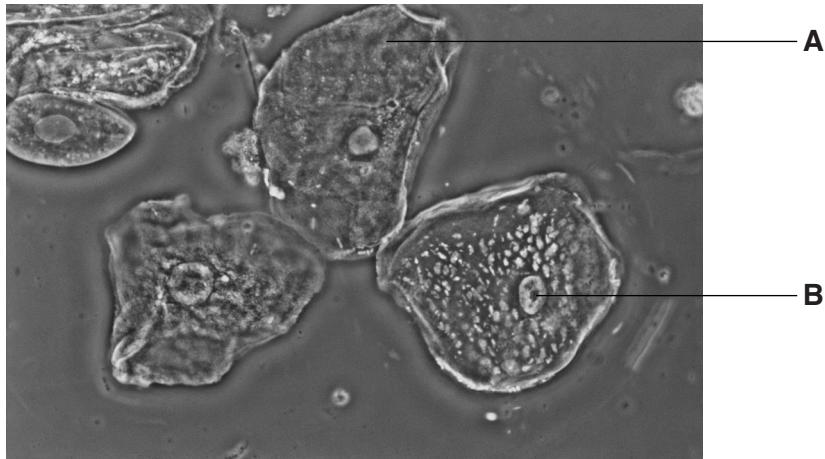


Fig. 1.1

- (a) (i) Name the parts labelled **A** and **B**.

A

B [2]

- (ii) The cells in Fig. 1.1 each have a cell membrane.

State **one** of the functions of a cell membrane.

.....
..... [1]

- (iii) State how the shape of the cells shown in Fig. 1.1 differs from the shape of a palisade mesophyll cell in a leaf.

.....
.....
..... [1]

(b) Fig. 1.2 shows an electron micrograph of a mitochondrion.

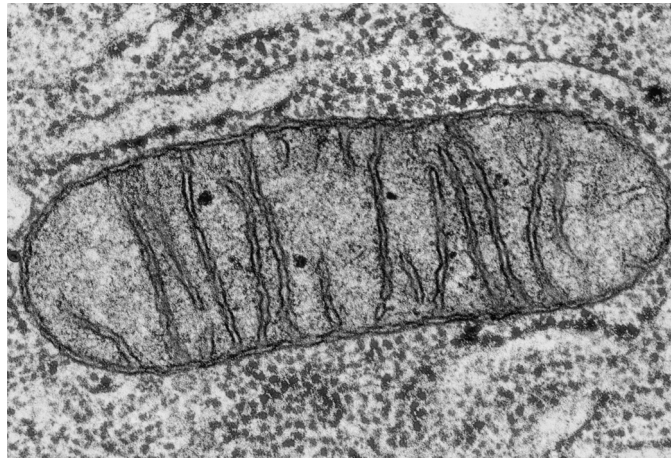


Fig. 1.2

Mitochondria have two membranes, an inner membrane and an outer membrane. The inner membrane is folded and used in respiration.

Suggest why the inner membrane of mitochondria is folded.

.....

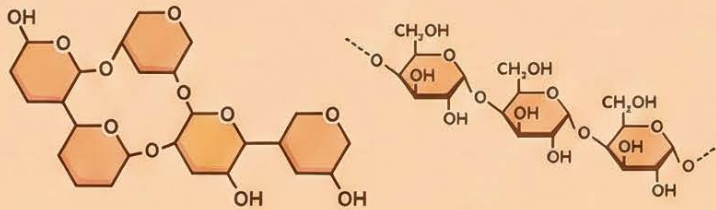
.....

.....[1]

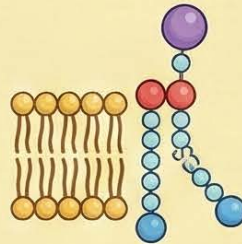
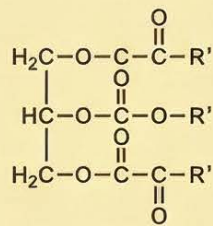
BIOLOGICAL MOLECULES

The Building Blocks of Life

CARBOHYDRATES



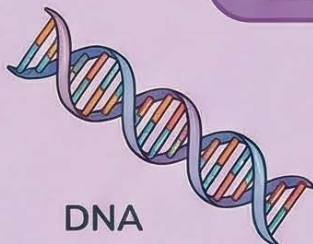
LIPIDS



PROTEINS



NUCLEIC ACIDS



DNA



RNA



6 Fig. 6.1 is a diagram of DNA.

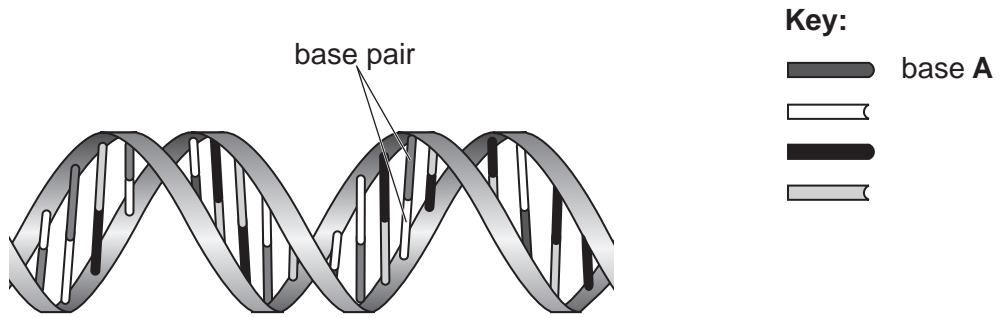


Fig. 6.1

(a) (i) State the letter of the base that pairs with A.

..... [1]

(ii) State the letters of the other bases in DNA.

..... [1]

(b) Outline the roles of DNA in a cell.

.....
.....
.....
.....
..... [2]

1 Water is an essential molecule for life.

(a) Complete the statements.

Water moves into and out of cells by

Water is known as a because it can dissolve solutes.

[2]

[

[3]

5 Milk is a source of some of the nutrients that are part of a balanced diet.

(a) Calcium and protein are two nutrients found in milk.

Describe the importance of calcium and protein in the diet.

calcium

.....

.....

protein

.....

.....

[4]

(d) Fig. 3.2 shows part of a DNA molecule from a chromosome of a cat.

Complete Fig. 3.2 by writing the letters for the base sequence of the other strand of the DNA molecule.

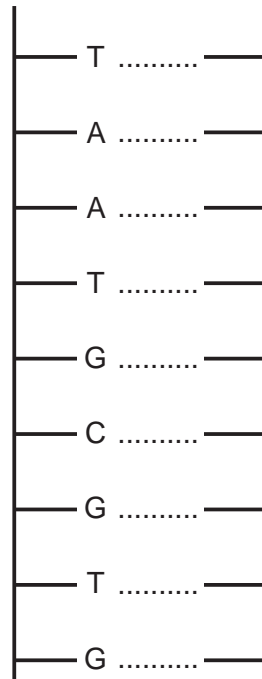


Fig. 3.2

[1]

The student took samples of the water outside the dialysis tubing at 5 minute intervals and tested the samples with Benedict's solution.

The results are shown in Table 3.1.

Table 3.1

time/minutes	results of the Benedict's tests on the water outside the dialysis tubing
0	blue
5	green
10	yellow
15	red

(i) Describe and explain the results shown in Table 3.1.

.....

.....

.....

.....

.....

.....

.....

..... [3]

(ii) The student repeated the investigation with a higher concentration of glucose in the dialysis tubing.

Predict the results that the student would observe.

.....

.....

..... [1]

(b) Mineral salts are another important component of a balanced diet.

State the importance of calcium ions and iron ions in a balanced diet.

calcium ions

.....

.....

iron ions

.....

.....

[4]

5 Genetic engineering is an example of an important biotechnology.

(a) Complete the passage below by filling in each space with a suitable word.

DNA is a biological molecule found in the of an animal cell.

The sequence of the in mRNA determines the order of the amino acids that will be assembled into a

When carrying out genetic engineering, sections of human DNA called are cut using restriction enzymes. Next bacterial plasmids are cut with the restriction enzymes to form complementary ends.

The cut section of human DNA is inserted into the cut plasmid and they are joined together to form a plasmid. These plasmids are inserted into and replication occurs. This process is used to produce human that is used to treat people with diabetes.

[9]

2 Phloem is used to transport sucrose and amino acids in plants. Sucrose is a carbohydrate.

(a) Describe the uses of carbohydrates **and** amino acids in plants.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) Fig. 6.2 shows a method of reproduction that some potato farmers use to produce more potato plants.

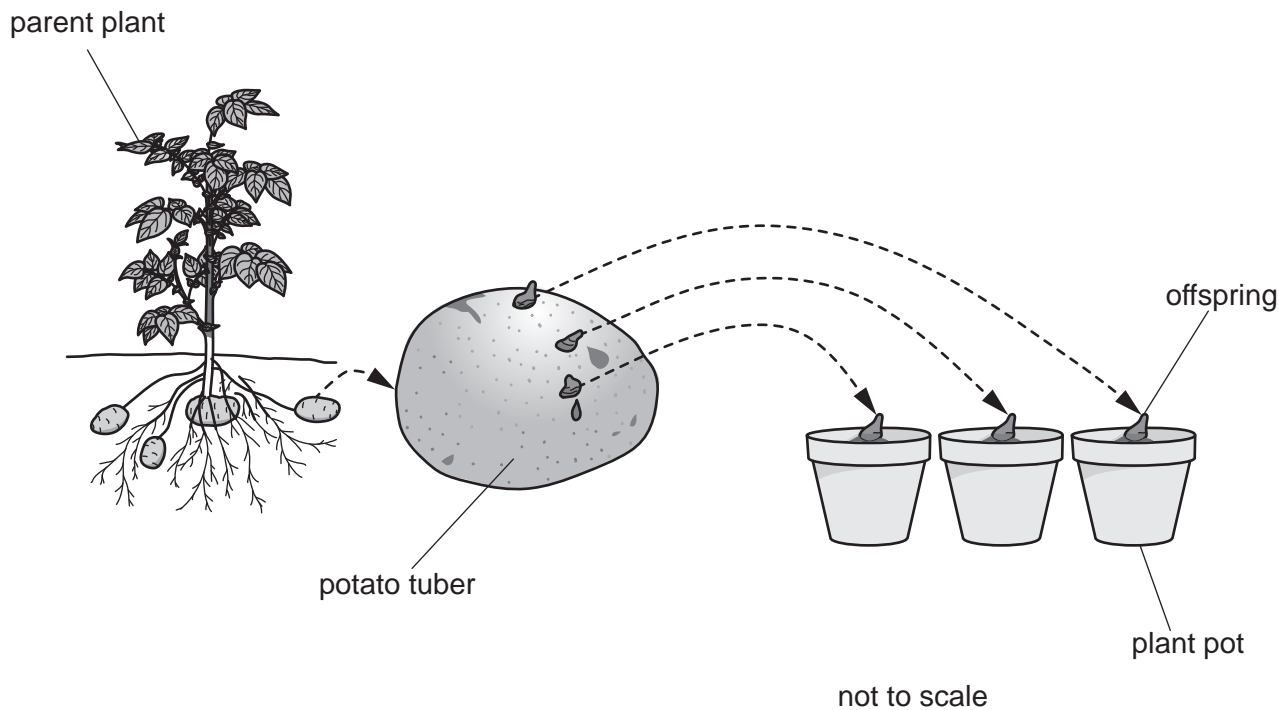


Fig. 6.2

Describe the advantages of the type of reproduction shown in Fig. 6.2 in crop production.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

(c) Potato tubers store starch.

Explain why plants store starch.

.....

.....

.....

.....

.....

.....

..... [2]

[Total: 7]

(iii) Amino acids are an example of a type of nutrient transported in the blood.

State **two** examples of larger molecules found in cells that are made from amino acids.

1

2

[2]

[Total: 12]

1 Fat is a necessary component of the human diet.

(a) State **three** ways in which the human body uses fat.

1.....

2.....

3.....

[3]

5 (a) (i) Describe the structure of a DNA molecule.

.....

.....

.....

.....

.....

.....

.....

.....

.....[3]

(e) Plants need nitrate ions for growth.

Explain why.

.....

.....

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.....

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.....

.....

[Total: 14]

- 1 Milk is sometimes referred to as a 'complete food' because it contains all the nutrients that a young mammal requires.

(a) Table 1.1 shows three nutrients that are contained in milk.

Complete the table by stating **one** role of each nutrient in the body of a young mammal.

Table 1.1

nutrient	role in the body
protein	
lactose (milk sugar)	
calcium	

[3]

6 A DNA molecule has two strands as shown in Fig. 6.1.

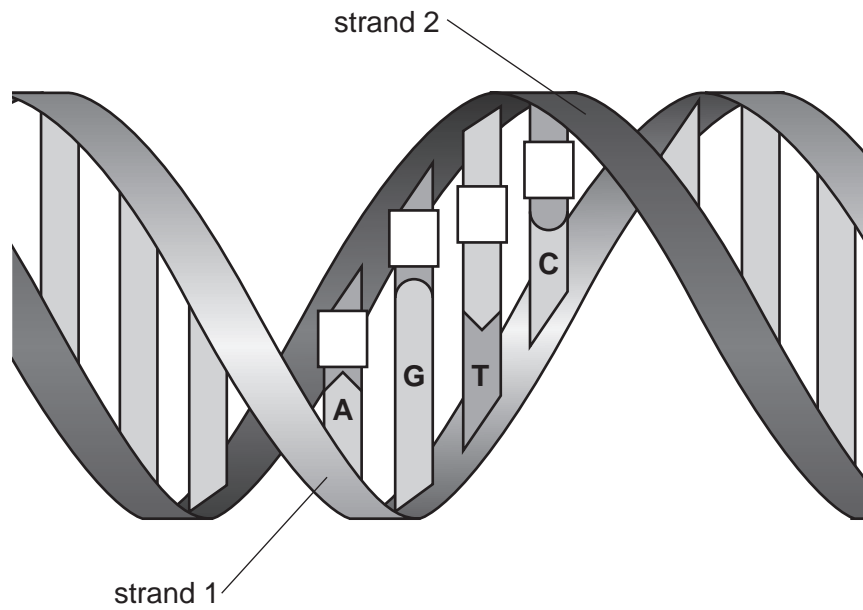


Fig. 6.1

(a) (i) Fill in the boxes on Fig. 6.1 to show the letter of the bases on strand 2 that will pair with the corresponding bases on strand 1. [2]

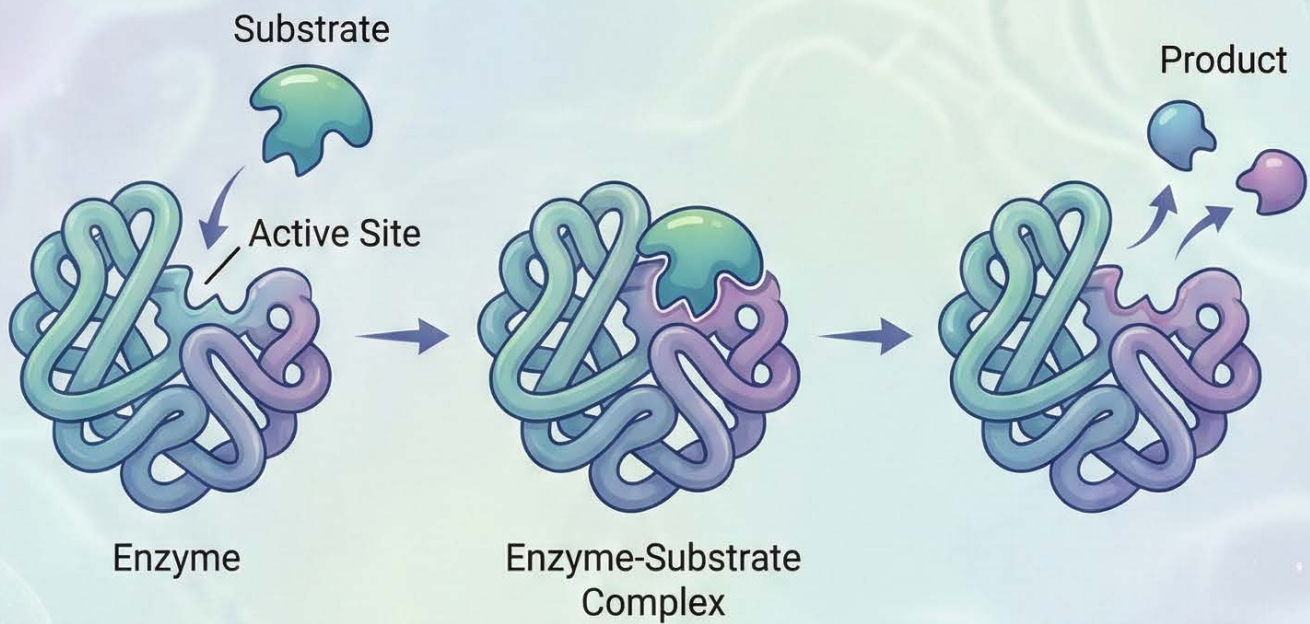
(ii) State the name for the structure of a DNA molecule as shown in Fig. 6.1.

.....[1]

ENZYMES

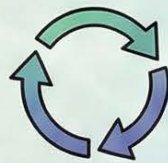
Biological Catalysts: Speeding Up Life's Reactions

Lock and Key



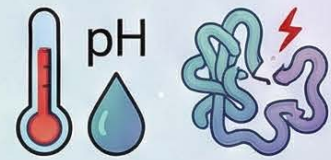
1. Specificity

Enzymes are a lock and key and specific complementary molecules.



2. Reusability

Enzymes can be used to construct complementary cycle.



3. Factors Affecting Activity

Enzymes are highly sensitive to changes in the environment of denatured enzyme.

Enzymes are essential for metabolism, digestion, and countless other life processes.

(b) Yeast is used in the production of ethanol to manufacture a type of biofuel.

Fig. 4.2 is a flow chart of the process.

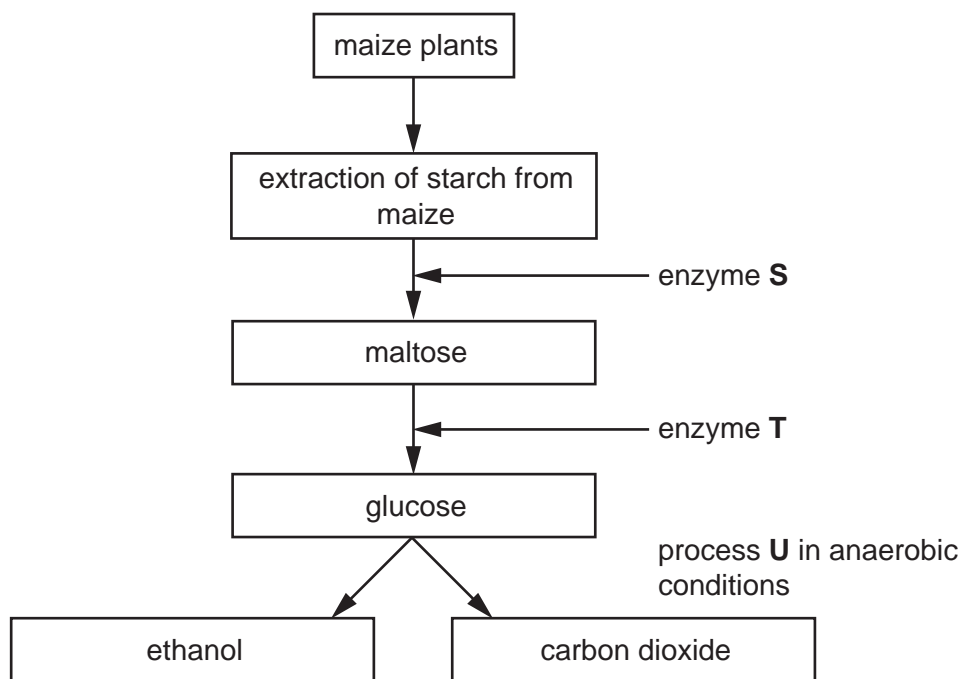


Fig. 4.2

(i) State the names of enzymes **S** and **T**.

S

T

[2]

(c) Fig. 5.1 shows a flow diagram for the production of lactose-free milk.

