

Week 7

IGCSE Biology

Homework bundle for this week

本周作业合集

exercises.lol

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6. Plant nutrition

Starter Quiz · 课前小测

IGCSE Biology

Name: _____ Score: _____

- The products of photosynthesis are:
 - ☐ glucose and oxygen
 - ☐ carbon dioxide and water
 - ☐ starch and protein
 - ☐ water and minerals
- A leaf is broad and flat mainly to:
 - ☐ have a large surface area to capture light
 - ☐ store water
 - ☐ protect the plant
 - ☐ attract insects
- The green pigment that absorbs light for photosynthesis is:
 - ☐ chlorophyll
 - ☐ glucose
 - ☐ haemoglobin
 - ☐ starch
- Which leaf layer contains the most chloroplasts?
 - ☐ the palisade layer
 - ☐ the waxy cuticle
 - ☐ the lower epidermis
 - ☐ the veins
- A limiting factor is one that:
 - ☐ is in shortest supply and holds back the rate
 - ☐ always speeds the reaction up
 - ☐ has no effect
 - ☐ is the product
- Which does a plant need for photosynthesis? (Select all that apply.)
 - ☐ light
 - ☐ carbon dioxide

- ☐ water
- ☐ protein

Tick every correct option.

7. Guard cells open and close the stomata.

- ☐ True
- ☐ False

8. Glucose made in photosynthesis is often stored as _____.

9. A leaf is _____ so that gases can diffuse in and out over short distances.

10. Stomata are pores that allow:

- ☐ gases to enter and leave the leaf
- ☐ water to be stored
- ☐ light to be absorbed
- ☐ sugar to be made

6. Plant nutrition

Answers · 答案

IGCSE Biology

1. **glucose and oxygen**

$\text{CO}_2 + \text{water} \rightarrow \text{glucose} + \text{oxygen}$.

2. **have a large surface area to capture light**

Large surface area maximises light capture.

3. **chlorophyll**

Chlorophyll in chloroplasts traps light energy.

4. **the palisade layer**

The palisade layer near the top absorbs the most light.

5. **is in shortest supply and holds back the rate**

The scarcest factor limits the rate.

6. **light; carbon dioxide; water**

Light, CO_2 and water (plus chlorophyll) are needed; protein is not a raw material.

7. **True**

They control gas exchange and water loss.

8. **starch**

Starch is the plant's storage carbohydrate.

9. **thin**

Thinness shortens the diffusion distance.

10. **gases to enter and leave the leaf**

Stomata let CO_2 in and O_2 out.

6.1 Photosynthesis

Name: _____ Class: _____ Date: _____

Total: 27 marks

KEY WORDS photosynthesis 光合作用 • rate 速率 • ions 离子 • carbon dioxide 二氧化碳
• temperature 温度

Objective

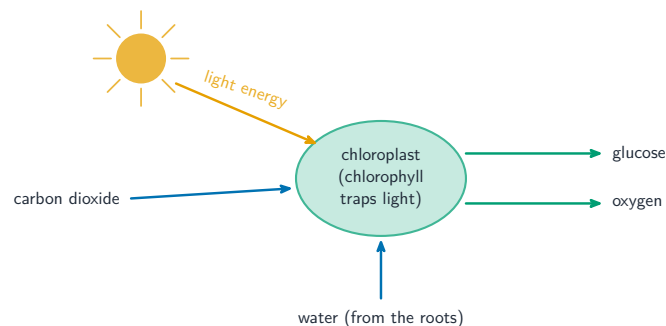
Build the skills to answer exam questions on **photosynthesis** 光合作用 — the equation, the role of **chlorophyll** 叶绿素, uses of glucose, minerals, and **limiting factors** 限制因素.

