

Plant structures and their functions practice questions

19 questions • 60 marks • mark scheme at the back

For Edexcel GCSE Combined Science 1SC0. **Higher tier** is only on the Higher paper.

Name

Total / 60

Photosynthesis and limiting factors Spec 6.1-6.6

1 Which of these describes why plants and algae are called producers? [1 mark]

- A. ☐ They absorb mineral ions from the soil
- B. ☐ They make their own food by photosynthesis
- C. ☐ They break down dead material
- D. ☐ They eat smaller organisms

2 Photosynthesis is an endothermic reaction. (a) State what is meant by an endothermic reaction. (1) (b) Name the source of energy for photosynthesis. (1) (c) Write the word equation for photosynthesis. (2) [4 marks]

3 A student measured the rate of photosynthesis of a plant at different light intensities. The rate increased until the light intensity reached 60 units. Above 60 units the rate did not increase. Explain why the rate stopped increasing above 60 units of light intensity. [3 marks]

- 4 The rate of photosynthesis falls sharply at temperatures above the optimum temperature. [3 marks]
Explain why.

- 5 **Higher tier** [3 marks]

The table shows the rate of photosynthesis of a plant at different light intensities, at two temperatures. The carbon dioxide concentration was the same in both investigations. Explain what the data show about the limiting factors of photosynthesis at 20 °C.

Rate of photosynthesis at two temperatures		
Light intensity (units)	Rate at 20 °C (arbitrary units)	Rate at 30 °C (arbitrary units)
20	10	10
40	20	20
60	25	30
80	25	40

- 6 **Higher tier** [3 marks]

A lamp is 10 cm from a piece of pondweed. At this distance the light intensity is 400 units and the pondweed releases 24 bubbles of oxygen per minute. Light is the limiting factor. The lamp is moved to 20 cm from the pondweed. (a) Calculate the light intensity at 20 cm. (2) (b) Predict the number of bubbles released per minute at 20 cm. (1)

Answer =

11 Compare the structure and function of xylem and phloem. (3)

[3 marks]

12 Describe how water moves from the soil to the air through a plant. (4)

[4 marks]

13 A plant is short of water. Explain why its stomata close. (2)

[2 marks]

14 Describe translocation and explain why it requires energy. (3)

[3 marks]

- 15** Explain how the structures of the xylem and the phloem are adapted to their functions in a plant. (6) **[6 marks]**

[illegible]

Leaves, water uptake and extreme environments Spec 6.11B–6.14B

- 16** Explain why a plant loses water faster on a windy day than on a still day. (2) **[2 marks]**

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- 17** A student used a potometer to measure water uptake. In three repeats, the air bubble moved 45 mm, 41 mm and 49 mm in 5 minutes. Calculate the mean rate of water uptake in mm per minute. (3) **[3 marks]**

Answer =

[illegible]

- 18** A leafy shoot has a mass of 40.0 g. After one day, its mass is 37.0 g. Calculate the percentage loss of mass. (2) **[2 marks]**

Answer =

19 Explain how light intensity, air movement and temperature affect the rate of water uptake by a plant. (6) **[6 marks]**

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Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

B B

2. [4]

- takes in energy from the surroundings (1) allow transfers energy from the surroundings
- light (1) allow sunlight, light energy
- carbon dioxide + water (1) allow reactants in either order
- → glucose + oxygen (1) allow products in either order

3. [3]

- light is no longer the limiting factor (1)
- another factor is limiting the rate (1)
- carbon dioxide concentration or temperature (1) allow named factor in a correct explanation, e.g. there is not enough carbon dioxide / it is too cold

4. [3]

- photosynthesis is controlled by enzymes (1)
- the (active site of the) enzymes changes shape / the enzymes are denatured (1)
- the substrate cannot fit / bind to the enzyme so the reaction is slower (1) allow fewer enzyme-substrate complexes form

5. [3] **Higher tier**

- at low light intensity (20 to 40 units) light intensity is the limiting factor (1) allow because the rate increases with light intensity and is the same at both temperatures
- above 60 units the rate at 20 °C stops increasing / levels off at 25 (1) allow from 60 units the rate at 20 °C is lower than at 30 °C
- so temperature is now the limiting factor (1) allow because the rate is higher at 30 °C, so a temperature of 20 °C is limiting; do not accept carbon dioxide (it was kept the same)

6. [3] **Higher tier**

- distance doubled so intensity is $\div 2^2$ ($\div 4$) (1)
- $400 \div 4 = 100$ units (1)
- $24 \div 4 = 6$ bubbles per minute (1) allow ecf from (a) for the same factor of reduction

7. [6]

Level 3 5-6	A clear, logical method that includes how light intensity is changed, how the rate is measured and how at least two other variables are controlled. Includes repeats or a mean. Scientific terms are used correctly.
Level 2 3-4	A method that states how light intensity is changed and how the rate is measured, with some attempt to control variables or repeat readings. There may be some gaps in the order or detail.
Level 1 1-2	A basic outline with few correct details, for example putting a lamp near a plant and counting bubbles. Little or no control of variables.