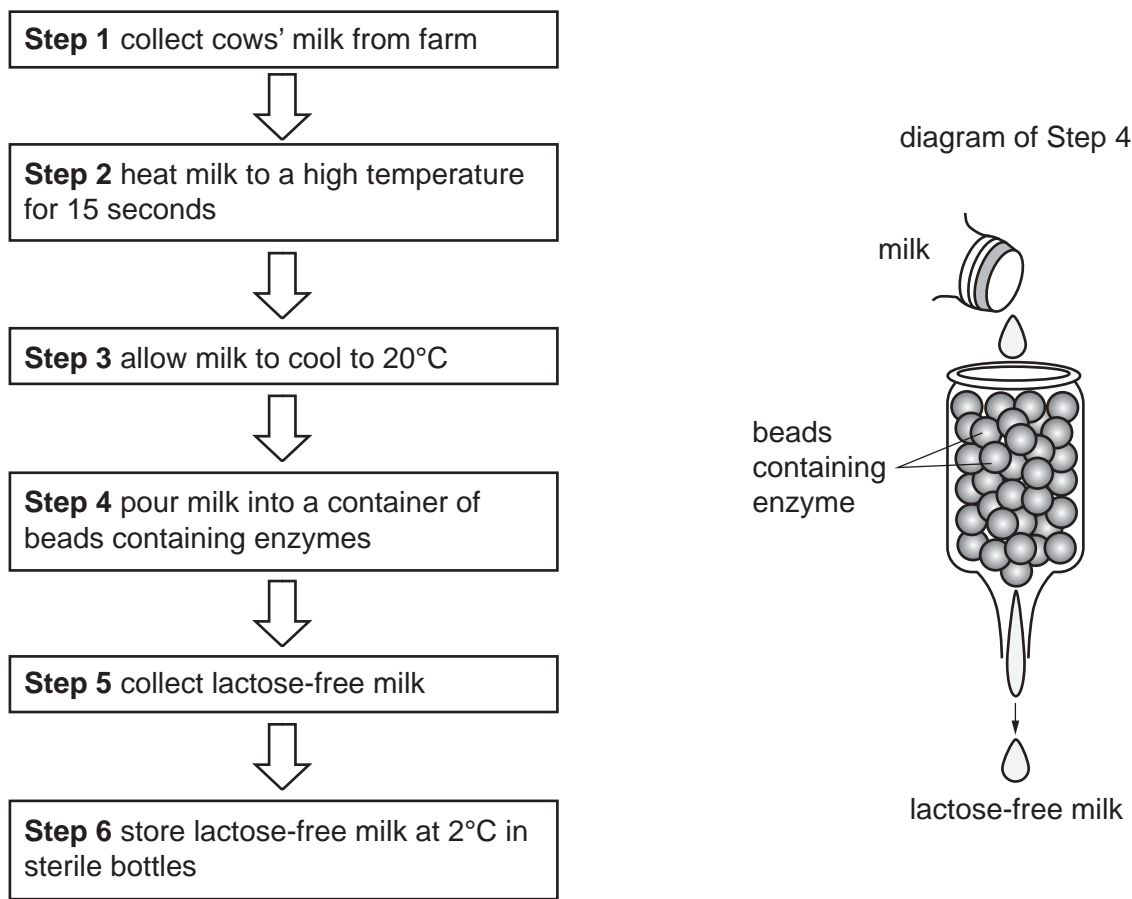


Fig. 5.1

(i) Explain how heating the milk in **step 2** in Fig. 5.1 ensures the hygienic preparation of lactose-free milk.

.....
.....
..... [1]

(ii) Explain why the milk must be cooled in **step 3** before it makes contact with the enzymes.

.....
.....
.....
.....
..... [2]

(iii) State the name of the enzyme used to make lactose-free milk in **step 4**.

..... [1]

- (iv) Suggest why the enzymes are kept in the beads in **step 4** rather than mixed as an enzyme solution with the milk.

.....
.....
..... [1]

2 Biological washing powders contain enzymes that break down food stains.

(a) Complete Table 2.1 by naming the enzymes that break down three substances in food stains and by stating the product or products.

Table 2.1

substance	enzyme	product(s)
starch		
fat		
protein		

[3]

Some students compared how effective biological and non-biological washing powders are at removing stains at temperatures between 10°C and 60°C.

- Pieces of stained cloth were washed using two different washing powders.
- The degree of stain removal was measured by using a light meter to record the percentage of light reflected from the cloth.
- A light meter gave a value of 100% when the cloth was completely clean.
- Any stain left on the cloth reduced the percentage of light reflected.

The results of the students' investigation are shown in Fig. 2.1.

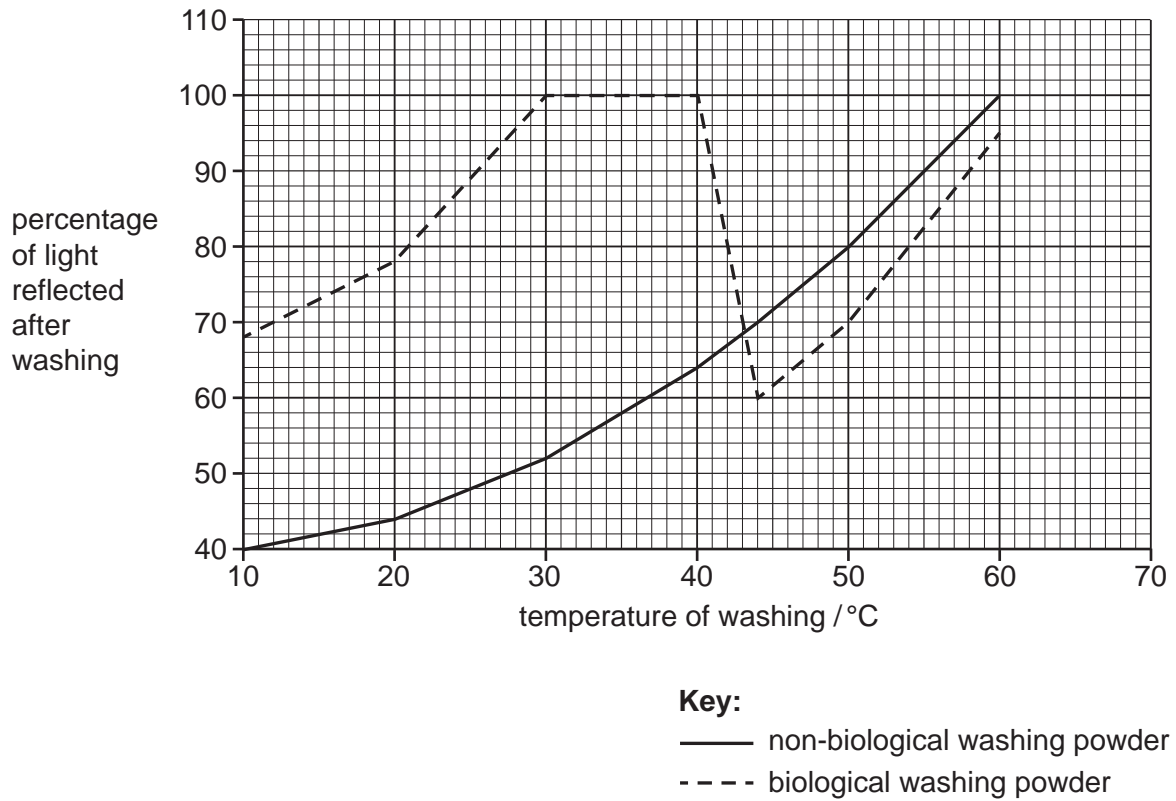


Fig. 2.1

(b) Compare the effectiveness of the two washing powders at removing stains.

Use the information in Fig. 2.1 in your answer.

.....

.....

.....

.....

.....

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.....

.....

.....

.....

..... [4]

- (c) The students suggested that the enzymes in the biological washing powder were denatured at high temperatures.

Explain why enzyme molecules do not function when they are denatured.

.....

.....

.....

.....

..... [2]

- 3** Cells in the lining of the stomach secrete gastric juice, which contains hydrochloric acid and pepsin.

(ii) Describe the function of pepsin.

.....

.....

.....

..... [2]

- 6 Fig. 6.1 is a photomicrograph of part of a cell from the pancreas that produces enzymes that are released into the small intestine.

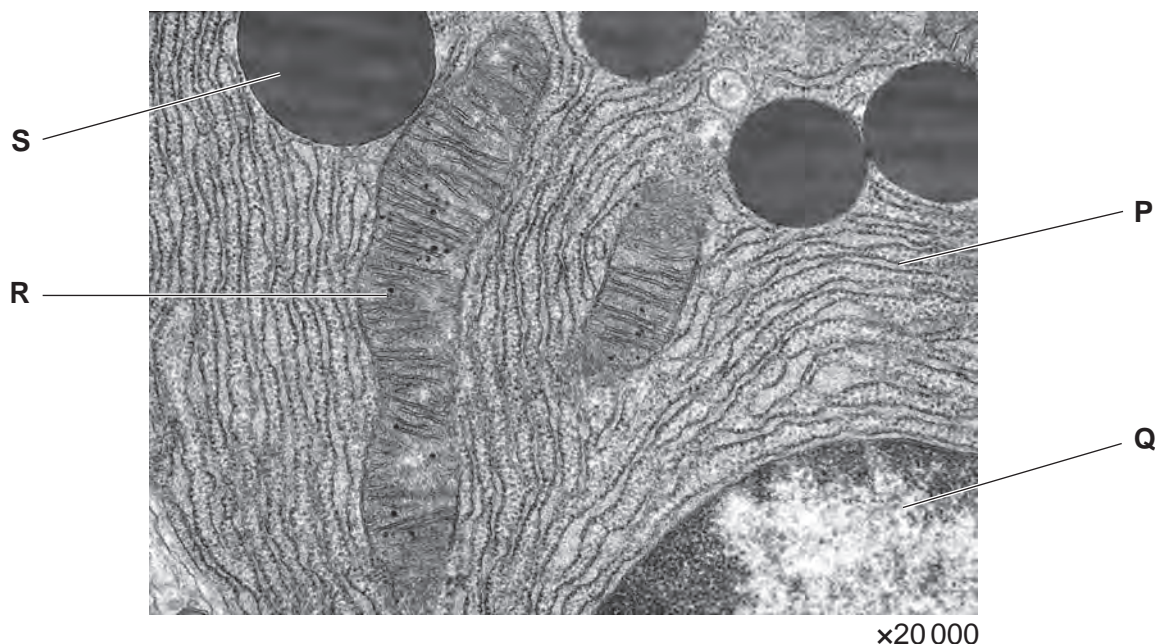


Fig. 6.1

- (b) The structure labelled **S** transports enzymes to the cell membrane for release into the pancreatic duct. These structures contain molecules of amylase, trypsin and lipase.

Complete the sentences with the most appropriate words.

Enzymes are made of protein and act as because they increase the rate of chemical reactions, but are not changed in those reactions. Amylase speeds up the digestion of to Trypsin continues the chemical digestion of protein begun by the enzyme in the stomach.

The optimum pH for pancreatic enzymes is greater than pH7. Bile is produced by the and enters the small intestine, where it stomach acid to provide the appropriate pH. Bile also breaks down fat by to increase the surface area for the action of lipase.

[7]

[Total: 10]

- 5 (a) Tissue plasminogen activators (TPAs) are human proteins that are used as drugs to break down blood clots.

TPAs break down blood clots by activating plasminogen. Plasminogen is a protein that is always present in the blood.

When activated, plasminogen forms a protease that breaks down fibrin molecules.

- (ii) State the products of the action of protease on the protein fibrin.

..... [1]

- (b) Shoot growth in plants is controlled by auxins. An enzyme in shoot tips converts molecules of an amino acid into auxins as shown in Fig. 2.2.

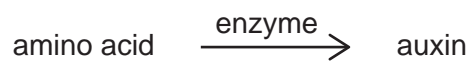


Fig. 2.2

Explain how a mutation in DNA results in an abnormal enzyme which does **not** catalyse the reaction shown in Fig. 2.2.

.....

.....

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.....

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..... [3]

(b) The digestive systems of young mammals are not fully developed.

Enzymes such as amylase, maltase and protease are often added to baby food to aid chemical digestion.

(i) Complete Table 6.1 by stating the substrate and product(s) for each enzyme reaction.

Table 6.1

enzyme	substrate	product(s)
amylase		
maltase		
protease		

[3]

(ii) Suggest why the temperature of baby food must be controlled when the enzymes are added.

.....

.....

..... [2]

(iii) State **one** other condition that must also be controlled to optimise enzyme activity.

..... [1]

[Total: 11]

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- (b) Enzymes catalyse the reactions of chemical digestion. Table 1.1 gives information about chemical digestion in three parts of the alimentary canal.

Complete Table 1.1.

Table 1.1

part of the alimentary canal	enzyme	substrate	product(s)
mouth		starch	
stomach			peptides
		fat	fatty acids and glycerol

[3]

- 6 (a) Define the term *chemical digestion*.

.....

.....

.....[2]

- (b) A student investigated the activity of the digestive enzyme pepsin.

Fig. 6.1 shows the apparatus used in the investigation.

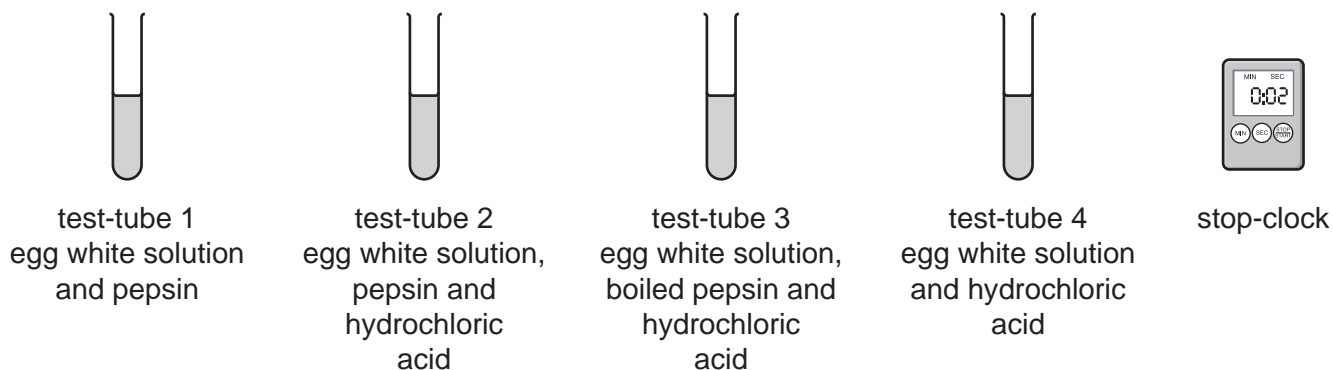


Fig. 6.1

The appearance of the four test-tubes was recorded at 0 and 5 minutes.

The protein in the egg white solution gives the solution a cloudy appearance.

The cloudy appearance clears when the protein in the egg white solution breaks down.

Table 6.1 shows the results.

Table 6.1

test-tube	contents	appearance at 0 mins	appearance after 5 mins
1	egg white solution, pepsin	cloudy	less cloudy
2	egg white solution, pepsin, hydrochloric acid	cloudy	clear
3	egg white solution, boiled pepsin, hydrochloric acid	cloudy	cloudy
4	egg white solution, hydrochloric acid	cloudy	cloudy

(c) Maltase is another digestive enzyme.

Describe the action of maltase **and** state where it acts in the alimentary canal.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 13]

5 (a) (i) Alcohol can be made by the microorganism yeast.

(b) Fig. 5.1 shows a computer model of the enzyme alcohol dehydrogenase, which is the enzyme responsible for breaking down alcohol.

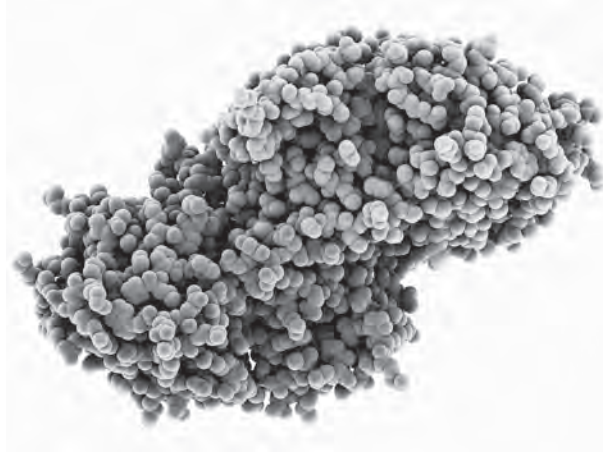


Fig. 5.1

Enzymes have a specific three dimensional shape.

Explain why the shape of an enzyme is important.

.....

.....

.....

.....

.....

.....

.....

.....[3]

(c) Table 5.1 shows the enzyme activity of alcohol dehydrogenase at different temperatures.

Table 5.1

temperature/°C	enzyme activity /arbitrary units
30	115
42	175

(i) The information in Table 5.1 shows that an increase in temperature increases the activity of alcohol dehydrogenase.

Explain why an increase in temperature causes an increase in enzyme activity.

.....

.....

.....

.....

.....

.....

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.....

.....[3]

(ii) State **one** factor, **other than** temperature, that affects enzyme activity.

.....[1]

- 6 (a) Table 6.1 shows some of the enzymes, their substrates, products and where they are produced in the digestive system.

Complete Table 6.1.

Table 6.1

enzyme	substrate	product(s)	location of enzyme production
.....	starch	.....	salivary glands
maltase	maltose	.....	.....
.....	.....	amino acids	stomach wall
.....	.....	amino acids	pancreas and small intestinal wall
lipase	fats	.....	.....

[5]

(c) The students added 1.5 cm³ of pectinase solution to pieces of apple in a beaker.

They then poured the mixture into the funnel.

They found that it took 10 minutes to collect 19 cm³ of juice.

(i) Calculate the rate of the enzyme reaction.

Show your working.

Write your answer to the nearest whole number.

..... cm³ per min [2]

(ii) The students performed four experiments using different ways to prepare the apples.

The same total mass and type of apple was used each time.

- A 0.5 cm³ apple cubes
- B 1.0 cm³ apple cubes
- C whole peeled small apples
- D whole unpeeled small apples

Predict **and** explain which experiment (A, B, C or D) would result in the fastest rate of reaction.

.....

.....

.....

.....

.....

.....[2]

[Total: 12]

3 Pepsin is a protease enzyme found in the alimentary canal.

(a) (i) Name the product formed from the digestion of proteins by protease enzymes.

.....[1]

(ii) State the organ in the alimentary canal where pepsin is secreted.

.....[1]

(b) A biologist performed an experiment to find the optimum pH for the activity of pepsin.

The enzyme activity was measured in four test-tubes. Each test-tube contained a 1 cm³ cube of cooked egg white which contains protein.

Fig. 3.1 shows the four test-tubes.

The biologist measured the time taken for the complete digestion of the cubes of cooked egg white.

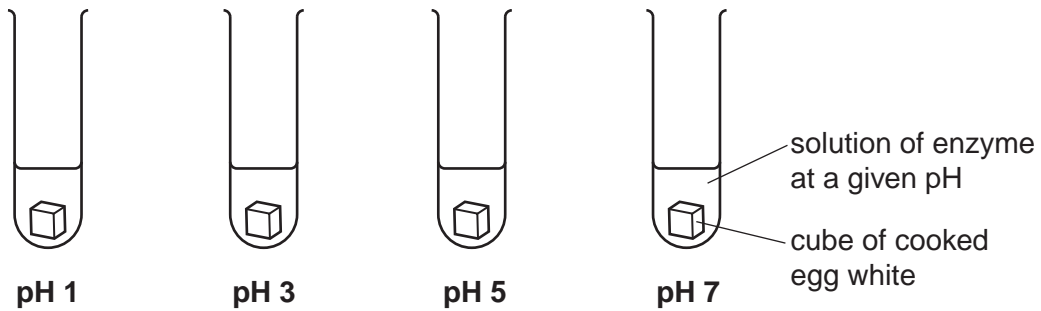


Fig. 3.1

(i) The biologist ensured all the cubes of cooked egg white were exactly the same size.

Suggest why.

.....
.....
.....
.....
.....[2]

(ii) Temperature must be controlled in this experiment.