You must be able to:

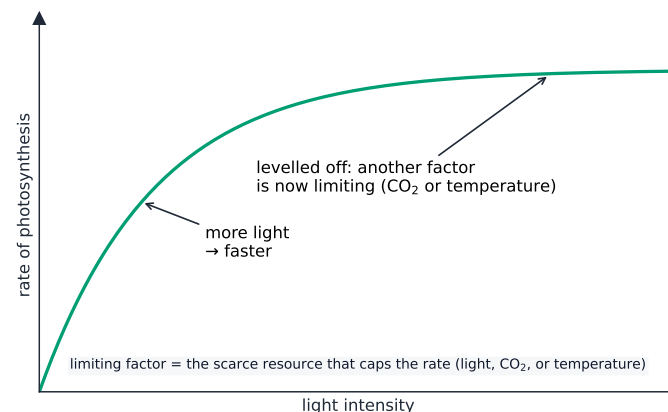
- write the word (and balanced) equation for photosynthesis
- state the uses of glucose and the roles of nitrate and magnesium ions
- describe how light, CO₂ and temperature affect the rate

1 Worked examples

Equation and rate



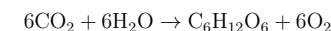
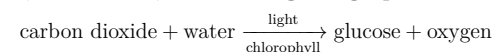
carbon dioxide + water → glucose + oxygen (in light, with chlorophyll)



More light → faster, until another factor becomes limiting

- glucose → starch (store), cellulose (walls), respiration, sucrose (transport).
- nitrate → amino acids; magnesium → chlorophyll.

The equation, the factors, and reading the graph



Chlorophyll is not a reactant: it absorbs the light energy and transfers it to the reaction, which is why it is written over the arrow.

A limiting factor 限制因素 is the factor in shortest supply, which holds the rate back. Three matter: **light intensity**, **carbon dioxide concentration** and **temperature**.

Reading a rate graph, which the exam asks every year. Where the line **rises**, the factor on the *x*-axis is limiting: more of it gives more photosynthesis. Where the line **levels off**, that factor is no longer limiting, so something else is — for a light-intensity graph, usually carbon dioxide concentration or temperature. If the line **falls** at high temperature, the reason is different in kind: the enzymes have been **denatured**, so their active sites no longer fit the substrate.

What the plant does with the glucose: respiration, to release energy; converted to starch for storage; converted to cellulose for cell walls; converted to sucrose for transport in the phloem; used with nitrate ions to make amino acids and then proteins.

Mineral ions. **Nitrate ions** are needed to make amino acids and so proteins; without them growth is stunted and older leaves turn yellow. **Magnesium ions** are needed to make chlorophyll; without them the leaves turn yellow between the veins.

Worked example. A graph shows the rate of photosynthesis against carbon dioxide concentration at 20 °C and at 30 °C. Both level off, but the 30 °C line levels off higher. Explain. At low concentrations the rate rises because carbon dioxide is the limiting factor. Both level off when carbon dioxide is no longer limiting. The 30 °C line levels off at a higher rate because the enzymes controlling photosynthesis work faster at the higher temperature, so temperature was the factor limiting the 20 °C line.

2 Practice

2.1 Write the word equation for photosynthesis. [2]

2.2 State the role of magnesium ions in a plant. [1]

2.3 Explain why a plant lacking nitrate ions grows poorly. [2]

2.4 State what is meant by a limiting factor. [1]

2.5 Give the balanced symbol equation for photosynthesis. [2]

3 Exam-style questions

3.1 Photosynthesis can only take place where there is light and: [1]

- A nitrate
- B chlorophyll
- C oxygen
- D protein

3.2 A graph shows photosynthesis rate rising with light intensity, then levelling off.

(a) Explain why the rate levels off at high light intensity. [2]

(b) Name one other factor that could then be limiting. [1]

3.3 State two uses a plant makes of the glucose produced in photosynthesis. [2]

3.4 A student measures the rate of photosynthesis of pondweed by counting the bubbles of gas released each minute at different light intensities, at two temperatures.

(a) Name the gas being collected, and explain why counting its bubbles measures the rate of photosynthesis. [2]

(b) At low light intensity both lines rise steeply and lie on top of each other. Explain what this shows. [2]

(c) At high light intensity the 25 °C line levels off higher than the 15 °C line. Explain why. [3]

(d) The student repeats the experiment at 45 °C and the rate is very low. Explain this result. [2]

(e) Suggest two variables the student must keep constant for the comparison to be valid.[2]

(f) Estimate what would happen to the rate if the student added sodium hydrogencarbonate solution, which releases carbon dioxide, at high light intensity. Explain your answer. [2]

Solutions

2.1 carbon dioxide + water → glucose + oxygen.