Indicative content

- place pondweed in a beaker of water with sodium hydrogencarbonate (to supply carbon dioxide)
- use a lamp at measured distances from the plant (e.g. 10, 20, 30, 40, 50 cm) to change light intensity
- count the bubbles of oxygen released in a set time, e.g. 1 minute, or collect and measure the volume of gas
- leave the plant to adjust at each distance before counting
- control temperature (heat shield / water bath), carbon dioxide concentration, the plant and other light sources
- repeat at each distance and calculate a mean
- safety: keep the lamp and cable away from the water

8. [1]

C C

9. [4]

- has a long thin projection / root hair (1)
- gives a large surface area for absorption (1)
- has many mitochondria (1)
- to release energy by respiration for active transport of mineral ions (1)
- has a thin cell wall (1)
- short distance for water / mineral ions to cross (1)
- cell sap is more concentrated than the soil water (1)
- so water enters by osmosis (1)
- Max 4: award each explanation mark only when linked to its adaptation

10. [1]

B B

11. [3]

- xylem is made of dead cells whereas phloem is made of living cells (1)
- xylem carries water and mineral ions whereas phloem carries sucrose (1)
- xylem walls are lignified whereas phloem cells have sieve plates / companion cells (1) allow phloem needs energy but xylem does not

12. [4]

- water enters the root hair cells (by osmosis) (1)
- water moves up through the xylem (1)
- water evaporates from the (surface of) cells in the leaf (1)
- water vapour diffuses out through the stomata (1)

13. [2]

- guard cells lose water / become limp (1)
- reduces water loss by transpiration / evaporation (1) allow stops the plant drying out

14. [3]

- transport of sucrose (1)
- from the leaves to the parts of the plant that use or store it / to growing regions (1) allow in the phloem
- phloem is made of living cells that use energy from respiration (1)

15. [6]

Level 3 5-6	A detailed explanation covering both tissues, linking structure to function for each, including lignin and dead cells in xylem and living cells using energy in phloem. Scientific terms are used accurately.
Level 2 3-4	Some correct structures are linked to the function of both tissues, or a detailed explanation of one tissue and a limited one of the other.
Level 1 1-2	Simple statements about what xylem and phloem carry, with little or no link to structure.

Indicative content

- xylem carries water and mineral ions from the roots to the rest of the plant
- xylem cells are dead, with no cytoplasm or end walls, forming a continuous hollow tube so water flows easily
- walls are lignified, which strengthens them and stops the tubes from collapsing / supports the plant
- phloem carries sucrose (translocation) around the plant
- phloem is made of living cells, which use energy from respiration to transport sucrose
- sieve plates (holes in the end walls) allow sucrose to move from cell to cell
- companion cells have many mitochondria to release the energy needed

16. [2]

- moving air carries away water vapour from around the stomata / leaf (1)
- so the concentration gradient is steeper / water vapour diffuses out faster (1)

17. [3]

- $(45 + 41 + 49) \div 3 = 45 \text{ mm}$ (1)
- $45 \div 5$ (1)
- 9 mm per minute (1) allow 9.0; allow correct answer with unit for 3 marks; allow ecf from an incorrect mean

18. [2]

- $(40.0 - 37.0) \div 40.0 \times 100$ (1)
- 7.5% (1) allow correct answer with no working for 2 marks

19. [6]

Level 3 5-6	All three factors are covered with the correct effect on water uptake and a clear explanation linked to stomata, evaporation or the concentration gradient. Scientific terms are used accurately.
Level 2 3-4	The effect of two or three factors is stated, with some correct explanation.
Level 1 1-2	The effect of one or two factors is stated with little or no explanation.

Indicative content

- increasing light intensity increases the rate of water uptake because stomata open in the light
- more water vapour diffuses out of the leaf, so more water is pulled up the xylem
- increasing air movement increases the rate because water vapour is carried away from the leaf
- this keeps a steeper concentration gradient so water vapour diffuses out faster
- increasing temperature increases the rate because water evaporates faster from the cells
- water vapour particles also move faster, so diffusion out through the stomata is faster