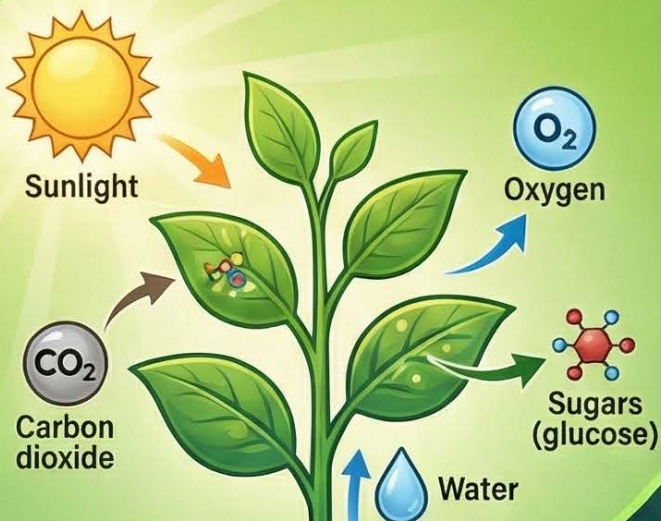
Describe how temperature could be controlled.

.....
.....[2]

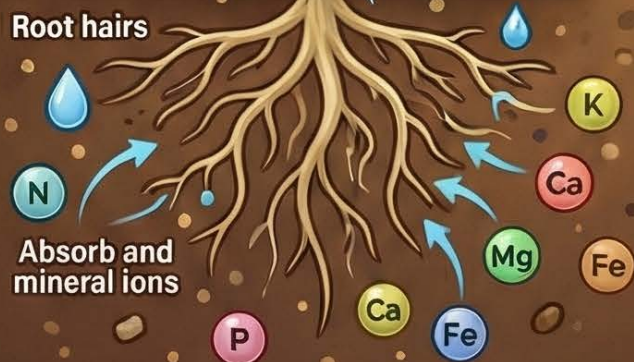
PLANT NUTRITION: Powering Growth & Life

Processes, Nutrients, and Transport

1. PHOTOSYNTHESIS (The Energy Process)



2. ESSENTIAL NUTRIENTS (From Soil & Air)

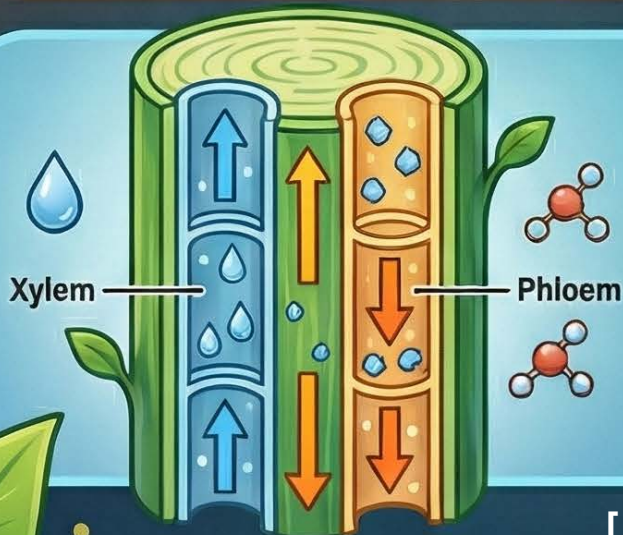


- Nitrogen** - for leaf growth
- Phosphorus** - for roots/flowers
- Potassium** for overall health

Micronutrients

Macrnutrients, function wates, phosphorious and prodates, and overall hental health

3. TRANSPORT SYSTEMS (Moving Water & Food)



[123]

Understanding plant nutrition is key to healthy ecosystems and agriculture.

2 Plants produce glucose in leaves and convert some of it to sucrose.

(a) (i) Explain how glucose is produced in leaves.

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

(ii) State the name of the process that plants use to move sucrose from a source to a sink.

..... [1]

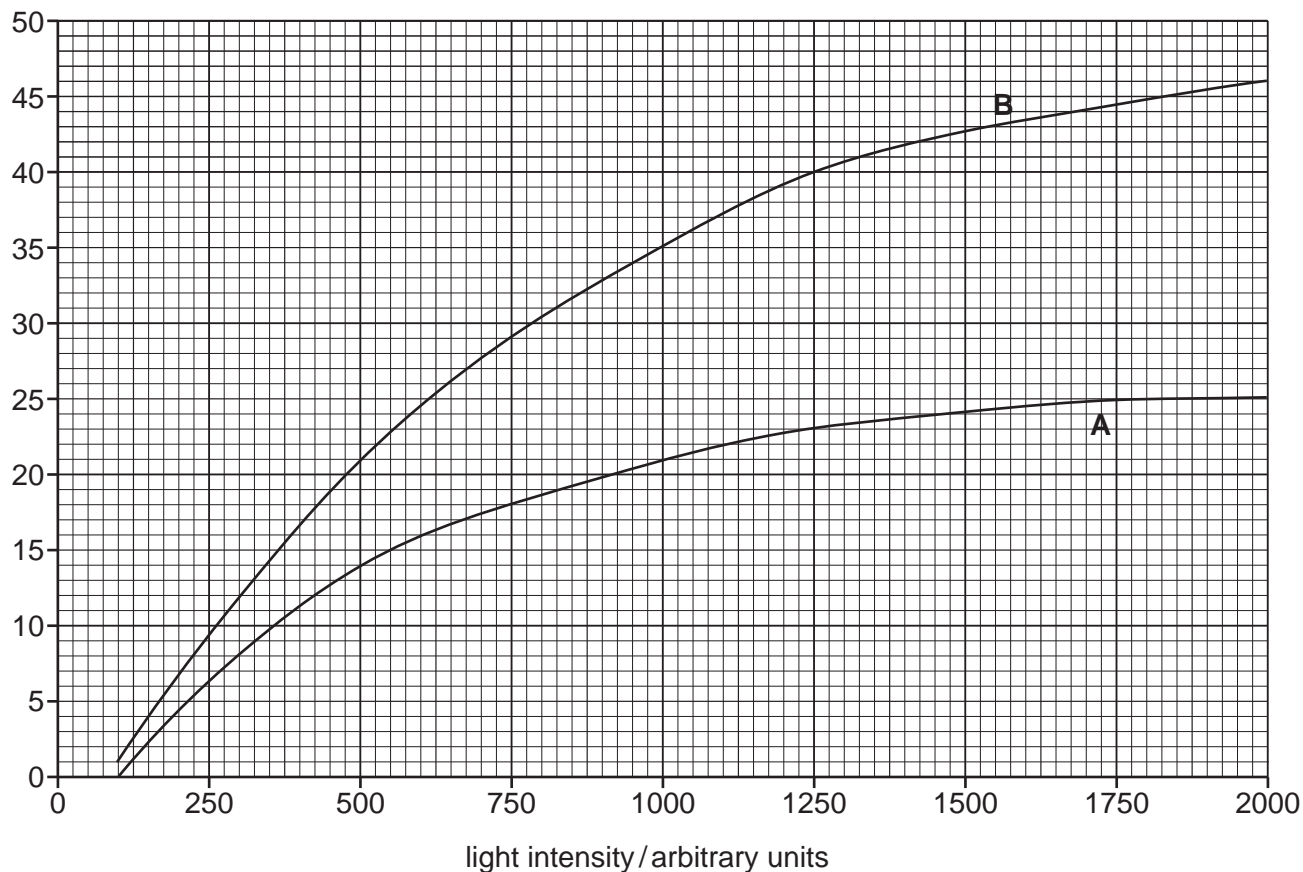
2 (a) State the **word** equation for photosynthesis.

..... [2]

(b) Scientists investigated the effect of light intensity on the rate of photosynthesis in the leaves of eucalyptus trees at two different concentrations of carbon dioxide, **A** and **B**.

The results are shown in Fig. 2.1.

rate of photosynthesis
/ $\mu\text{mol per m}^2 \text{ per s}$



Key:

A carbon dioxide concentration
140 ppm

B carbon dioxide concentration
1000 ppm

Fig. 2.1

- (i) Suggest **and** explain why the scientists kept the temperature of the leaves at 20°C while they recorded results.

.....
.....
.....
.....
..... [2]

- (ii) Calculate the percentage increase in the rate of photosynthesis at a light intensity of 1250 arbitrary units when the carbon dioxide concentration was increased from 140ppm to 1000ppm.

Show your working and give your answer to the nearest whole number.

..... %
[3]

- (iii) Describe the effect of increasing light intensity on the rate of photosynthesis when the concentration of carbon dioxide was 140ppm.

.....
.....
.....
.....
.....
.....
..... [3]

- (iv) Explain the effect of increasing light intensity on the rate of photosynthesis when the concentration of carbon dioxide was 1000 ppm.

Use the term *limiting factor* in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 14]

2 The concentration of atmospheric carbon dioxide has increased considerably in recent years.

(a) Describe the possible causes of increased atmospheric carbon dioxide.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

(b) Soybean plants, *Glycine max*, were grown in two separate plots.

Each plot used a carbon dioxide enrichment system to control the atmospheric carbon dioxide concentration.

The atmospheric carbon dioxide concentrations in the two plots were kept at:

- 370 ppm, which is similar to the current atmospheric carbon dioxide concentration
- 550 ppm, which is a possible future atmospheric carbon dioxide concentration.

When the soybean plants were fully grown, scientists calculated the average rates of photosynthesis at regular intervals from 04:00 to 22:00 for both plots.

The results are shown in Fig. 2.1.

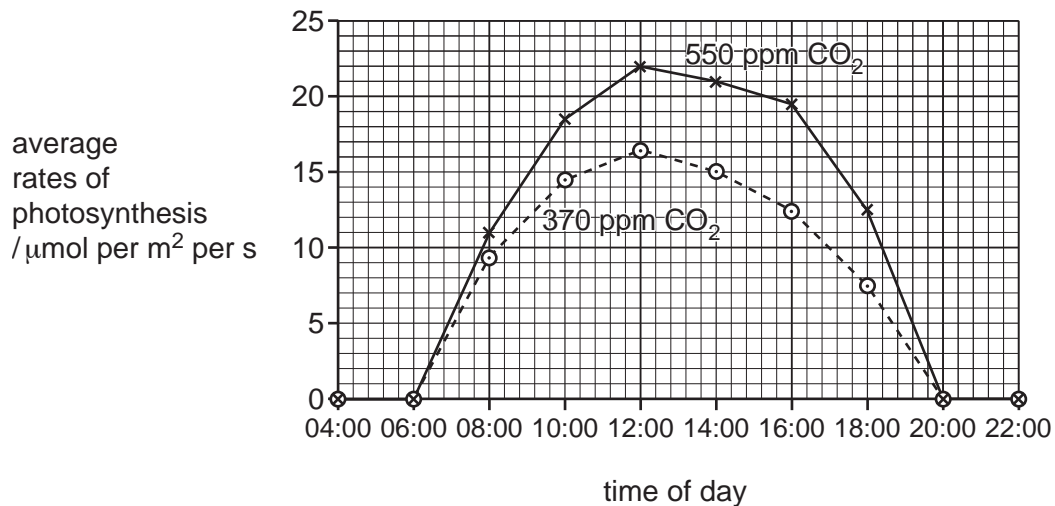


Fig. 2.1

(c) The scientists also made observations of the leaf structure of the soybean plants.

Epidermis and mesophyll tissues are adapted for photosynthesis.

Complete Table 2.1 by stating **two** structural features of each of these tissues **and** explain how each feature is an adaptation for photosynthesis.

Table 2.1

tissue	feature	how the feature is an adaptation for photosynthesis
epidermis	1 .....	.....

	2 .....	.....
mesophyll	.....	.....

	2 .....	.....

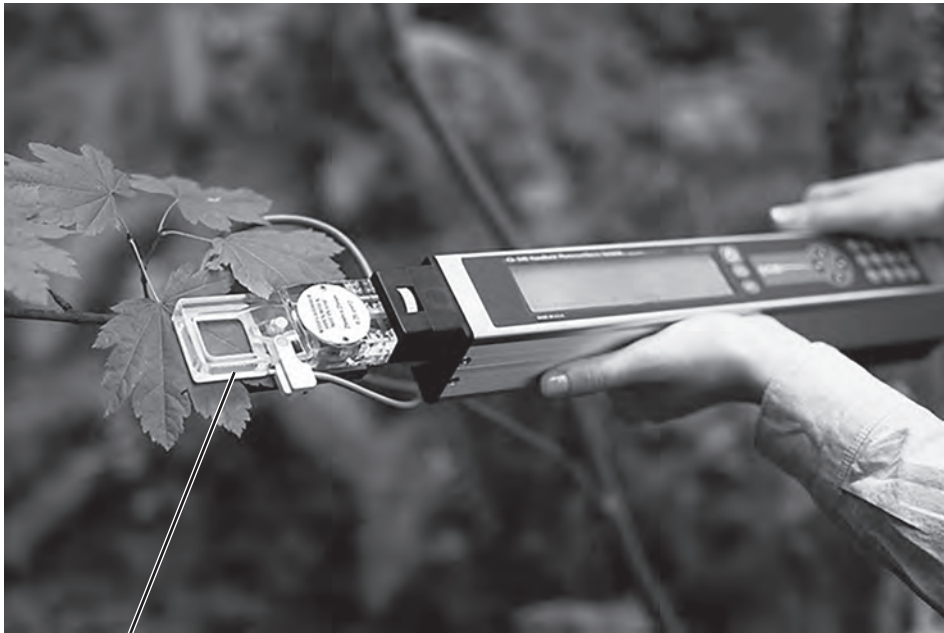
[4]

2 The rate of photosynthesis of terrestrial plants can be determined by measuring the uptake of carbon dioxide.

(a) Explain why plants take up carbon dioxide during photosynthesis.

.....
.....
.....
.....
..... [2]

(b) The rate of photosynthesis of parts of individual leaves can be measured using a hand-held device as shown in Fig. 2.1.



transparent chamber

Fig. 2.1

This apparatus allows air to flow through the transparent chamber that encloses part of the leaf. The apparatus measures the carbon dioxide concentration of the air entering and leaving the chamber.

Explain how the results from the apparatus can be used to calculate the rate of photosynthesis.

.....
.....
.....
..... [2]

- (c) A student used the apparatus shown in Fig. 2.1 to investigate the effect of temperature on the rate of photosynthesis of the leaves of Chinese plantain, *Plantago asiatica*, at two different concentrations of carbon dioxide, **A** and **B**.

Fig. 2.2 shows the results of the investigation.

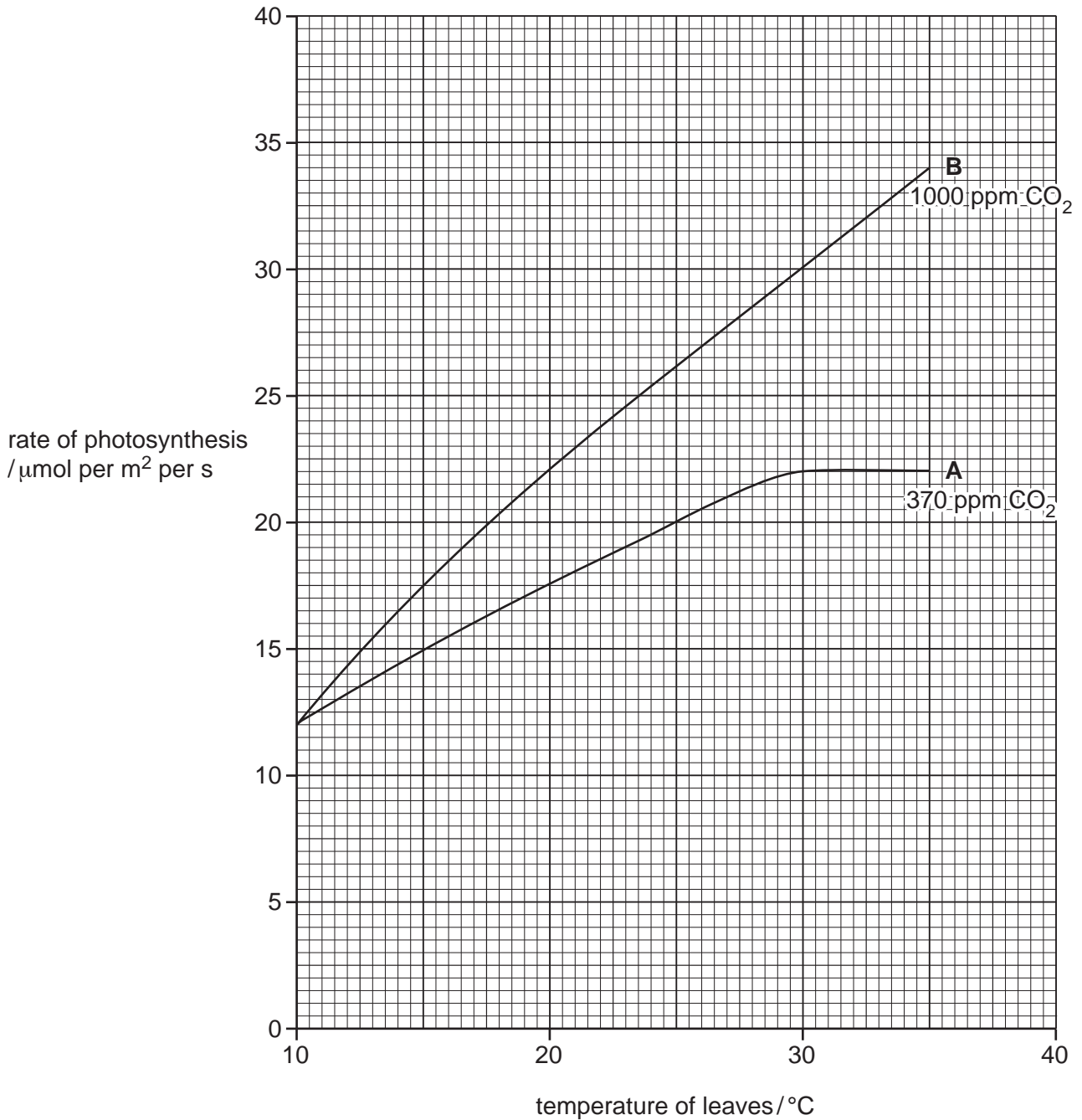


Fig. 2.2

- (i) State **one** environmental factor that should have been kept constant in this investigation.

..... [1]

- (ii) Describe the effect of temperature on the rate of photosynthesis when carbon dioxide concentration **A** was supplied.

Use the data from Fig. 2.2 in your answer.

.....

.....

.....

.....

.....

.....

.....

..... [3]

- (iii) Calculate the percentage increase in the rate of photosynthesis at 30 °C when the carbon dioxide concentration was increased from **A** to **B** as shown in Fig. 2.2.

Show your working and give your answer to the nearest whole number.

..... %

[2]

- (iv) Explain the effect of increasing temperature on the rate of photosynthesis for carbon dioxide concentration **B**.

Use the term *limiting factor* in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

- (v) The student concluded that carbon dioxide concentration is the factor limiting the rate of photosynthesis between 30 °C and 35 °C for the results shown for **A** in Fig. 2.2.

State the evidence for this conclusion.

.....

.....

..... [1]

- (d) A similar investigation was carried out on Arizona honeysweet, *Tidestromia oblongifolia*, that grows in Death Valley in California where the highest temperatures may be greater than 45°C.

The results are shown in Fig. 2.3.