2.2 needed to make chlorophyll.

2.3 Nitrate ions are needed to make amino acids and so proteins; without proteins the plant cannot build new cells, so growth is stunted and the older leaves turn yellow.

2.4 The factor in shortest supply, which holds back the rate of the reaction.

2.5 $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$.

3.1 B. Photosynthesis needs chlorophyll (and light).

3.2 (a) another factor is now limiting; e.g. CO_2 concentration or temperature is in short supply.

(b) carbon dioxide concentration (or temperature).

3.3 any two of: stored as starch; made into cellulose; used in respiration; converted to sucrose for transport.

3.4 (a) Oxygen; it is a product of photosynthesis, so the faster the bubbles are released, the faster photosynthesis is happening.

(b) Light intensity is the limiting factor at this point, so increasing it increases the rate, and temperature makes no difference because it is not limiting here.

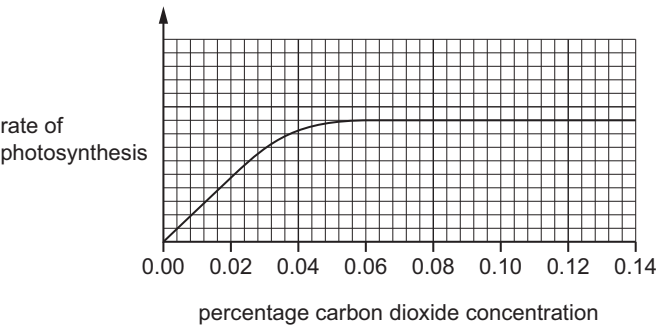
(c) Above a certain intensity light is no longer the limiting factor, so both lines level off; at 25 °C the enzymes controlling photosynthesis work faster than at 15 °C, so the rate at which the plant can use the light is higher, and temperature was limiting the 15 °C line.

(d) The enzymes have been denatured by the high temperature; their active sites have changed shape so the substrate no longer fits, and the reaction almost stops.

(e) Any two of: the distance of the lamp, or light intensity when it is not the variable; the concentration of carbon dioxide; the species and mass of pondweed; the volume of water; the time counted.

(f) The rate would increase, because at high light intensity carbon dioxide is the limiting factor, and supplying more of it removes that limit.

8 The graph shows the rate of photosynthesis of a plant in full sunlight in different concentrations of carbon dioxide. All other factors were kept constant.



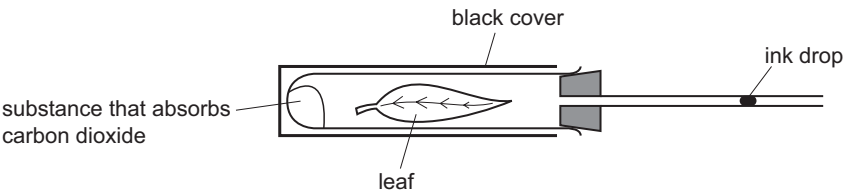
What limits the rate of photosynthesis at 0.02% carbon dioxide concentration?

- A carbon dioxide concentration
- B humidity
- C light intensity
- D temperature

8 Which substance contains magnesium ions?

- A cellulose
- B chlorophyll
- C glucose
- D glycerol

10 The diagram shows an experiment to investigate gas exchange in a leaf.



In which direction does the ink drop move and for what reason?

	direction	reason
A	towards the leaf	photosynthesis
B	towards the leaf	respiration
C	away from the leaf	photosynthesis
D	away from the leaf	respiration

5 (a) (i) State the balanced chemical equation for photosynthesis.

..... [2]

(ii) Chlorophyll is needed for photosynthesis.

State the name of the mineral ion needed to make chlorophyll.

..... [1]

(iii) State the name of the carbohydrate used for energy storage in a plant.

..... [1]

(b) A plant shoot was placed in a light-proof box. A hole was cut in one side of the box and a light was shone into the box.

Fig. 5.1 shows the plant shoot at the start of the investigation and after one week.

