

Photosynthesis and limiting factors: practice questions

7 questions • 23 marks • mark scheme at the back

For Edexcel GCSE Biology 1BI0 and Combined Science 1SC0. **Triple only** is not in Combined Science. **Higher tier** is only on the Higher paper.

Name

Total / 23

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 =

[6 marks]

[illegible]

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