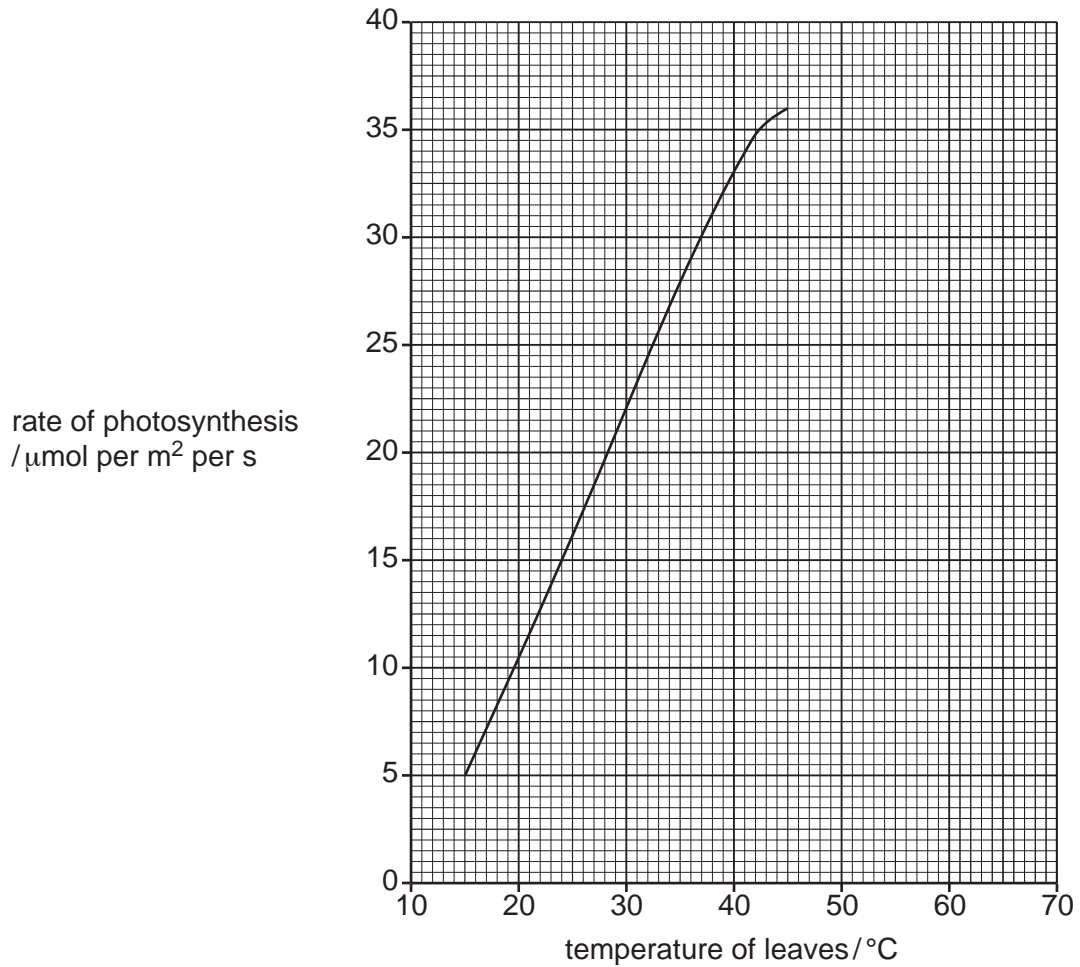


Fig. 2.3

Predict **and** explain what would happen to the rate of photosynthesis if the investigation is continued at temperatures higher than 45°C.

.....

.....

.....

.....

..... [2]

[Total: 16]

3 (a) Fig. 3.1 is a photomicrograph of part of the upper surface of a broad bean leaf, *Vicia faba*.

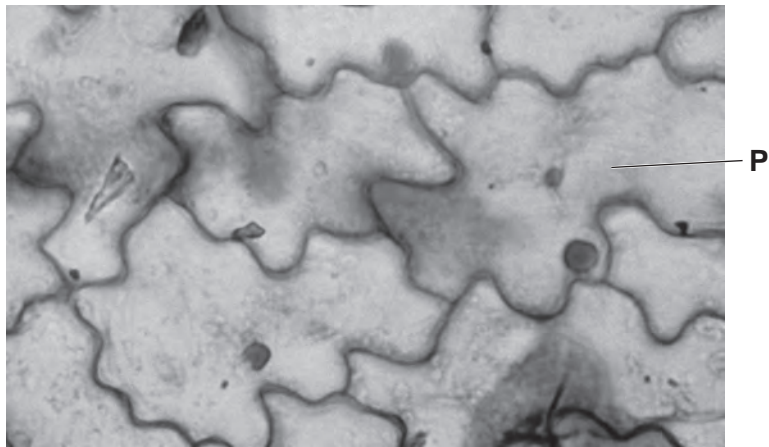


Fig. 3.1

(i) On Fig. 3.1, identify and label **two** structures that are visible in cell **P**. [2]

(ii) State the name of the tissue shown in Fig. 3.1.

.....[1]

(iii) The tissue shown in Fig. 3.1 is transparent.

Explain why it is important to the plant that the tissue shown in Fig. 3.1 is transparent.

.....
.....
.....
.....
.....
.....
.....
.....[3]

(b) The food available to animals in the Arctic tundra is limited. There is a short growing season for plants and the environmental conditions do not favour high rates of photosynthesis and growth compared with temperate and tropical ecosystems.

State **three** conditions that limit plant growth rates.

1

2

3

[3]

- 3 Fig. 3.1 is a scanning electron micrograph of a vertical section through part of the leaf of a broad bean plant, *Vicia faba*.



Fig. 3.1

- (a) (i) State the names of the tissues labelled **A** and **B**.

A

B

[2]

- (ii) The cells in regions **B** and **C** in Fig. 3.1 have a large surface area.

Explain why this is necessary for the functioning of the leaf cells.

.....

 [3]

- (iii) Explain why there are many interconnecting air spaces within the leaf.

.....

 [2]

6 Students investigated the effect of mineral ion deficiencies on the growth of radish plants.

The seeds that were used in the experiment were from plants that had been self-pollinated for many generations and were therefore all genetically identical.

(a) Explain the advantage of using genetically identical radishes in this investigation.

.....

.....

.....

.....[2]

The radish seedlings were divided into four groups. Each group was grown in a different mineral ion solution as follows:

- 1 complete solution containing all the major mineral ions
- 2 solution with all the major mineral ions except **nitrate ions**
- 3 solution with all the major mineral ions except **magnesium ions**
- 4 solution with all the major mineral ions except **phosphate ions**

The apparatus used to investigate the growth of the plants is shown in Fig. 6.1.

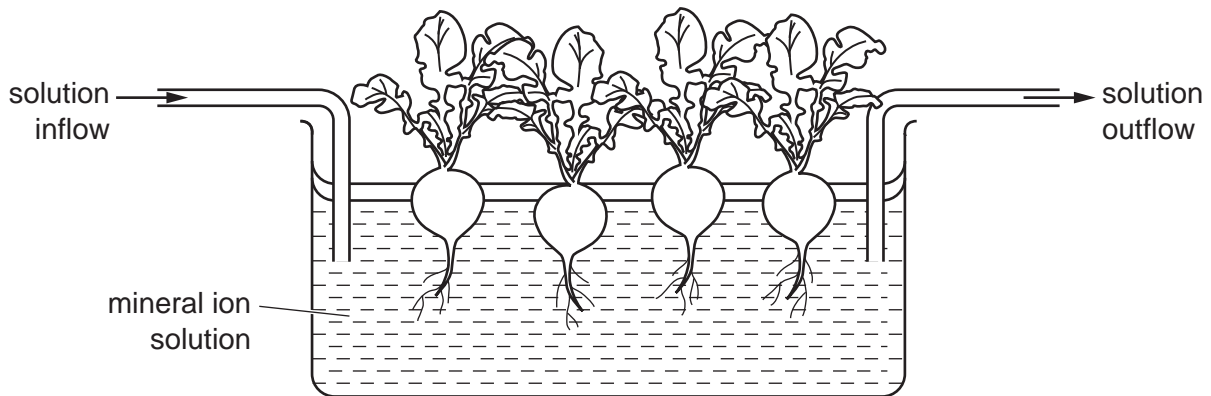


Fig. 6.1

(b) State **three** other environmental factors that could affect the growth of the seedlings.

1.....

2.....

3.....

[3]

The results of the investigation are shown in Table 6.1.

Table 6.1

group	mineral ion solution	number of plants	total dry mass of all plants/mg			mean dry mass of one plant/mg
			leaves	roots	total	
1	complete	8	1880	1110	2990	374
2	without nitrate ions	10	1410	750	2160	216
3	without magnesium ions	9	1600	260	1860	207
4	without phosphate ions	9	1670	140	1810	201

(c) Describe **and** explain the results for the radishes grown without nitrate ions (group 2).

.....

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.....

[4]

(d) Describe the likely appearance of the radish plants grown in the solution without magnesium ions (group 3) and explain your answer.

appearance.....

.....

explanation.....

.....

.....

[3]

(e) Phosphate ions are a component of DNA.

Suggest why the radish plants in group 4 grew less than the radish plants in the complete solution (group 1).

.....

.....

.....

.....

..... [2]

[Total: 14]

6 (a) Name **one** feature of dicotyledonous leaves that distinguishes them from monocotyledonous leaves.

.....[1]

(b) Explain why a leaf is an organ.

.....
.....[1]

(c) Photosynthesis occurs in leaves.

State the balanced chemical equation for photosynthesis.

.....[3]

(d) Fig. 6.1 is an image of a section through a dicotyledonous leaf from a scanning electron microscope.

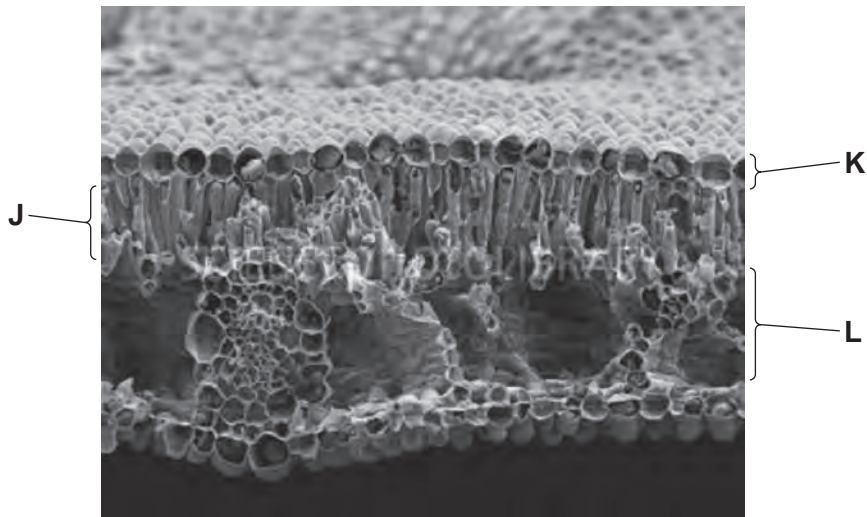


Fig. 6.1

Identify the layers labelled in Fig. 6.1 and explain how their adaptations allow photosynthesis to occur in the leaf.

(i) layer J
adaptation for photosynthesis
..... [2]

(ii) layer K
adaptation for photosynthesis
..... [2]

(iii) layer L
adaptation for photosynthesis
..... [2]

(e) Plants need nitrate ions for growth.

Explain why.

.....
.....
.....
.....
.....
.....
..... [3]

[Total: 14]

(c) Fig. 4.2 shows a section through the leaf of a water lily.

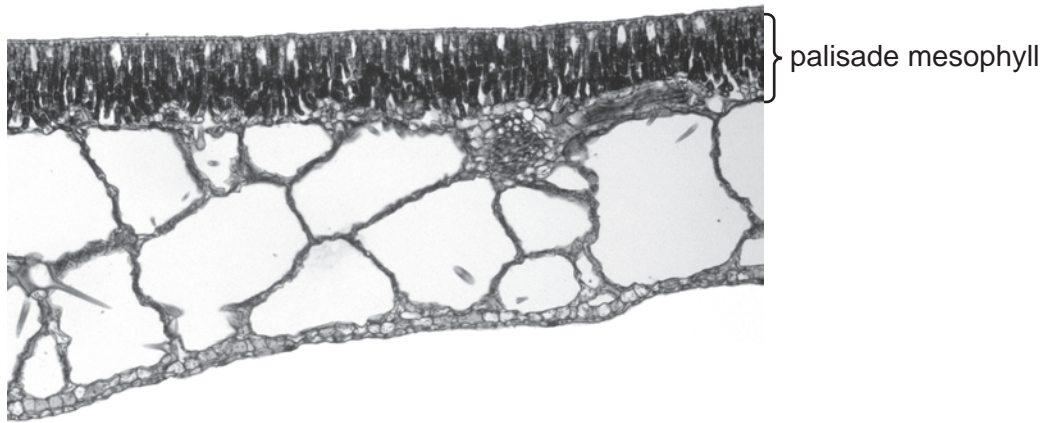


Fig. 4.2

(i) State why the palisade mesophyll is a tissue.

.....
..... [1]

(ii) Name **two** other tissues that are present in the leaf in Fig. 4.2.

1
2 [2]

(d) The large air spaces are an adaptation of water lily leaves. Suggest why.

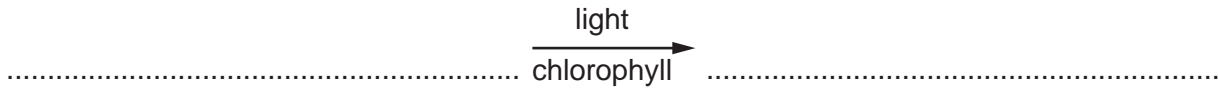
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..... [2]

(e) Hydrophytes are adapted to aquatic habitats.

State the name used for plants that are adapted to dry habitats.

..... [1]

6 (a) State the balanced chemical equation for photosynthesis.



[2]

A student investigated the effect of different wavelengths of light on the rate of photosynthesis of the water plant, *Cabomba*.

The student used the apparatus shown in Fig. 6.1.

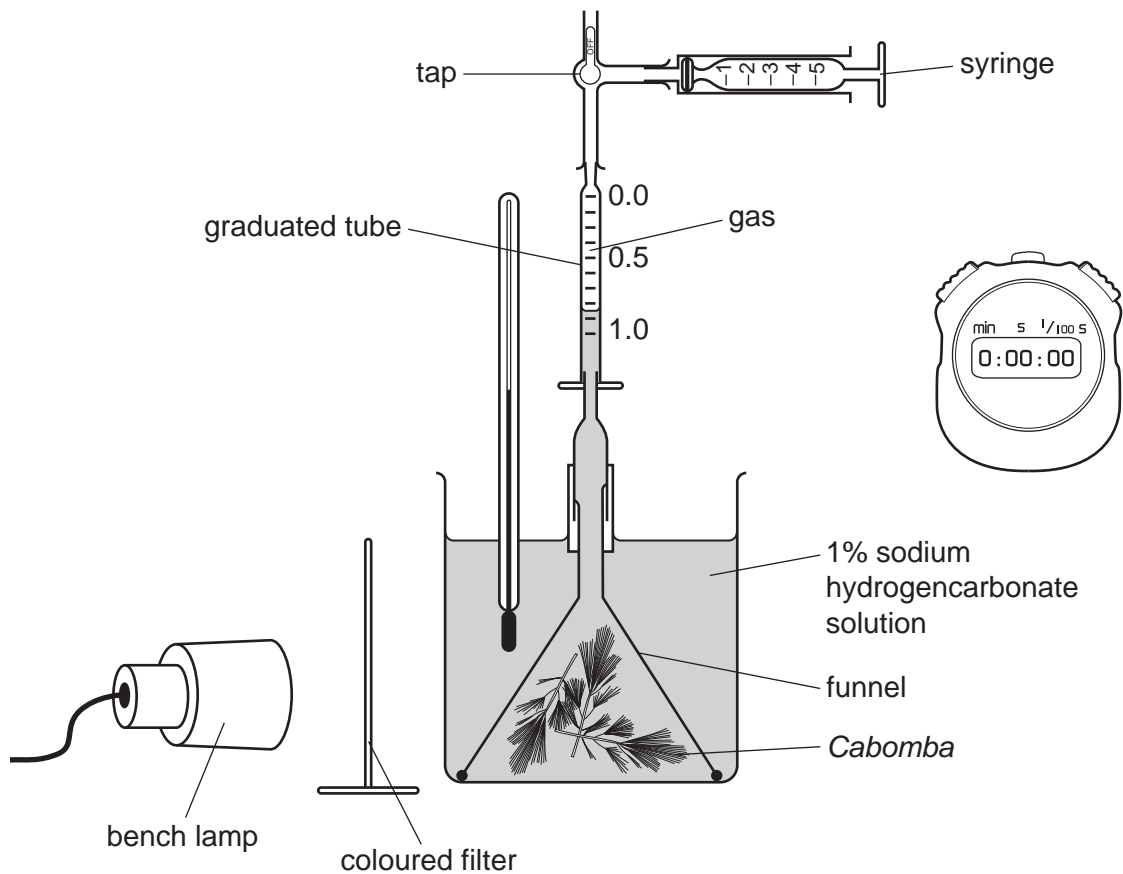


Fig. 6.1

(b) The student collected the gas produced by the plant for five minutes. The results are shown in Table 6.1.

Table 6.1

colour of filter	wavelength of light / nm	volume of gas collected / cm ³
violet	400	0.80
blue	475	0.80
green	550	0.20
yellow	600	0.40
red	675	0.90

Describe the effect of wavelength of light on the rate of photosynthesis as shown in the student's results in Table 6.1.

You will gain credit if you use data from the table.

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[3]

(c) State how the student would calculate the rates of photosynthesis from the results in Table 6.1.

.....

.....

[1]

(d) State why the student:

(i) kept the lamp at the same distance during the investigation,

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.....
.....

[1]

(ii) used sodium hydrogencarbonate solution.

.....
.....
.....

[1]

(e) State **three** uses in a plant of the carbohydrate produced in photosynthesis.

1.....
2.....
3.....

[3]

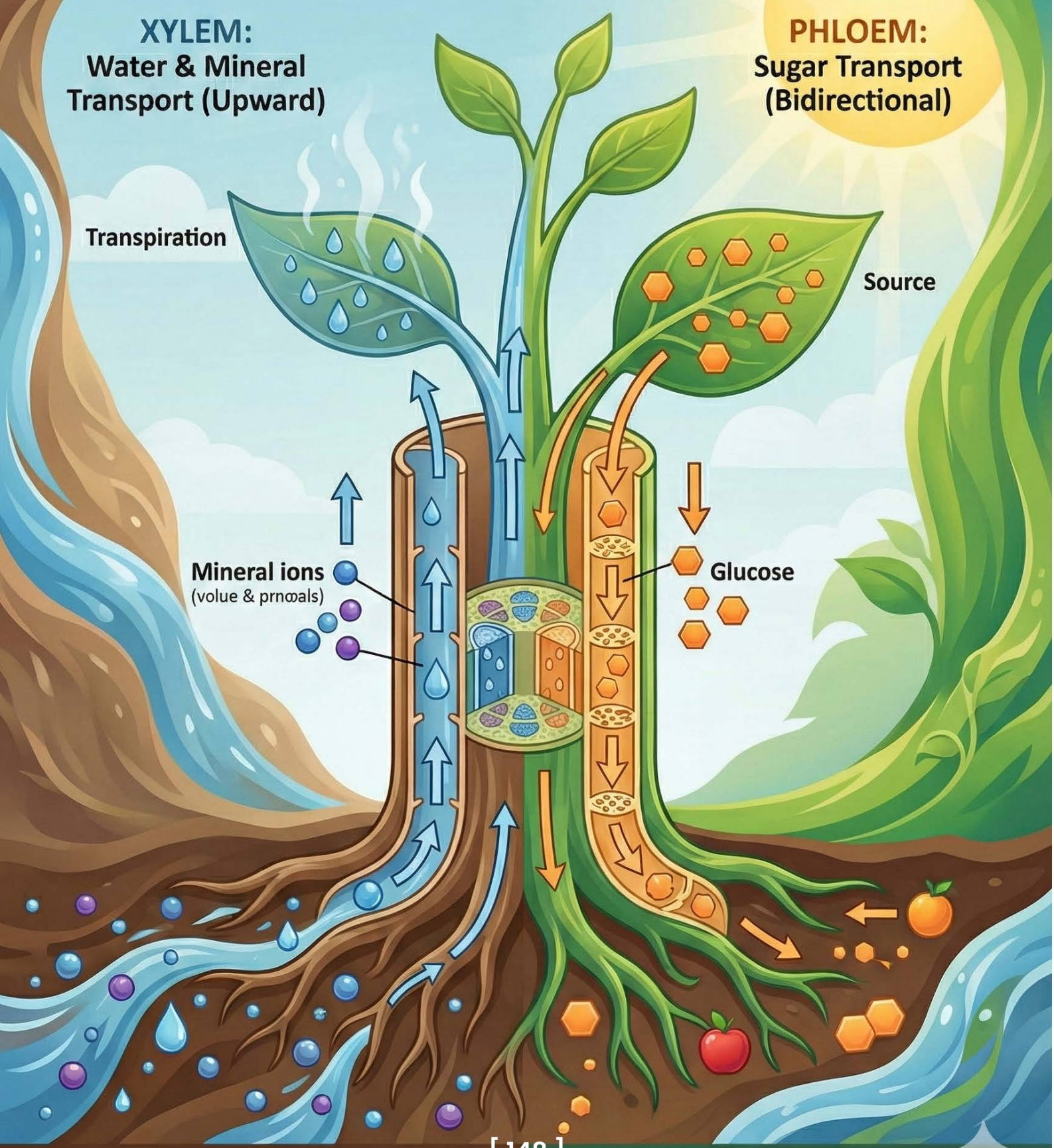
[Total: 11]

TRANSPORT IN PLANTS: Water & Nutrient Highways

Xylem & Phloem: The Vital Vascular Systems

XYLEM:
Water & Mineral
Transport (Upward)

PHLOEM:
Sugar Transport
(Bidirectional)



(c) A plant was **not** watered for one week.