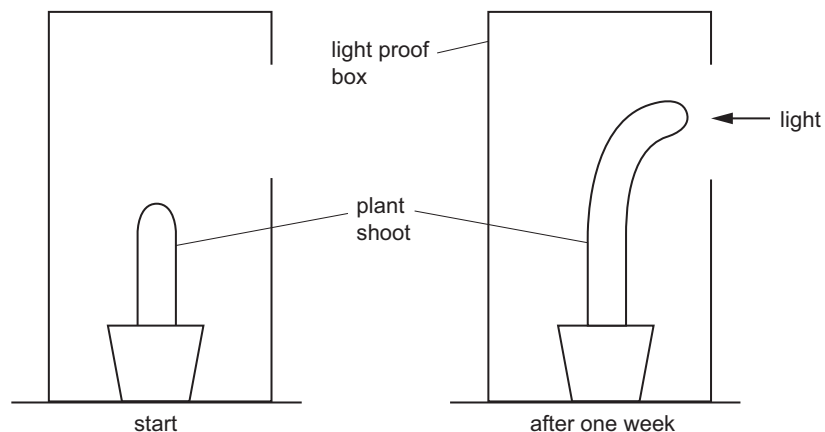


Fig. 5.1

(i) Identify the tropic response shown by the plant shoot in Fig. 5.1.

..... [1]

(ii) Explain the chemical control of the tropic response shown by the plant shoot in Fig. 5.1.

.....

 [4]

(iii) Explain how the type of tropic response shown in Fig. 5.1 is an advantage to a plant.

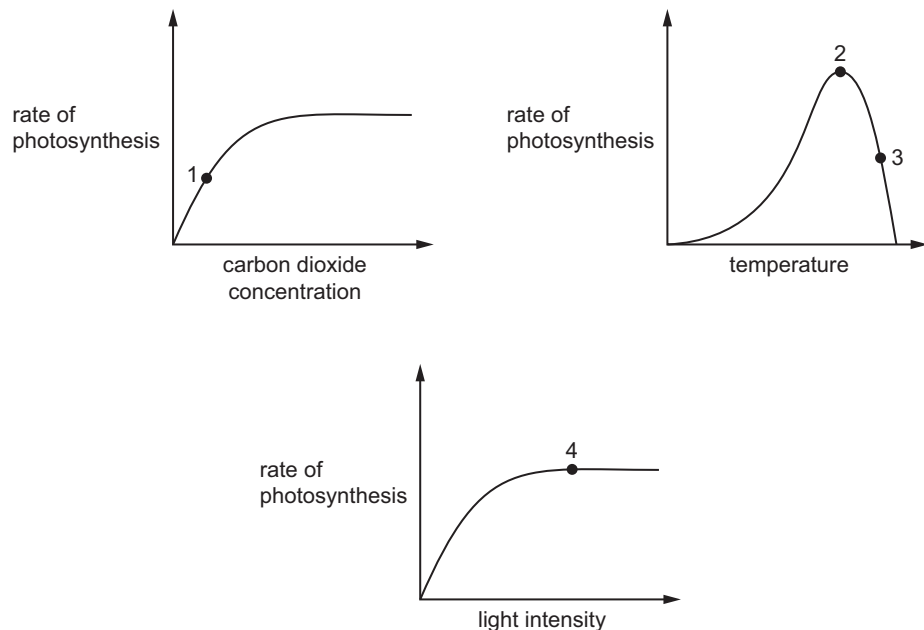
.....

 [2]

[Total: 11]

- 9 A student investigated how the rate of photosynthesis is affected by carbon dioxide concentration, temperature and light intensity.

The graphs show the results.



What is a correct statement for these results?

- A Carbon dioxide concentration is a limiting factor at 1.
- B No enzymes are denatured at 3.
- C Light intensity is a limiting factor at 4.
- D Temperature is a limiting factor at 2.