Fig. 1.2 shows a series of photographs of the plant during the week.



day 0

day 3

day 7

Fig. 1.2

Explain how the lack of water has affected the support of the leaves of the plant shown in Fig. 1.2.

Use the term *turgor pressure* in your answer.

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..... [3]

[Total: 8]

4 Xerophytes grow in habitats with low rainfall and soils that often have high concentrations of salts.

Fig. 4.1 shows the xerophyte *Yucca treculeana* growing on salt flats.



Fig. 4.1

(a) (i) Explain how xerophytes, such as *Y. treculeana*, are adapted to absorb sufficient water in the conditions in which they live.

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..... [4]

(ii) Explain how xerophytes are adapted to reduce water loss to the atmosphere.

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.....
..... [3]

(iii) Xerophytes often have many defence mechanisms that reduce or prevent herbivores eating them.

Suggest how xerophytes protect themselves against herbivores.

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.....
..... [2]

4 Some crop farmers use herbicides on their fields.

Fig. 4.1 shows a farmer spraying a rice crop with herbicides.



Fig. 4.1

(a) Herbicides kill weeds.

Explain why farmers use herbicides.

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..... [2]

(b) Fields of crop plants were sprayed with two herbicides. A farmer measured the concentration of the two herbicides, **A** and **B**, in a lake near the fields.

The water in the lake was sampled at intervals for two weeks.

Fig. 4.2 shows the results.

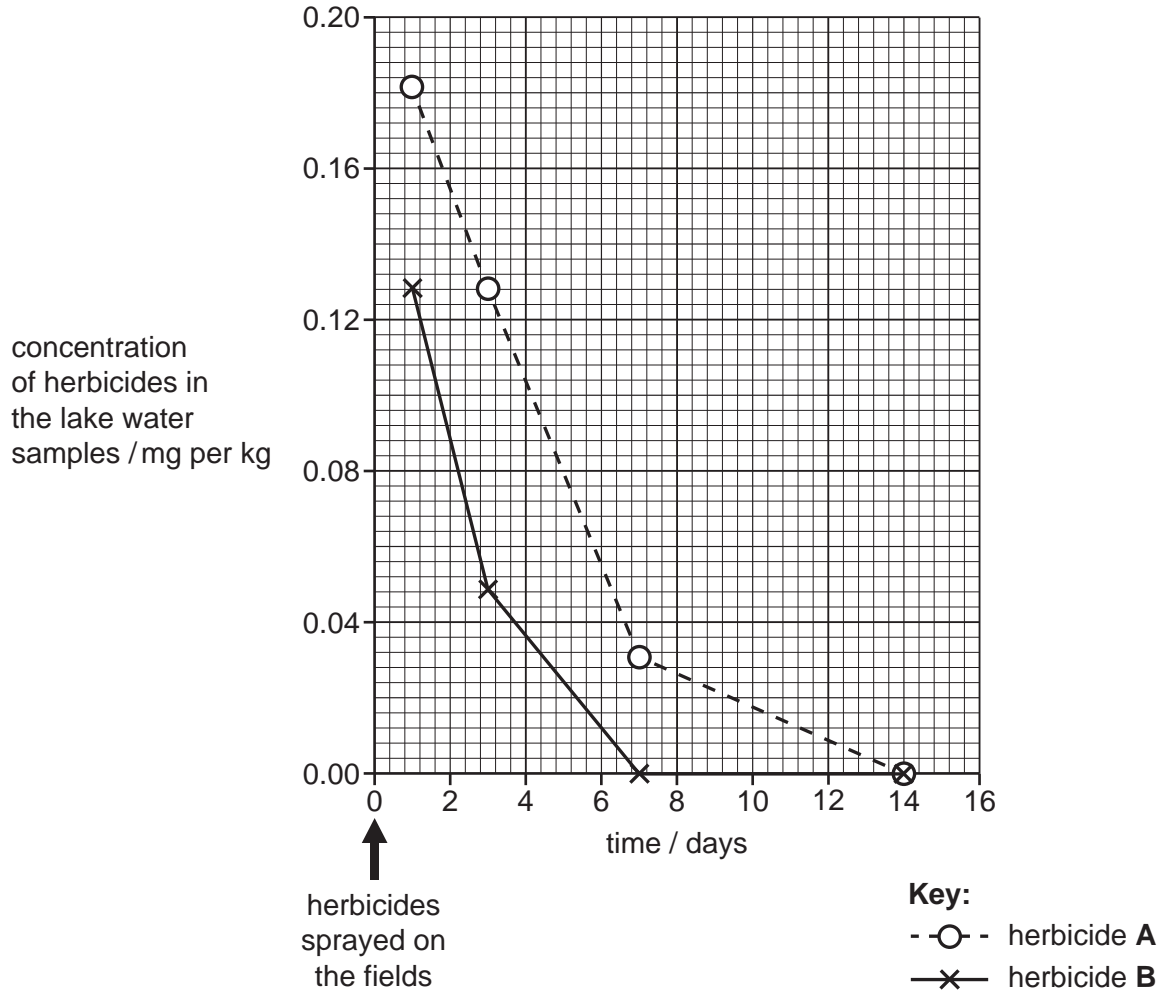


Fig. 4.2

(i) Compare the concentrations of herbicide **A** and herbicide **B** in the lake.

Use the information in Fig. 4.2 to support your answer.

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[3]

(c) Herbicide **A** is a synthetic plant hormone called 2,4-D that selectively kills dicotyledonous plants only.

(i) State **two** features that distinguish leaves of dicotyledonous plants from leaves of monocotyledonous plants.

- 1
- 2 [2]

(ii) State the name of a natural plant hormone that stimulates cell elongation.
..... [1]

(iii) Herbicide **B** is a chemical that prevents the uptake of magnesium ions.
Suggest how herbicide **B** kills plants.
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..... [3]

[Total: 15]

- 6 (a) Fig. 6.1 is a diagram showing some parts of a plant. The circle shows a magnified cross-section of part of the stem.

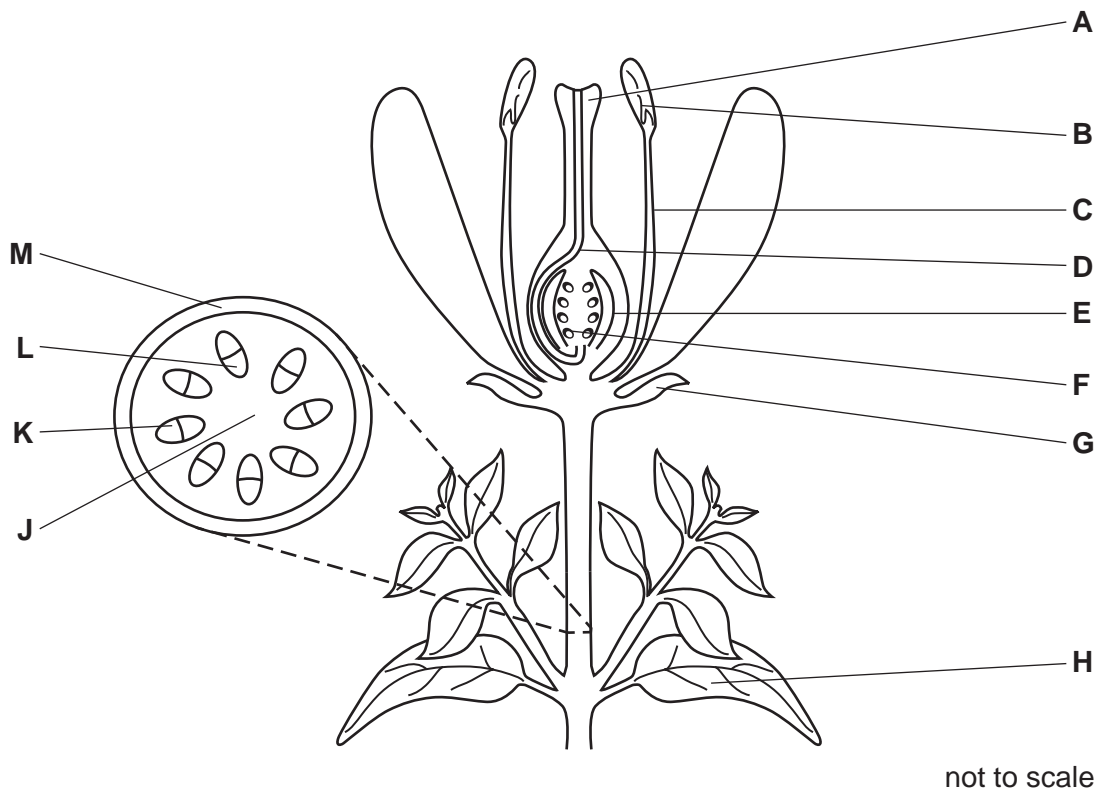


Fig. 6.1

- (i) Table 6.1 contains statements about the functions of some of the structures in Fig. 6.1.

Complete the table by:

- stating the name of the structure
- identifying the letter that labels that structure.

Table 6.1

function	name of structure	letter from Fig. 6.1
provides support to the stem		
produces glucose		

[2]

(iii) State the name of the process that describes the transport of sucrose in a plant.

..... [1]

(iv) State **one** letter from Fig. 6.1 that is a structure that is an example of a source for sucrose transport.

..... [1]

(b) In addition to sucrose, amino acids are also transported in plants.

(i) State the name of a mineral ion that becomes part of an amino acid.

..... [1]

(ii) State the name of the structures inside cells that assemble amino acids into proteins.

..... [1]

(iii) State the name of the group of molecules that are made of proteins and act as catalysts.

..... [1]

[Total: 11]

2 Plants produce glucose in leaves and convert some of it to sucrose.

(a) (i) Explain how glucose is produced in leaves.

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.....
.....
.....
.....
..... [3]

(ii) State the name of the process that plants use to move sucrose from a source to a sink.

..... [1]

(iii) Roots can be an example of a sink.

Explain why sometimes roots act as a source rather than a sink.

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.....
..... [2]

(b) The movement of sucrose in plants can be modelled using laboratory apparatus.

Fig. 2.1 shows the apparatus used to model the movement of sucrose in a plant:

- Partially permeable bags were attached tightly to the ends of tube **Q**.
- The bag representing a **source** was filled with a coloured sucrose solution.
- The bag representing a **sink** was filled with water.
- The containers and tube **Q** and tube **S** were filled with water.

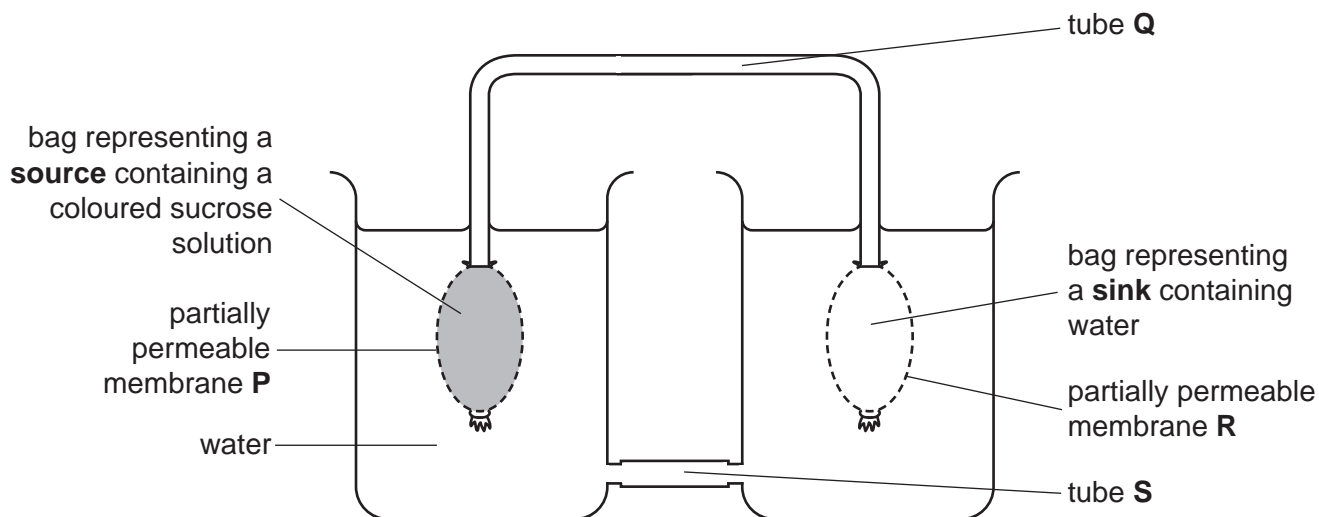


Fig. 2.1

Fig. 2.2 shows the position of the coloured sucrose solution 30 minutes after the apparatus was set up.

The arrows show the direction of the movement of the liquids.

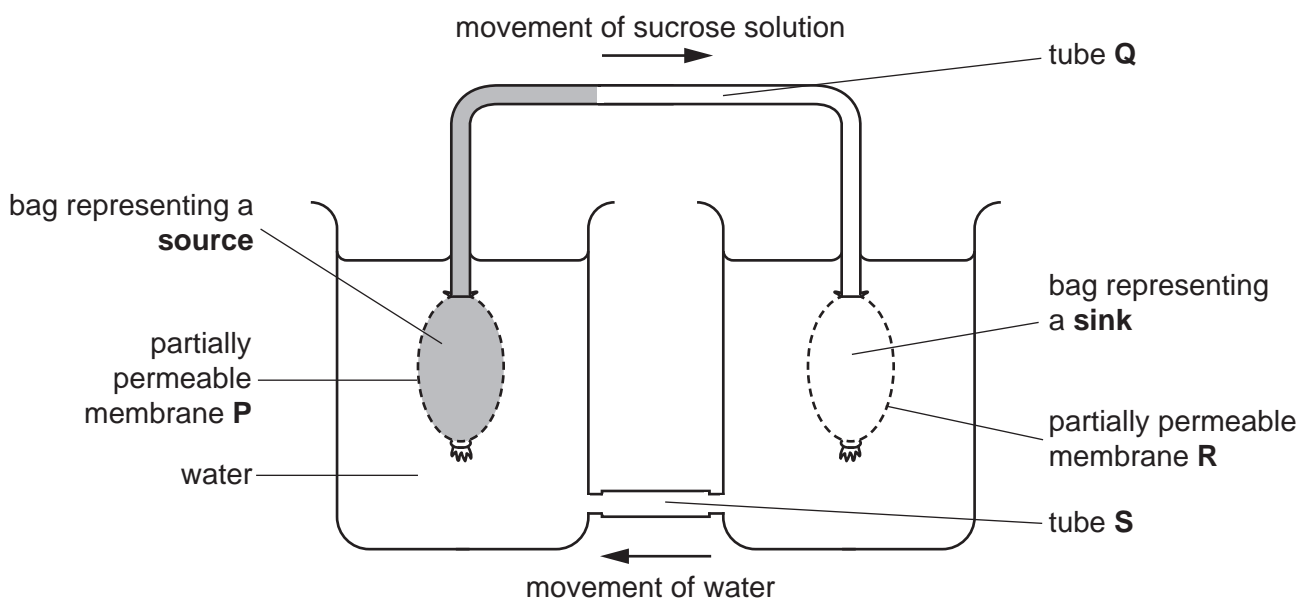


Fig. 2.2

- (i) State the name of the tissue represented by tube **Q** and the name of the tissue represented by tube **S** in Fig. 2.2.

Q

S

[2]

- (ii) Explain why the sucrose solution moves along tube **Q** in the model in Fig. 2.2.

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..... [4]

- (c) In plants the movement of sucrose is usually continuous. However, after 2 hours the movement of sucrose in tube **Q** in Fig. 2.2 stopped.

Suggest why the movement of sucrose in tube **Q** stopped.

.....
.....
..... [1]

- (d) Amino acids are also transported through plants.

State the name of the mineral ion that is used to make amino acids.

..... [1]

[Total: 14]

2 Fig. 2.1 shows part of a cross-section of the stem of a young sunflower plant.

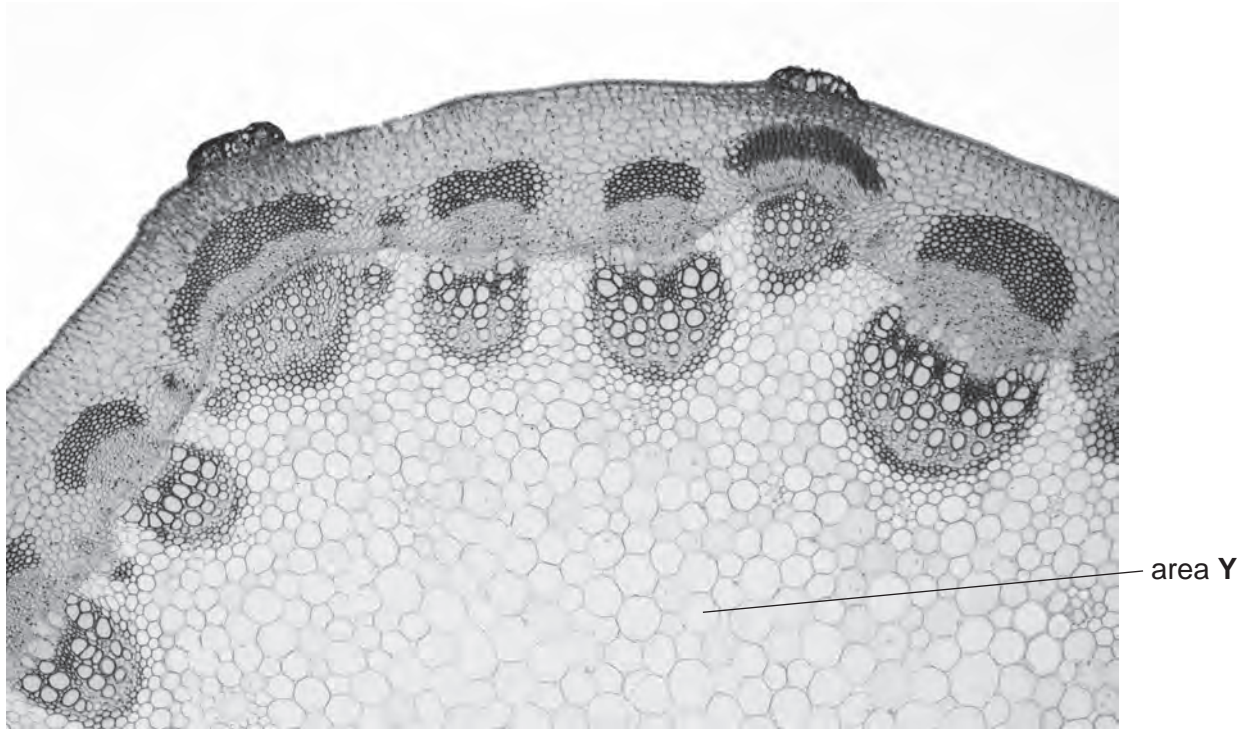


Fig. 2.1

(a) Draw a circle around **one** vascular bundle on Fig. 2.1.

Label the **xylem** in the vascular bundle with the letter **X**.

[2]

(b) Explain how the cells in **area Y** are able to support the stem so that it stays upright.

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..... [3]

- (c) Researchers used carbon dioxide that contained a traceable source of carbon (^{13}C) to investigate translocation of sucrose from the leaves of bean plants, *Phaseolus vulgaris*.

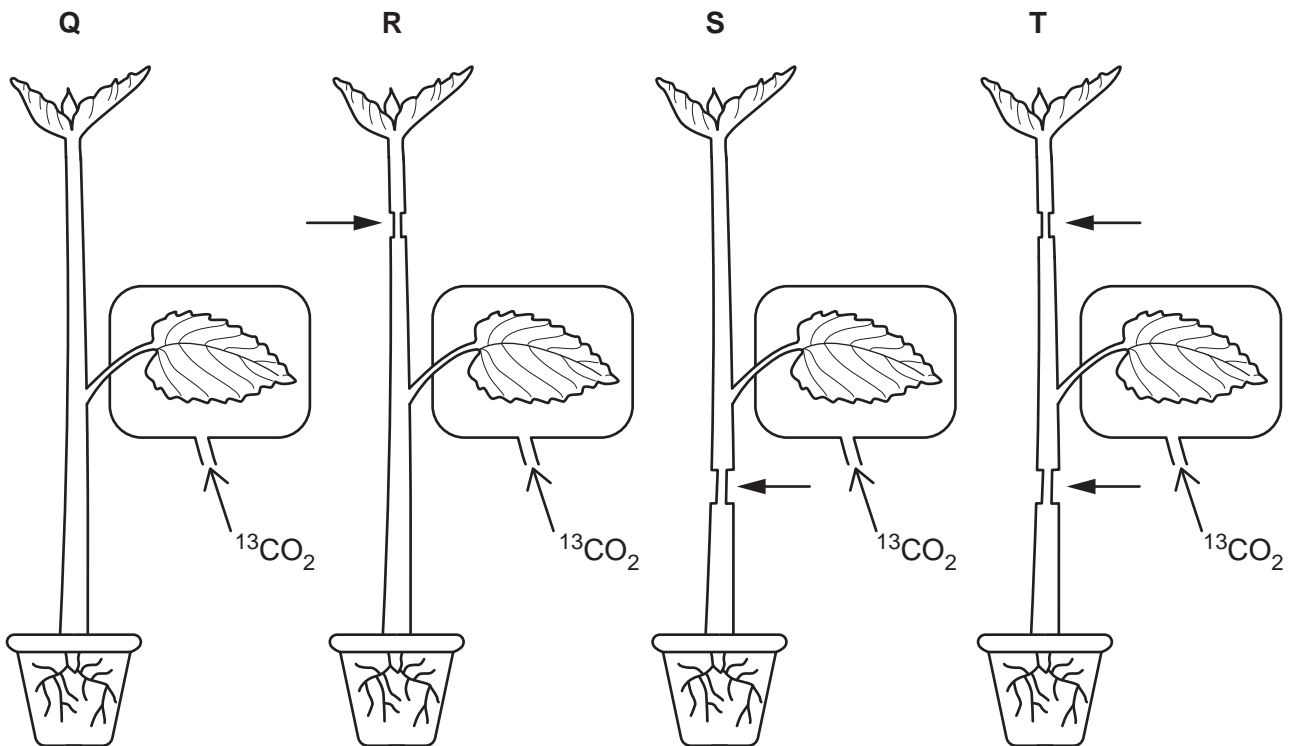
Fig. 2.2 shows that glucose produced in photosynthesis is converted to sucrose for translocation.



Fig. 2.2

Researchers selected four plants, **Q**, **R**, **S** and **T**, which had leaves that were of similar sizes. The leaves on the four plants were supplied with $^{13}\text{CO}_2$.

After the leaves had started to make sucrose, the researchers cut away a ring of tissue in different places as shown in Fig. 2.3. The rings of tissue that were removed from plants **R**, **S** and **T** contained the phloem.



Key: \longrightarrow the positions on the stems where rings of tissue containing phloem were removed.

Fig. 2.3

2 Phloem is used to transport sucrose and amino acids in plants. Sucrose is a carbohydrate.

(b) Fig. 2.1 shows a diagram of a plant. The arrows point to circles containing magnified cross-sections of those parts of the plant.

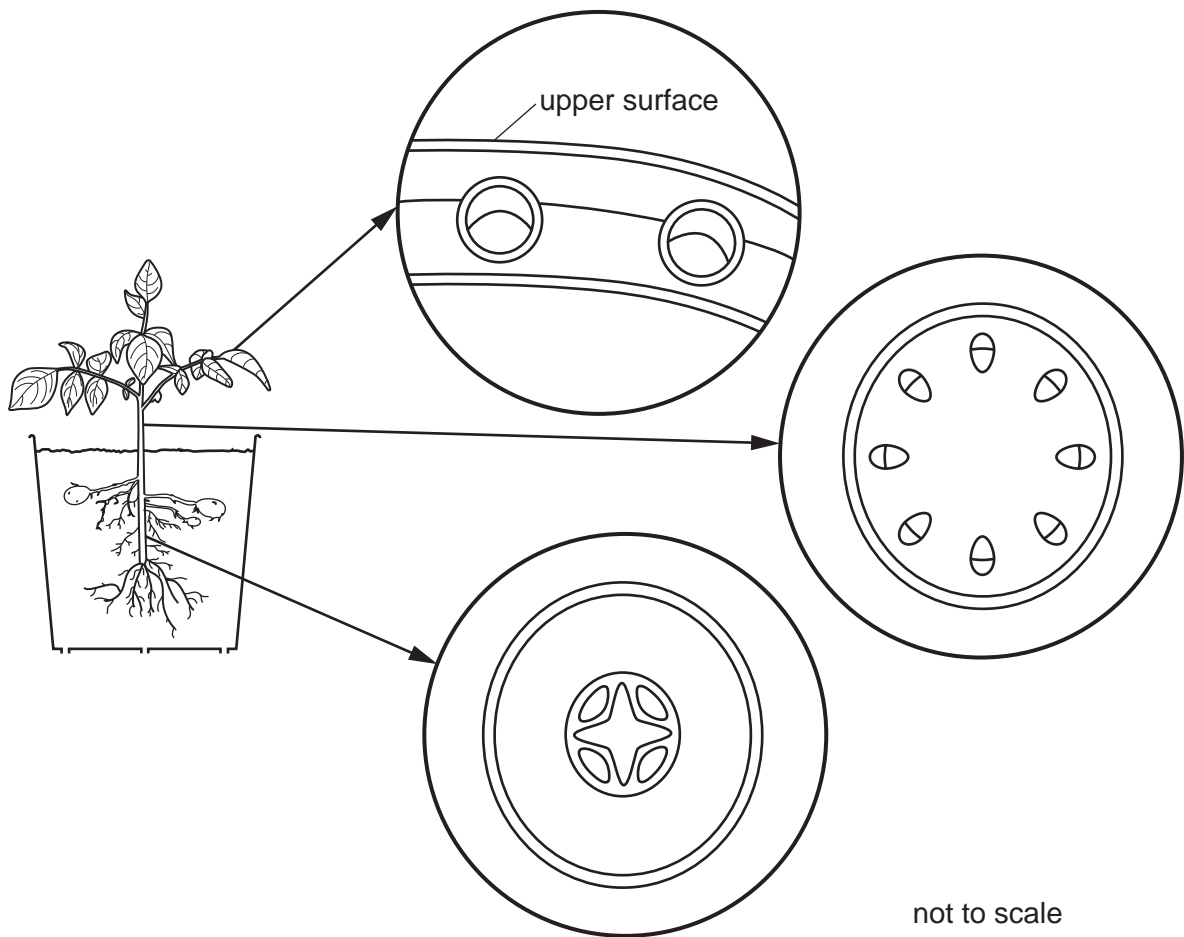


Fig. 2.1

Label the position of the phloem in each of the three magnified sections in Fig. 2.1.

Use a label line and the letter **P** for each section.

[3]

(c) Aphids are used by investigators to discover how plants transport sucrose.

Fig. 2.2 shows an aphid with its mouthparts inserted into a plant stem to feed on the liquid in the phloem.



Fig. 2.2

A plant was put in a dark cupboard for several days.

Four aphids, **A**, **B**, **C** and **D**, were then placed on the plant in the dark cupboard as shown in Fig. 2.3.

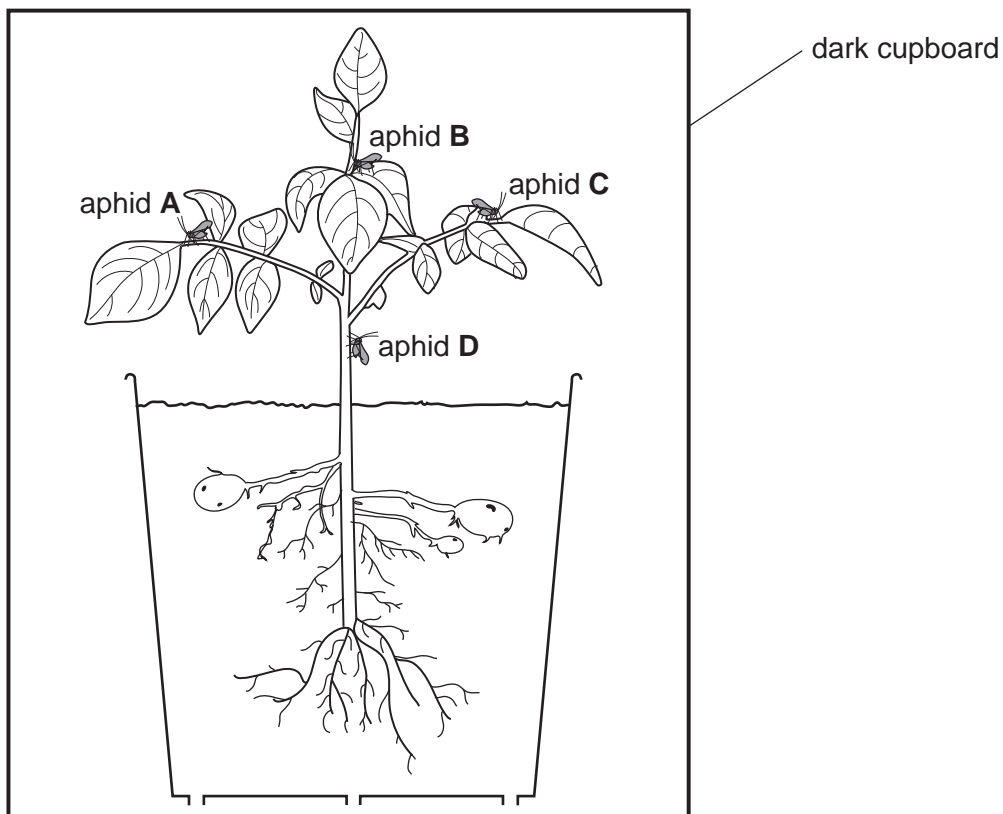


Fig. 2.3

(i) Immediately after the aphids were placed on the plant it was observed that:

- all the aphids ingested the same volume of liquid from the phloem
- aphid **D** ingested the highest concentration of sucrose.

Explain why aphid **D** ingested the highest concentration of sucrose.

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..... [3]

(ii) Many crop farmers try to prevent insects such as aphids from damaging their plants.

Describe how modern technology is used to reduce damage to crop plants by insects.

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..... [3]

(iii) Other insects are useful to crop farmers.

Give **one** example of how insects are useful to farmers.

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..... [1]

[Total: 14]

(b) Stomata are found on the lower surface of broad bean leaves.

Describe the function of stomata.

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.....[3]

(c) More than 40 years ago, botanists studied the leaves of broad bean plants and discovered that guard cells control the opening and closing of stomata. They found that stomata were open when the guard cells were turgid.

Table 3.1 shows some of their measurements.

Table 3.1

	closed stomata	open stomata
ion concentration in guard cells/pmole	0.3	2.5
guard cell volume/ μm^3	4000.0	6500.0
turgor pressure in the guard cells/MPa	2.0	4.8
width of stomatal opening/ μm	0.0	8.0

(i) Ions move into guard cells by active transport.

Describe how the ions move into the guard cells.

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.....[2]

3 (a) Fig. 3.1 is a photomicrograph of some xylem vessels.

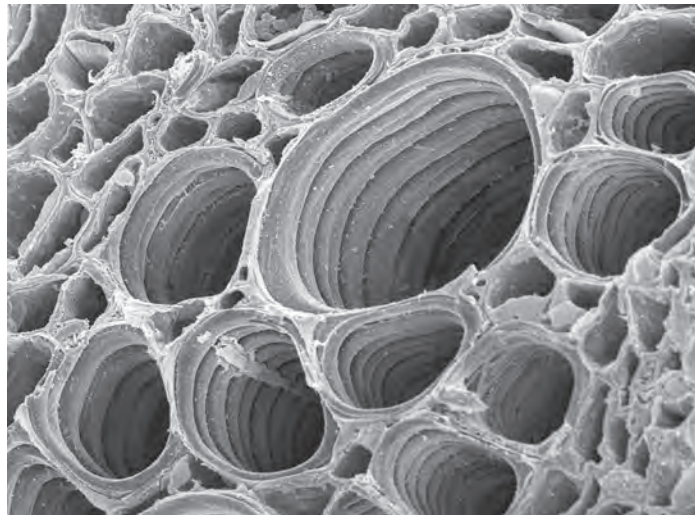


Fig. 3.1

(i) State **one** structural feature of xylem vessels and explain how this is related to the function of water transport.

feature

.....

explanation

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[2]

(ii) Explain the mechanism that is responsible for the movement of water in xylem vessels.

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..... [4]

(iii) State **one** role of xylem vessels **other than** transport.

..... [1]

(b) The rate of transpiration is affected by several factors including the temperature and the humidity of the air.

State **and** explain the effect of an increase in temperature on the rate of transpiration.

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..... [3]

[Total: 10]

(c) Scientists wanted to determine the flow-rate of water in roots.

They measured the flow-rate in three zones of onion roots as shown in Fig. 3.2.

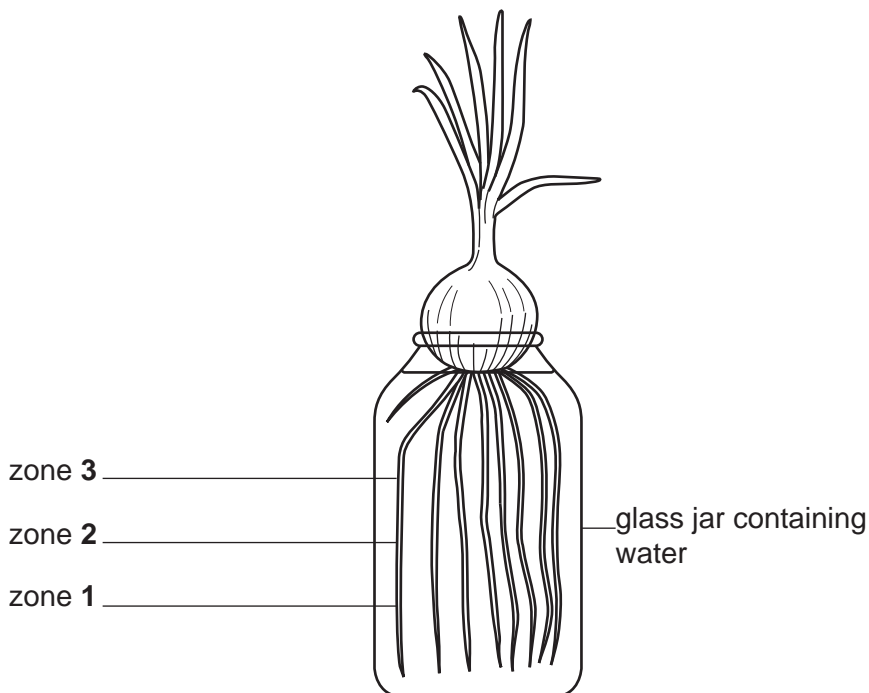


Fig. 3.2

They measured the flow-rate in healthy roots and roots that had been treated with a toxic solution.

Their results are shown in Table 3.1.

Table 3.1

zone in Fig. 3.2	average flow-rate of water/arbitrary units	
	healthy roots	treated roots
1	150	160
2	230	200
3	280	270

(i) Calculate the percentage increase in the average flow-rate between zone 1 and 3 for healthy roots.

Give your answer to **two** significant figures.

Show your working.

..... %
[2]

- (ii) The scientists observed that the xylem vessels nearer the root tip were narrower than the xylem vessels higher up the root.

Describe how the width of xylem vessels in different zones of a root affects the average flow-rate of water. Use the information in Table 3.1 in your answer.

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.....[3]

- (iii) Suggest why there was little difference in the flow-rate in healthy roots and in roots treated with the toxic solution.

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.....[2]

[Total: 15]

3 Aphids are insects that feed on the phloem sap in plants.

Fig. 3.1 shows a diagram of an aphid with its mouth parts inserted into the stem of a plant.

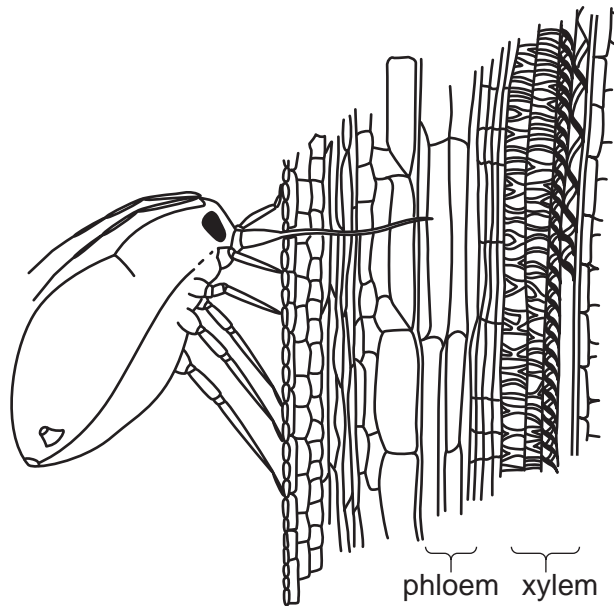


Fig. 3.1

(a) The mouth parts of the aphid reach the phloem tissue of the stem.

(i) State the name of the foods the aphid could suck out of the phloem tissue.

1

2 [2]

(ii) Explain the role of phloem in plant transport. Use the words **source** and **sink** in your answer.

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..... [4]

(b) Fig. 3.1 shows some of the features of xylem.

Describe how xylem is adapted for its functions.

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..... [6]

(c) Some farmers spray their crops with insecticides to kill pests such as aphids.

Explain the benefits of killing pests.

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..... [2]

[Total: 14]

- 3 A student cut a section of a root and made an outline drawing of the distribution of tissues as shown in Fig. 3.1.

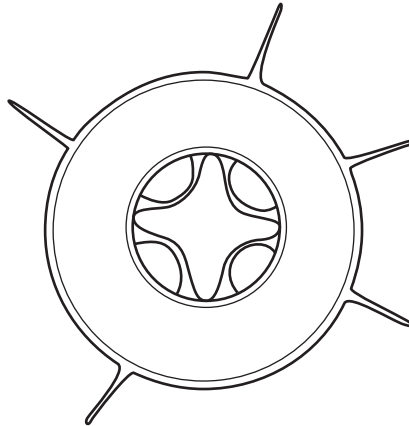


Fig. 3.1

- (a) (i) Identify the position of the xylem tissue by drawing a label line and the letter **X** on Fig. 3.1. [1]
- (ii) State why xylem is a tissue.

.....

.....

.....

..... [2]

- (b) Water absorbed by the roots moves through the stem and enters the leaves. Most of this water is lost in transpiration.

Explain how the internal structure of leaves results in the loss of large quantities of water in transpiration.

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..... [3]

[Total: 6]

4 (a) Water is one requirement for photosynthesis.

State **two** other requirements needed by plants to carry out photosynthesis.

1

2

[2]

Table 4.1 shows the number of hectares of forested area in some countries in Africa in the years 1990, 2000 and 2005.

Table 4.1

country	hectares of forest per 1000 hectares of land		
	1990	2000	2005
Cameroon	25	22	21
Tanzania	41	37	35
Nigeria	17	13	11
Zambia	49	45	43
Zimbabwe	22	19	18

(b) Calculate the percentage loss of forested area in Nigeria between **2000** and **2005**.

Show your working and give your answer to the nearest whole number.

..... %
[2]

(c) Some forested areas are cleared to provide land to grow crop plants. Deforestation reduces the local rainfall and the concentration of water vapour in the air.

(i) Describe **and** explain how a reduced concentration of water vapour in the air would increase the movement of water through crop plants.

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[3]

(ii) Describe how water moves from the soil into the roots of crop plants.