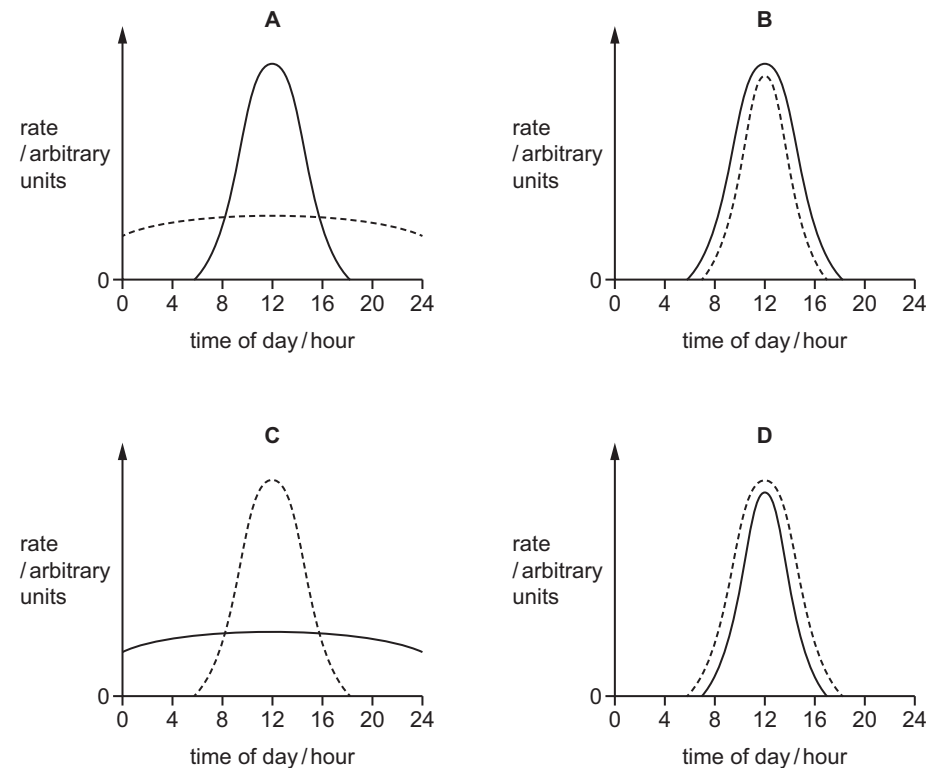
- 6 What is the balanced chemical equation for photosynthesis?

- A $3\text{CO}_2 + 3\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 3\text{O}_2$
- B $6\text{CO}_2 + 6\text{O}_2 \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O}$
- C $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
- D $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow 6\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$

- 10 The graphs show how the rate of photosynthesis and the rate of respiration in a plant changed over a 24-hour period.

Which graph shows the correct rate of photosynthesis and rate of respiration?

key
 — photosynthesis
 - - - - - respiration



6.2 Leaf structure

Name: _____ Class: _____ Date: _____

Total: 20 marks

KEY WORDS stomata 气孔 • mesophyll 叶肉 • cuticle 角质层 • palisade mesophyll 栅栏叶肉 • adapted 适应

Objective

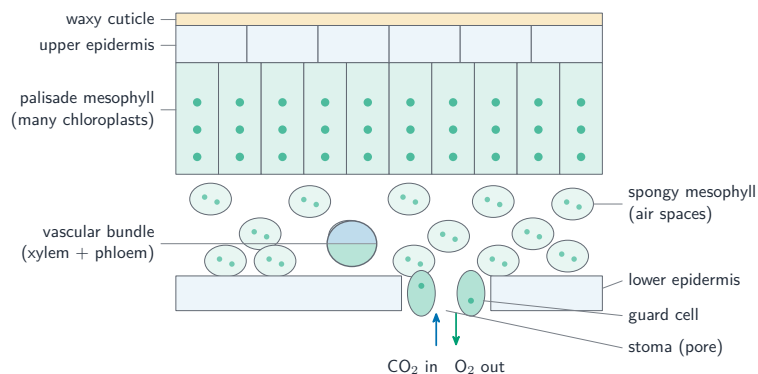
Build the skills to answer exam questions on **leaf structure** 叶的结构 — the tissues of a leaf and how each is **adapted** 适应 for photosynthesis and gas exchange.