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..... [3]

(d) Describe the consequences of deforestation on the animals that live in forests.

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..... [4]

[Total: 14]

PLANT SENSITIVITY

Responding to the Environment:
Tropisms & Nastic Movements.



Positive Phototropism
(Stem grows towards light)

1. PHOTOTROPISM (Response to Light)

2. GRAVITROPISM (Response to Gravity)



Negative
Gravitropism

Positive
Gravitropism

3. THIGMOTROPISM & NASTIC MOVEMENTS (Response to Touch)



Thigmotropism



Nastic Movements

These responses allow plants to adapt and survive in their changing surroundings.

1 Plants are sensitive to light.

(a) Fig. 1.1 shows a sequence of diagrams for two young plant seedlings. The seedlings were first grown in pots with light from all directions and then placed into boxes.

- Seedling **A** was placed in a box with light entering from one side only.
- Seedling **B** was placed in a box with no light.

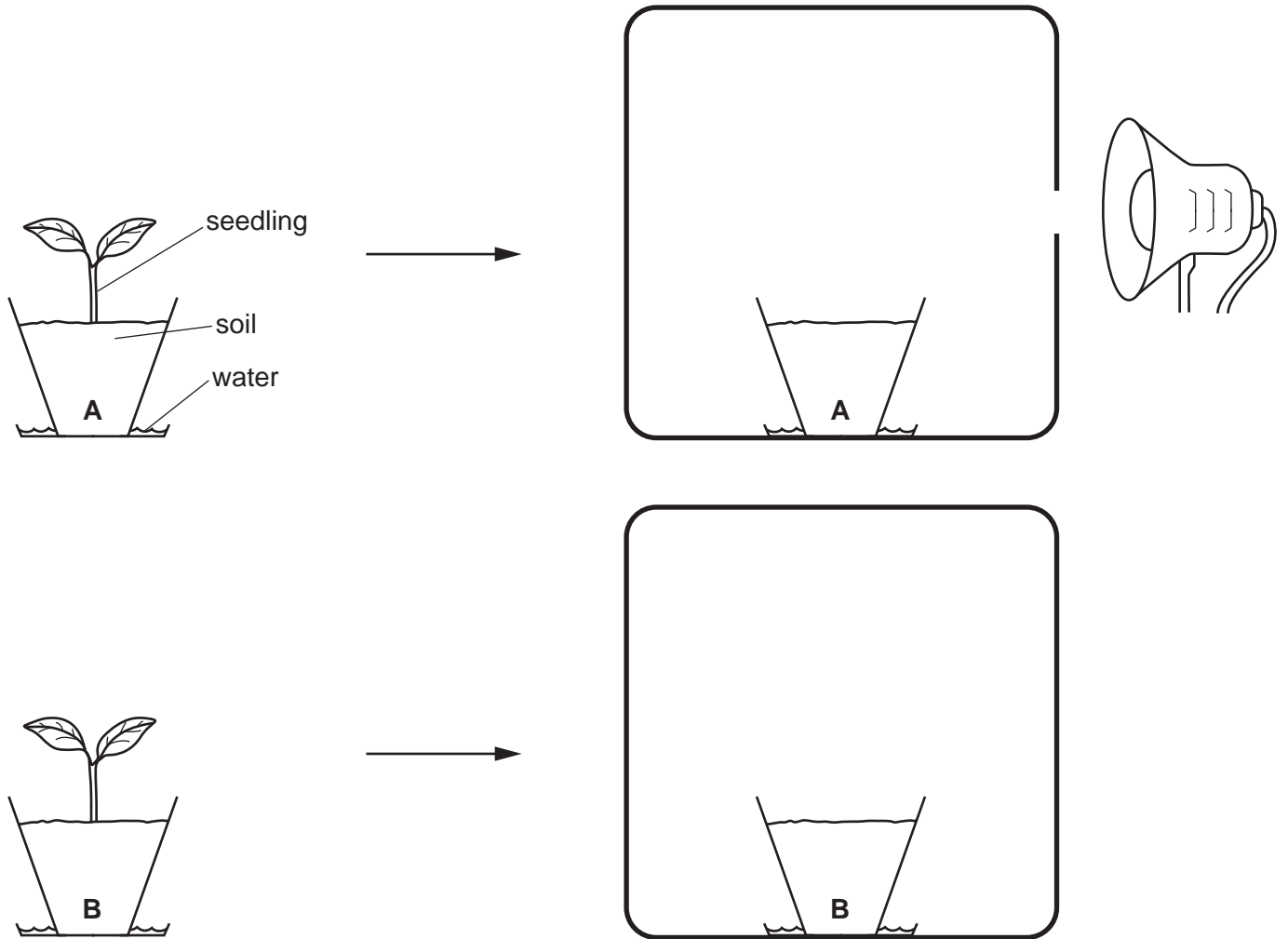


Fig. 1.1

Complete Fig. 1.1 by drawing seedling **A** and seedling **B**, in the boxes, to show the expected direction of their growth after one week. [2]

(b) Plants are also sensitive to gravity.

(i) Define the term *sensitivity*.

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.....
..... [2]

(ii) Explain the role of plant hormones in gravitropism.

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..... [4]

(iii) Gravitropism enables plants to survive in their environment.

Explain how gravitropism enables a plant to survive.

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.....
..... [2]

(c) Herbicide **A** is a synthetic plant hormone called 2,4-D that selectively kills dicotyledonous plants only.

(i) State **two** features that distinguish leaves of dicotyledonous plants from leaves of monocotyledonous plants.

- 1
- 2 [2]

(ii) State the name of a natural plant hormone that stimulates cell elongation.
..... [1]

(iii) Herbicide **B** is a chemical that prevents the uptake of magnesium ions.
Suggest how herbicide **B** kills plants.
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..... [3]

[Total: 15]

6 Fig. 6.1 shows some cells from the shoot tip of an onion, *Allium cepa*.

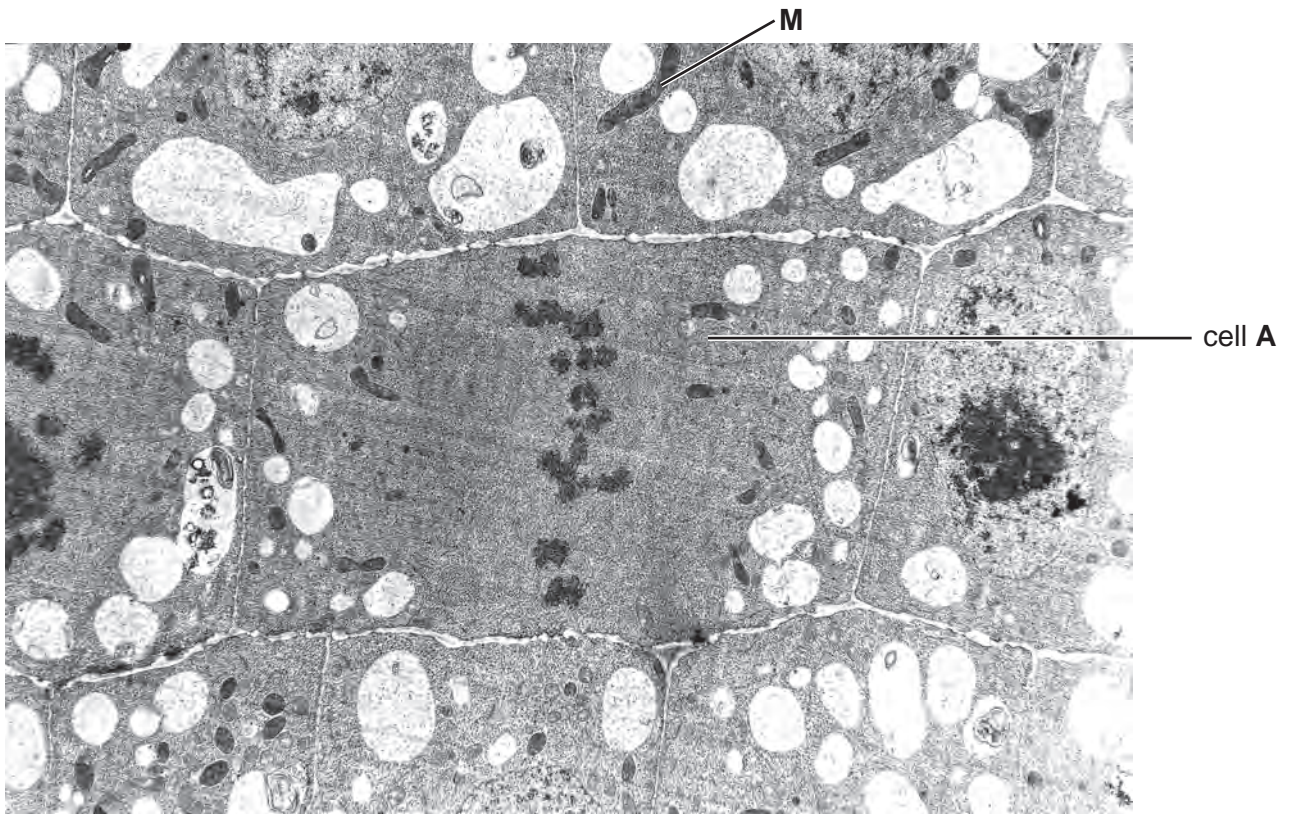


Fig. 6.1

(a) (i) State the evidence visible in Fig. 6.1 that identifies the cells of *A. cepa* as plant cells.

..... [1]

(ii) Cell A is dividing by mitosis.

State the role of mitosis in a shoot tip.

.....
.....
..... [1]

5 2,4-D is a synthetic plant auxin that is used as a weedkiller.

Researchers investigated the effectiveness of different treatments of 2,4-D on the control of the weed *Conyza canadensis* in fields of maize, *Zea mays*.

The results are shown in Table 5.1.

Table 5.1

treatment	time of treatment			mean dry mass of weeds/g per m ²	weed density/number of weeds per m ²
	day 7	day 23	day 33		
A	✓			7.40	6.20
B		✓		3.90	4.90
C			✓	0.50	1.20
D	✓	✓		0.66	1.90
E	✓		✓	0.18	0.98
F		✓	✓	0.07	0.29
G	✓	✓	✓	0.08	0.51

(a) (i) Maize farmers that had been using treatment **C** were advised by the researchers to change to treatment **F**.

Discuss the advantages and disadvantages of changing to treatment **F**.

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.....
.....
.....
.....
.....
.....
.....
.....[4]

(ii) Suggest **two** factors that could decrease the effectiveness of 2,4-D.

1

2

[2]

2 Fig. 2.1 is a flow chart that shows the events that occur as light travels through the eye.

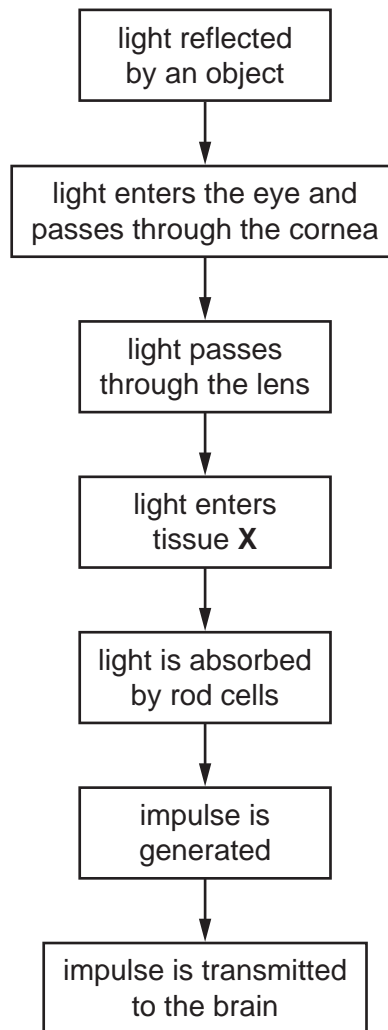


Fig. 2.1

- (a) (i) State the name of the tissue X.
..... [1]
- (ii) State the name of the nerve that transmits impulses from the eye to the brain.
..... [1]
- (iii) State what happens to rays of light as they enter the cornea and the lens.
..... [1]

(iv) Describe the role of rod cells.

.....

.....

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.....

.....

[2]

(b) A plant, *Arabidopsis thaliana*, was placed on its side in the dark. Fig. 2.2 is a series of drawings made of the plant, over seven days, as it responded to a change in its surroundings.

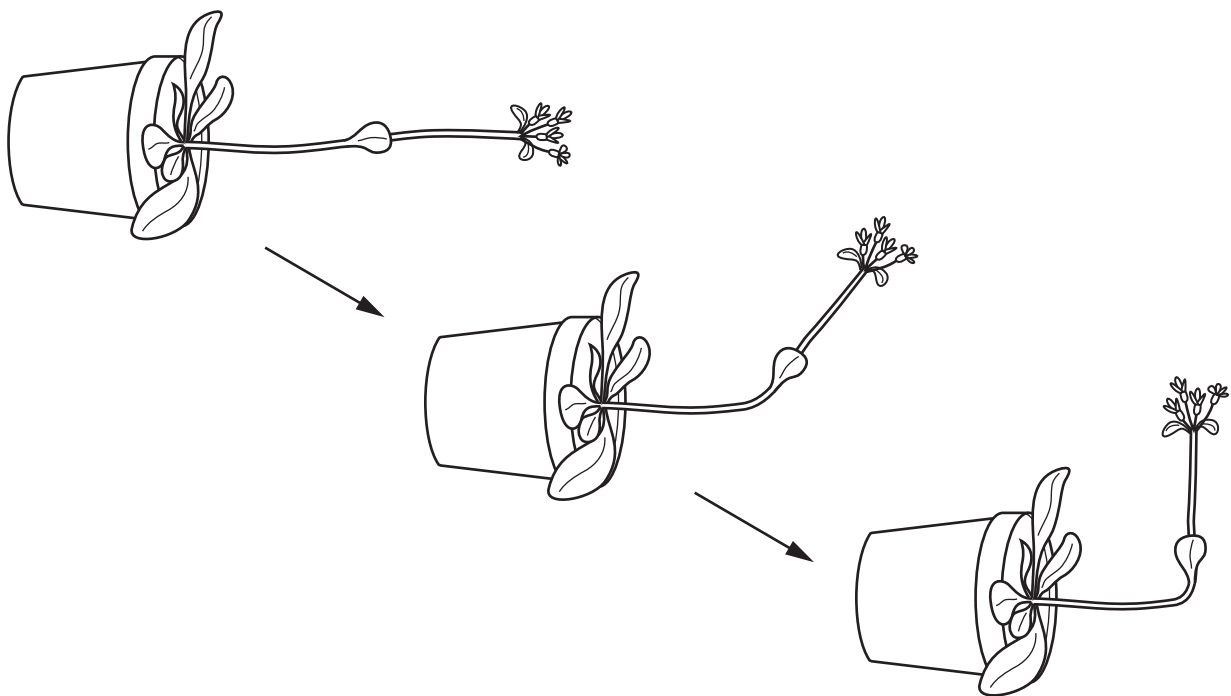


Fig. 2.2

(i) State the stimulus to which the plant responded.

.....

[1]

(ii) Name the growth response shown by the plant.

.....

[2]

(iii) Explain the advantage to plants of the growth response shown in Fig. 2.2.

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[2]

(iv) Auxins control the growth responses of seedlings.

Explain how auxins control the growth response of *A. thaliana*, shown in Fig. 2.2.

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[4]

[Total: 14]

(c) Fig. 2.3 shows three pots of seedlings that have been kept in different conditions.

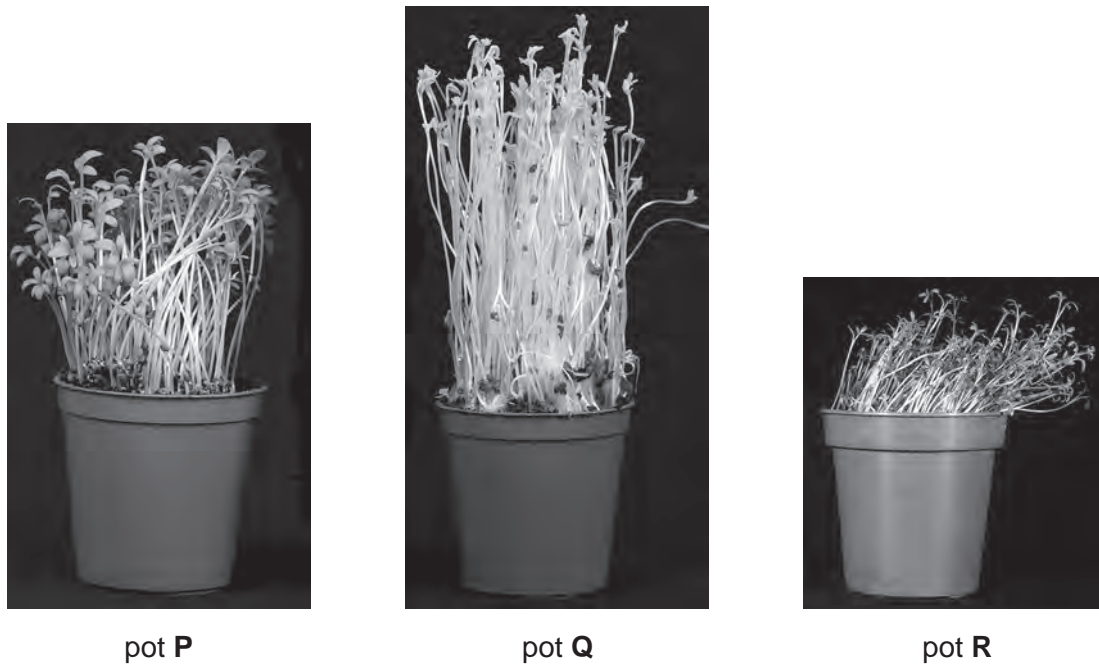


Fig. 2.3

(i) State the conditions in which pots **P** and **Q** were kept.

P

Q

[1]

(ii) State the name of the growth response shown by the seedlings in pot **R**.

.....

[2]

(iii) Explain the advantage to the seedlings of this growth response.

.....
.....
.....
.....
.....

[2]

(iv) Auxins control the growth responses of seedlings.

Explain how auxins control the growth response of the seedlings in pot **R**.

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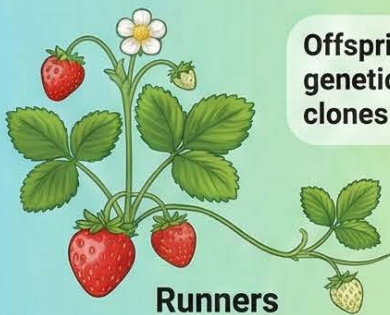
[4]

[Total: 16]

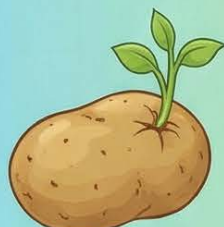
PLANT REPRODUCTION

The Cycle of Life: Flowers, Seeds, and Growth.

ASEXUAL REPRODUCTION (Vegetative Propagation)



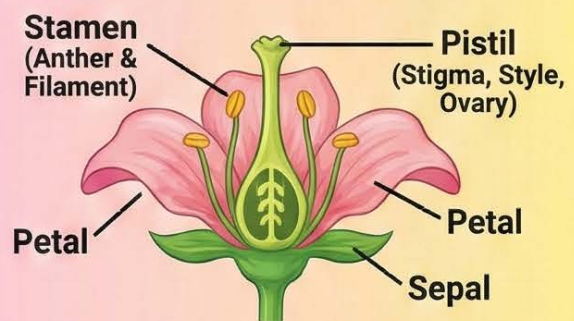
Offspring are genetically identical clones of the parent.



Methods involve stems, roots, or leaves.



SEXUAL REPRODUCTION (Flowering)



Involves fusion of male (pollen) and female (ovule) gametes.



Results in genetic variation.

Both methods are vital for plant survival and the continuation of species.

4 (a) Fig. 4.1 shows a bee with pollen on its legs.



Fig. 4.1

Bees are insects that pollinate some flowering plants. They are attracted to the flowers by their colour, scent and nectar.

(i) Describe other ways in which flowers and pollen grains are adapted for insect pollination.

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.....
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..... [3]

(ii) State where pollen is produced in a flower.
..... [1]

(iii) State the name of the process that produces haploid pollen nuclei.
..... [1]

(iv) Explain why it is important that the pollen nuclei are haploid.
.....
..... [1]

(b) (i) Describe how the pollen that is carried by an insect to another flower results in the formation of a plant embryo.

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..... [5]

(ii) Describe the advantages of cross-pollination.

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..... [2]

(c) Some people are concerned that genetically modified plants might cross-pollinate with wild varieties of plants.

(i) Suggest how farmers could prevent cross-pollination between genetically modified plants and wild varieties of plants.

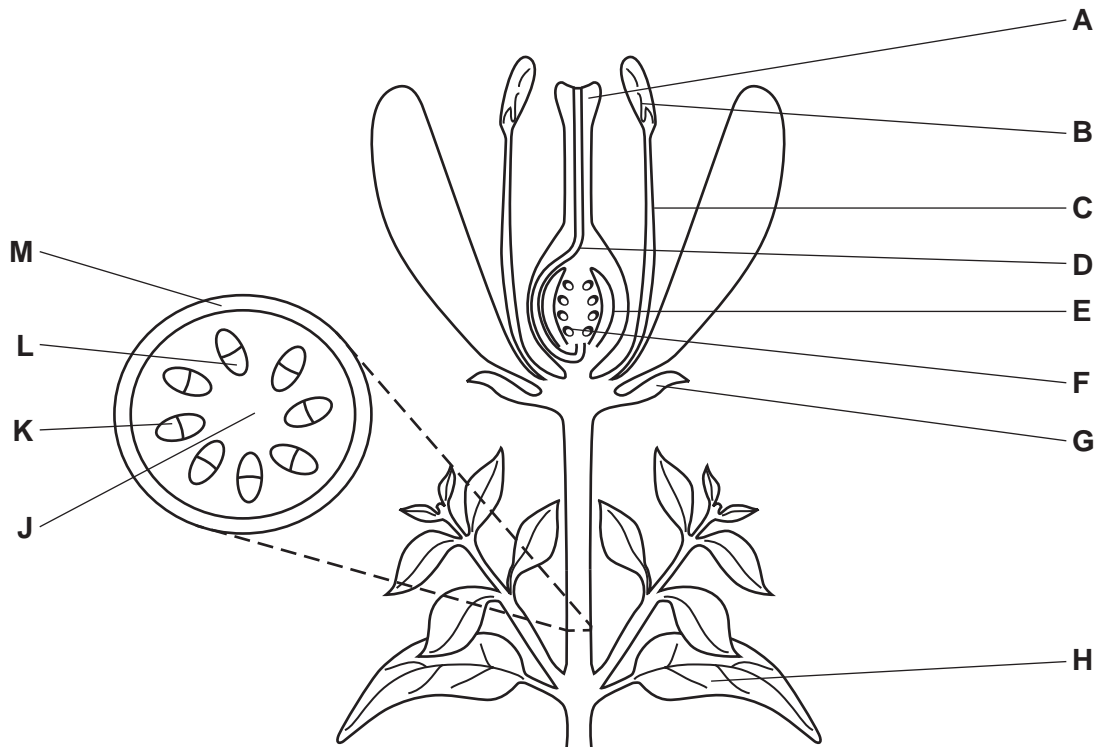
.....
.....
..... [1]

(ii) State **two** advantages of genetically modified crops.

1
2 [2]

[Total: 16]

- 6 (a) Fig. 6.1 is a diagram showing some parts of a plant. The circle shows a magnified cross-section of part of the stem.



not to scale

Fig. 6.1

- (i) Table 6.1 contains statements about the functions of some of the structures in Fig. 6.1.

Complete the table by:

- stating the name of the structure
- identifying the letter that labels that structure.

Table 6.1

function	name of structure	letter from Fig. 6.1
provides support to the stem		
protects flower bud		
produces glucose		
produces pollen		
delivers male nuclei to the site of fertilisation		

[5]

- (ii) State **one** letter from Fig. 6.1 that identifies a structure that contains a **haploid** nucleus.
..... [1]
- (iii) State the name of the process that describes the transport of sucrose in a plant.
..... [1]
- (iv) State **one** letter from Fig. 6.1 that is a structure that is an example of a source for sucrose transport.
..... [1]
- (b) In addition to sucrose, amino acids are also transported in plants.
- (i) State the name of a mineral ion that becomes part of an amino acid.
..... [1]
- (ii) State the name of the structures inside cells that assemble amino acids into proteins.
..... [1]
- (iii) State the name of the group of molecules that are made of proteins and act as catalysts.
..... [1]
- [Total: 11]

4 Johnson grass, *Sorghum halepense*, is wind-pollinated.

(a) Fig. 4.1 shows some Johnson grass flowers.



Fig. 4.1

(i) State the genus of Johnson grass.

..... [1]

(ii) Describe **two** features **visible in Fig. 4.1** that show that Johnson grass flowers are adapted for wind-pollination.

1

.....

2

.....

[2]

(b) Fig. 4.2 shows a section through a carpel shortly after pollination.

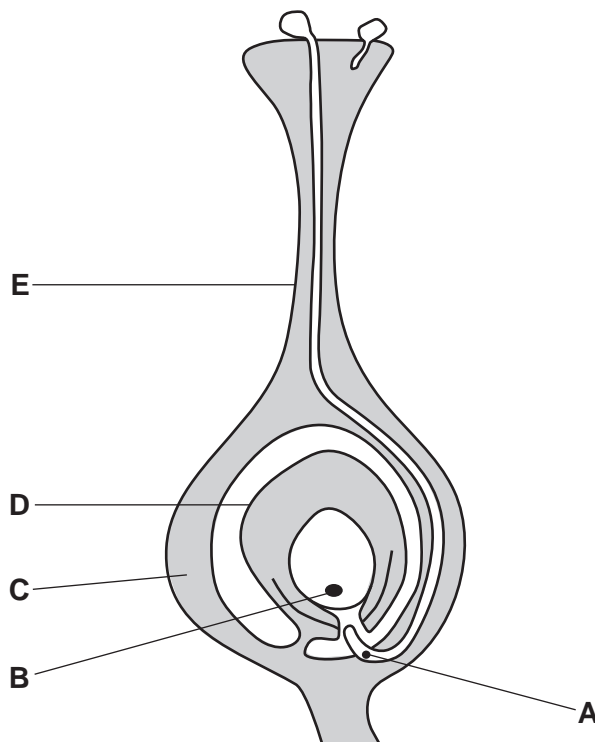


Fig. 4.2

(i) State the names of the parts of the carpel labelled **C**, **D** and **E**.

C

D

E

[3]

(ii) Complete the sentences:

Pollen grains are formed in anthers. During their formation the number of chromosomes in the nuclei is halved by the process of This means the male nucleus **A** in the pollen tube is described as a nucleus.

When nucleus **A** with nucleus **B**, the chromosome number doubles to form a nucleus. The name of this process is Then the divides by the process of to form an embryo.

[7]

(c) Discuss the advantages of sexual reproduction to a wild population of flowering plants such as Johnson grass.

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..... [5]

(d) Sexual reproduction requires energy.

State **three** uses of energy in organisms **other than in reproduction**.

1
2
3 [3]

[Total: 21]

5 Grass plants are wind-pollinated. Fig. 5.1 shows a flower from a species of grass plant.



Fig. 5.1

(a) (i) Describe **and** explain how the features of the flower shown in Fig. 5.1 are adaptations for wind-pollination.

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

(ii) State **one** letter in Fig. 5.1 that identifies a structure where meiosis occurs.

..... [1]

(b) Wheat has flowers similar to those in Fig. 5.1, but reproduces by self-pollination.

Explain the consequences of self-pollination for a population of plants.

.....

.....

.....

.....

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..... [4]

(e) Wheat plants are monocotyledons.

State **one** feature of monocotyledons that can be used to distinguish them from dicotyledons.

..... [1]

[Total: 15]

(b) Fig. 6.2 shows a method of reproduction that some potato farmers use to produce more potato plants.

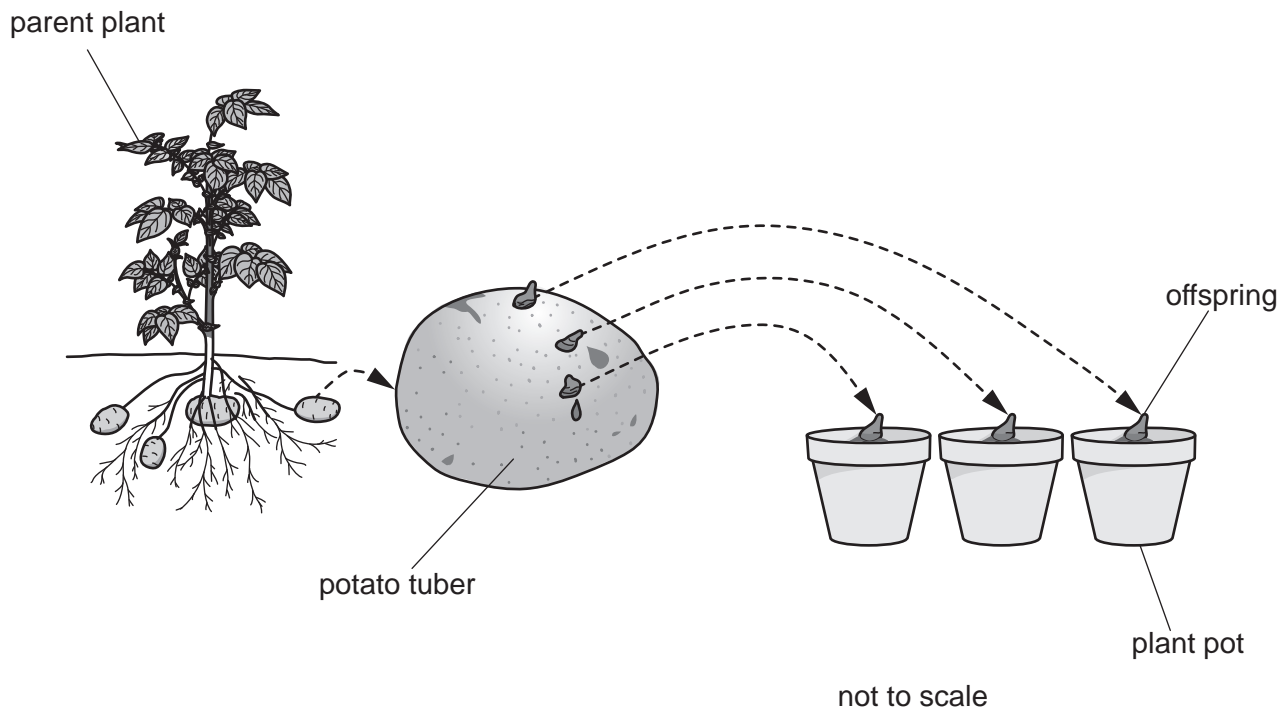


Fig. 6.2

Describe the advantages of the type of reproduction shown in Fig. 6.2 in crop production.

.....

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.....

.....

.....

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.....

.....

..... [3]

(c) Potato tubers store starch.

Explain why plants store starch.

.....

.....

.....

.....

..... [2]

[Total: 7]

2 (a) Fig. 2.1 shows some flowers of a snapdragon plant, *Antirrhinum majus*.

Snapdragons are insect-pollinated plants.



Fig. 2.1

(i) State **one** feature visible in Fig. 2.1 that suggests these flowers are insect-pollinated.

..... [1]

(ii) State how self-pollination differs from cross-pollination.

.....
.....
..... [1]

(iii) Suggest why self-pollination might be advantageous to a population of plants.

.....
.....
.....
.....
.....
.....
.....
.....
..... [3]

(d) Fig. 2.3 shows how several strawberry plants can be formed from one parent plant.

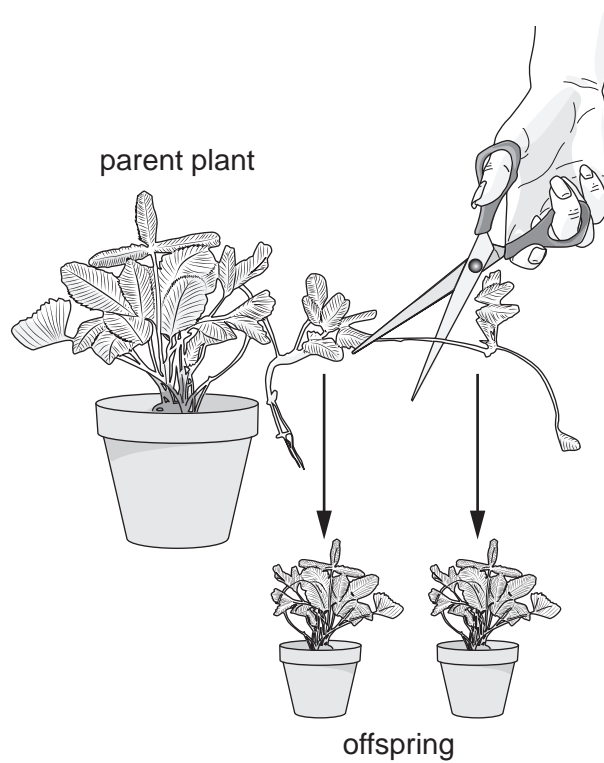


Fig. 2.3

(i) Explain the type of reproduction that produces plants by the method shown in Fig. 2.3.

.....

.....

.....

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.....

.....

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.....

..... [3]

(ii) Explain the **disadvantages** of the type of reproduction shown in Fig. 2.3.

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.....

.....

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..... [3]

[Total: 12]

6 (a) Fig. 6.1 is a half-flower drawing of pride of Barbados, *Caesalpinia pulcherrima*.

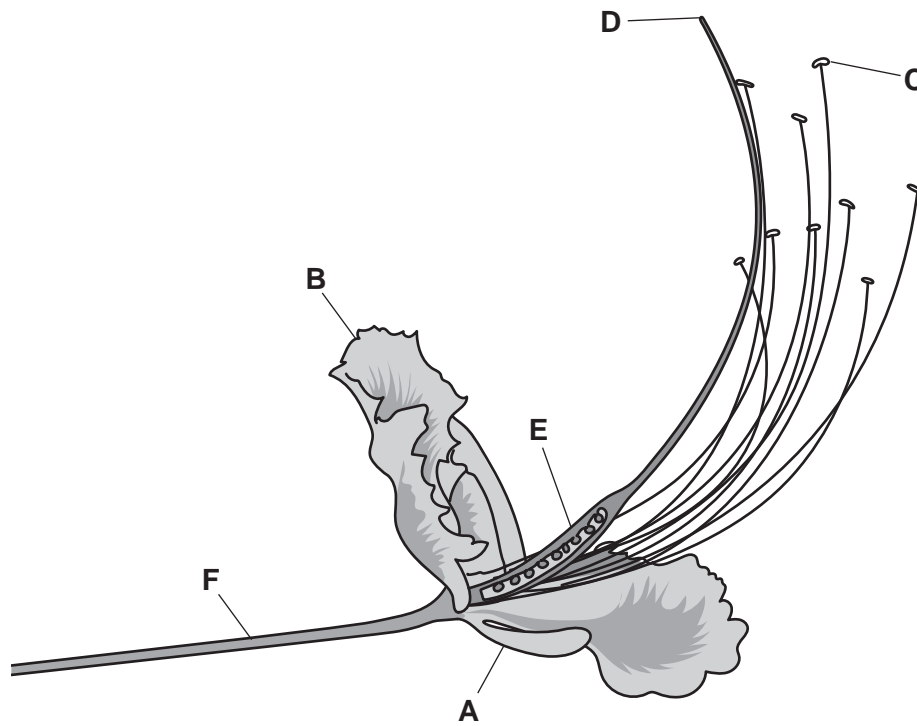


Fig. 6.1

Complete Table 6.1 by stating the letter from Fig. 6.1 that indicates the organ where each function occurs and the name of the organ.

Table 6.1

function	letter from Fig. 6.1	name of the organ
meiosis to produce pollen grains		
pollination		
development of seeds		
protection of flower in the bud		

[4]

(b) Fig. 6.2 is a scanning electron micrograph of some pollen grains from wind-pollinated flowers and insect-pollinated flowers.

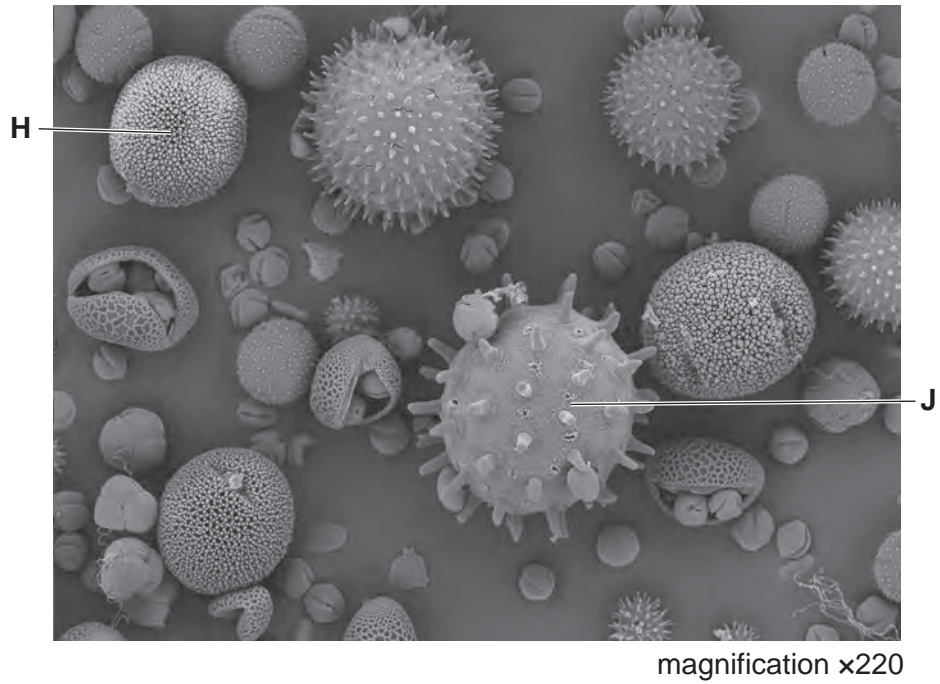


Fig. 6.2

(i) Write the formula that would be used to calculate the actual diameter of pollen grain **H**.

[1]

(ii) The actual diameter of pollen grain **H** is 0.082 mm.

Convert this value to micrometres (μm).

Space for working.

..... μm [1]

(iii) Explain how the pollen grain labelled **J** is adapted for insect pollination.

.....
.....
.....
.....
.....
.....[2]

(c) Pollen grains grow tubes, which contain haploid male gamete nuclei.

(i) One of these male gamete nuclei fuses with the female gamete.

State the part of the flower that contains the female gamete.

.....[1]

(ii) Define the term *haploid nucleus*.

.....
.....
.....[1]

(iii) Explain why it is important for gametes to be haploid.

.....
.....
.....[1]

[Total: 11]

(c) One group of students recorded the change in temperature as the seeds germinated in five insulated flasks, labelled **A** to **E**.

(i) Suggest why germinating seeds increase in temperature.

.....
.....
.....[2]

(ii) The students sterilised the seeds before their investigation.

Their teacher told them to use a sterilising solution to wash the seeds because steam would kill the seeds and prevent the seeds from germinating.

Explain why steam sterilisation would prevent seed germination.

.....
.....[1]

The results from this group of students are shown in Table 5.1.

Table 5.1

flask	pH	group 1
		temperature of seeds after 72 hours/°C
A	2.0	20.6
B	3.5	20.3
C	4.0	21.2
D	5.5	34.1
E	7.0	46.2

(iii) Describe the results obtained by group 1.

.....
.....
.....
.....
.....[2]

(d) The second group of students placed 100 seeds in each of five Petri dishes, labelled 1 to 5.

Group 2 used the same range of pH values as group 1.

They recorded the percentage of seeds that had germinated after 72 hours.

Their results are shown in Table 5.2.

Table 5.2

Petri dish	pH	group 2
		percentage of seeds germinated after 72 hours
1	2.0	20
2	3.5	82
3	4.0	19
4	5.5	65
5	7.0	87

The teacher thought that group 2 had forgotten to add the sulfuric acid to one of their Petri dishes.

Suggest which Petri dish was not set up correctly.

.....[1]

[Total: 15]