You must be able to:

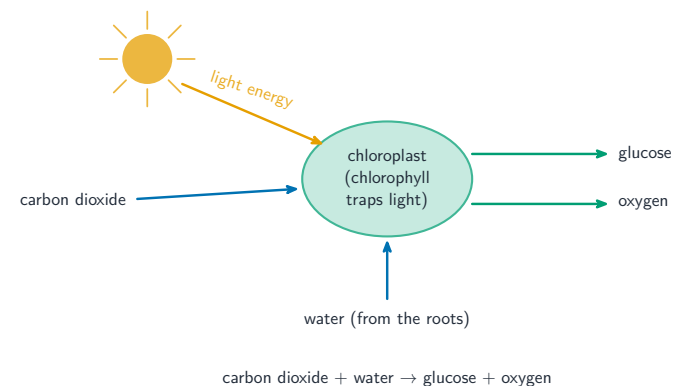
- name the leaf tissues and give the job of each
- explain how leaf features suit photosynthesis
- describe the role of stomata and guard cells

1 Worked examples

■ The leaf in cross-section



Each tissue is adapted for photosynthesis and gas exchange



The leaf is the organ of photosynthesis

- **palisade mesophyll**: packed with chloroplasts, near the top → most photosynthesis.
- **spongy mesophyll**: air spaces → gases move easily.
- **stomata** (lower surface) with **guard cells** → let CO₂ in, O₂ out.

2 Practice

2.1 Name the leaf tissue where most photosynthesis happens.

[1]

2.2 State the function of the stomata.

[1]

3 Exam-style questions

3.1 Palisade mesophyll cells are well suited to photosynthesis because they:

[1]

- **A** have no chloroplasts
- **B** are packed with chloroplasts near the top of the leaf
- **C** are deep in the leaf
- **D** have a thick cuticle

3.2 A leaf is broad and thin.

(a) Explain how being broad helps the leaf.

[1]

(b) Explain how the air spaces in the spongy mesophyll help.

[2]

3.3 State the role of the guard cells.

[2]

3.4 A cross-section through a leaf shows a waxy cuticle, upper epidermis, palisade mesophyll, spongy mesophyll, xylem and phloem, and a lower epidermis containing stomata and guard cells.

(a) For the **palisade mesophyll**, the **spongy mesophyll** and the **stomata**, state one way each is adapted and explain how that adaptation helps the leaf.

[6]

(b) Explain why most stomata are found on the lower surface of the leaf.

[2]

(c) Name the tissue that brings water to the leaf and the tissue that carries sugars away.

[2]

(d) Explain why a leaf is thin and flat.

[2]

Solutions

2.1 the palisade mesophyll.

2.2 they let carbon dioxide in and oxygen out (gas exchange).

3.1 B. Palisade cells are packed with chloroplasts near the top.

3.2 (a) a large surface area catches more light.

(b) the air spaces let gases (CO_2 and O_2) move easily to and from the cells.

3.3 the guard cells open and close the stomata to control gas exchange (and water loss).

3.4 (a) **Palisade mesophyll** — tall cells packed closely at the top of the leaf and full of chloroplasts; this puts the most chloroplasts where the light is strongest, so the maximum light is absorbed. **Spongy mesophyll** — loosely packed cells with large air spaces between them; gases can diffuse quickly to and from every cell. **Stomata** — pores that guard cells open and close; they let carbon dioxide in and oxygen out, and can close to reduce water loss when needed.

(b) The lower surface is shaded and cooler, so less water evaporates from stomata there than would be lost from the hot upper surface.

(c) Water arrives in the **xylem**; sugars leave in the **phloem**.

(d) Flat gives a large surface area to catch light and to exchange gases; thin means carbon dioxide has only a short distance to diffuse to reach the palisade cells.

9 A student wrote some statements about the palisade mesophyll and spongy mesophyll tissues.

- 1 The spongy mesophyll tissue is near the stomata for gas exchange.
- 2 Only palisade mesophyll cells have chloroplasts for photosynthesis.
- 3 Palisade cells are closely packed but there are air spaces in the spongy mesophyll tissue.

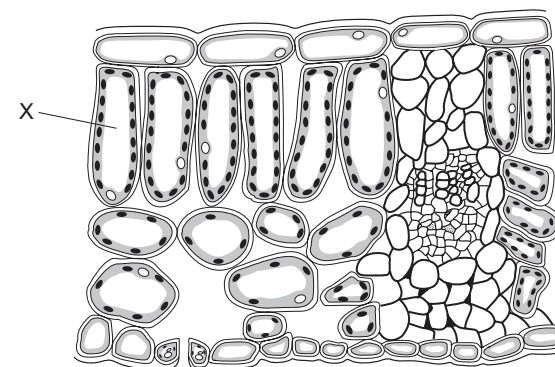
Which statements are correct descriptions of the two tissues?

- A 1, 2 and 3 B 1 and 2 only C 1 and 3 only D 2 and 3 only

8 Which descriptions of adaptations for photosynthesis are correct for spongy mesophyll tissue?

	air spaces for efficient gas exchange	long, rectangular cells to absorb light
A	yes	yes
B	yes	no
C	no	yes
D	no	no

10 The diagram shows a cross-section of part of a leaf.

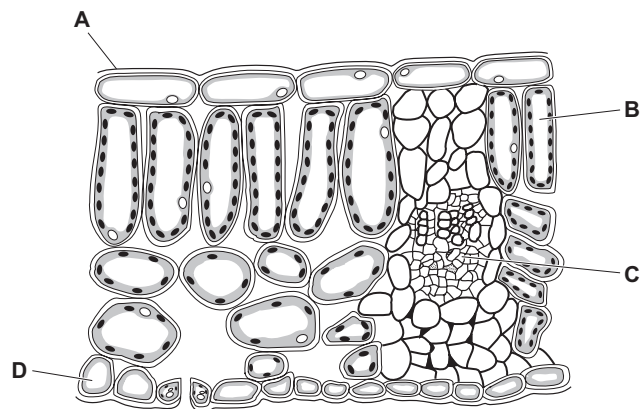


What is the cell labelled X?

- A epidermis
B guard cell
C palisade mesophyll
D spongy mesophyll

9 The diagram shows part of a cross-section of a leaf.

Which structure is a palisade mesophyll cell?



11 The photomicrograph shows part of the lower surface of a leaf.



What is the structure labelled X?

- A** guard cell
B palisade mesophyll cell
C spongy mesophyll cell
D xylem vessel

5 (a) Fig. 5.1 shows a cross-section of a leaf.

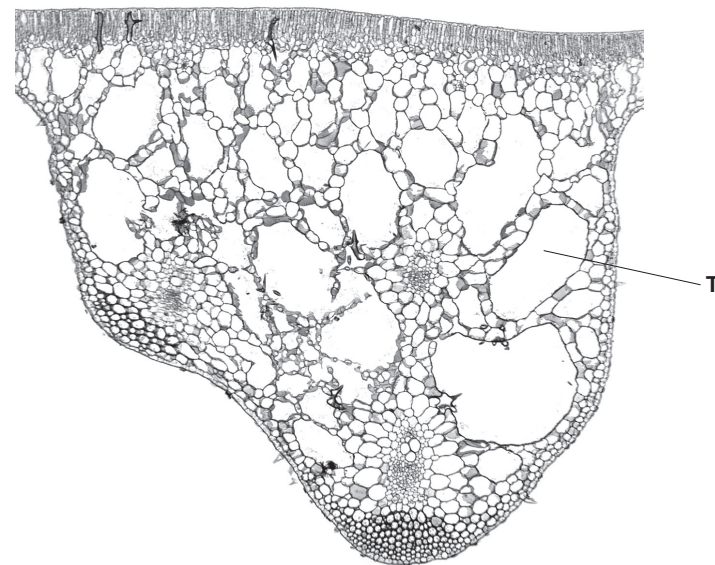


Fig. 5.1

- (i) On Fig. 5.1, draw a circle around **one** vascular bundle. [1]
- (ii) On Fig. 5.1, draw a label line and the letter **X** to identify the palisade mesophyll tissue. [1]
- (iii) State the name of the cell structure in palisade mesophyll cells where photosynthesis occurs. [1]
-
- (iv) Describe the functions of the tissues in a vascular bundle in a leaf.

10

(b) The leaf shown in Fig. 5.1 is from an aquatic plant adapted to live in water. The leaves float on the surface of the water.

(i) State the term used to describe plants that are adapted to live in water.

..... [1]

(ii) Identify feature **T** shown in Fig. 5.1 **and** explain how this feature adapts the leaf to float on the surface of the water.

feature **T**

explanation

.....

[2]

(iii) Explain **one** other adaptation of this group of aquatic plants.

.....

.....

..... [2]

[Total: 12]