AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 4.4.1.2

Rate of photosynthesis

Past-paper questions

Tier	**Foundation**
Question groups	**7**
Available paper years	**2018–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.4.1.2 Rate of photosynthesis

Question 01

June 2018 | 8464/B/1F | Original Q2

0 2 This question is about photosynthesis.

0 2 . 1 What are the **two** products of photosynthesis?

[2 marks]

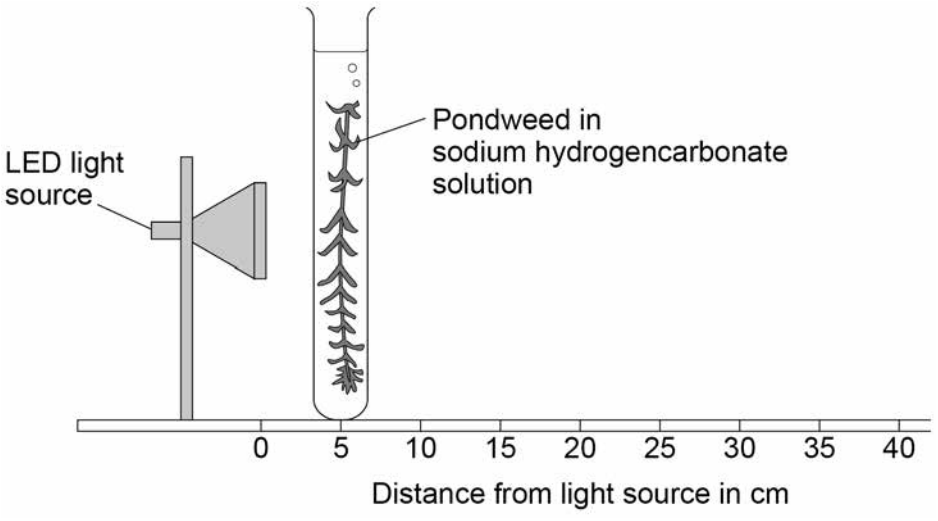
Tick **two** boxes.

- Carbon dioxide ☐
- Chlorophyll ☐
- Glucose ☐
- Oxygen ☐
- Water ☐

A student investigated the effect of light intensity on the rate of photosynthesis.

Figure 4 shows the apparatus.

Figure 4



This is the method used.

1. Place the pondweed at 5 cm from the light source.
2. Measure the rate of photosynthesis by counting the number of bubbles produced in 30 seconds.
3. Repeat the investigation with the pondweed at different distances from the light source.

4.4.1.2 Rate of photosynthesis

Question 01 · continued

0 2 . 2 How could the student measure the rate of photosynthesis more accurately?

[2 marks]

Tick **two** boxes.

- Count the number of bubbles produced in 1 minute ☐
- Measure the change in mass of the pondweed in 30 seconds ☐
- Measure the volume of gas produced in 30 seconds ☐
- Place the pondweed further from the light source ☐
- Use water instead of sodium hydrogencarbonate solution ☐

0 2 . 3 The LED light source does **not** get hot.

Why is this important?

[1 mark]

Table 1 shows the student's results.

Table 1

Distance of light source from pondweed in cm	Number of bubbles produced in 30 seconds
5	40
10	13
15	5
20	2
25	1
30	0

4.4.1.2 Rate of photosynthesis

Question 01 · continued

0 2 . 4 Calculate the number of bubbles produced in 2 minutes when the light source was 10 cm from the pondweed.

[1 mark]

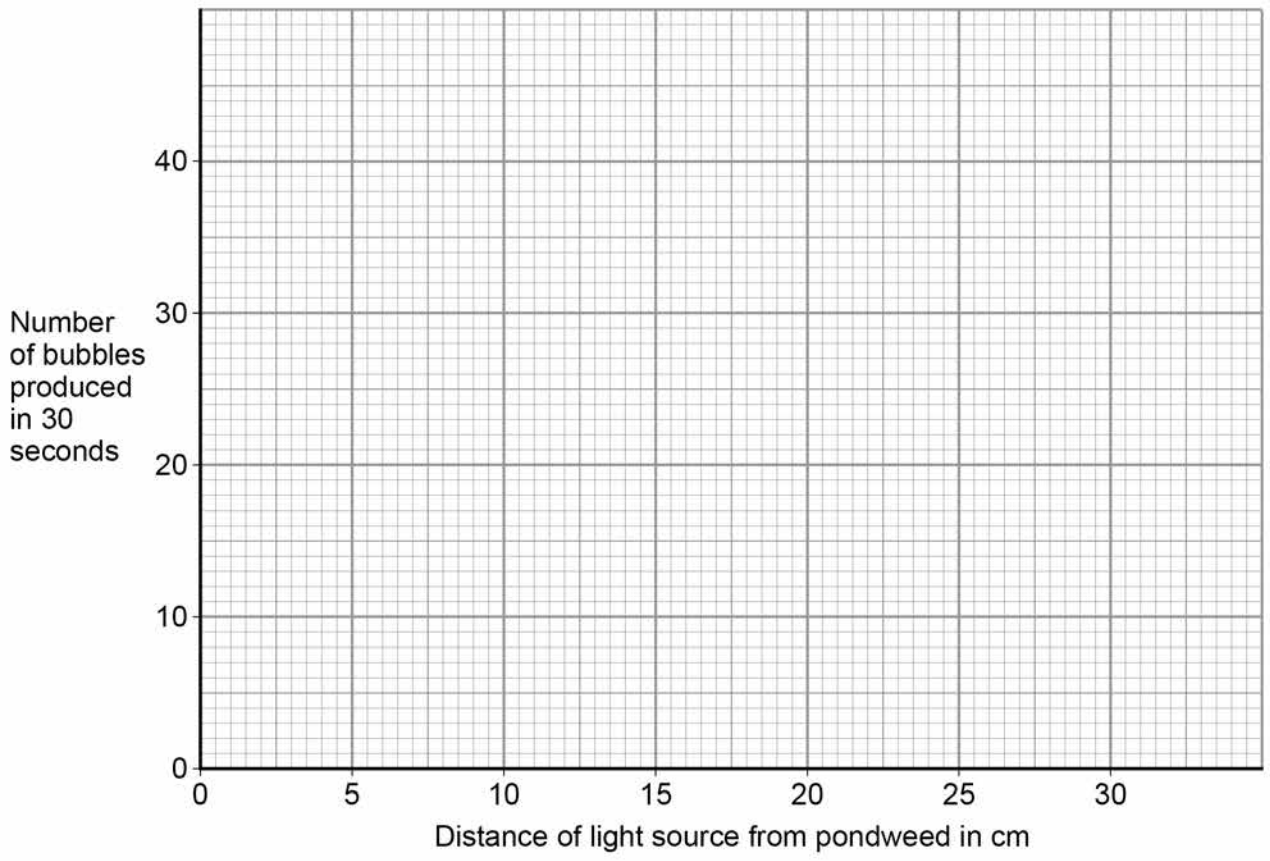
Number of bubbles produced in 2 minutes = _____

0 2 . 5 Plot the data from **Table 1** on **Figure 5**

Draw a line of best fit.

[3 marks]

Figure 5



0 2 . 6 Give **one** conclusion that can be made from these results.

[1 mark]

10

4.4.1.2 Rate of photosynthesis

Question 02

0 6 Many biotic and abiotic factors can affect the growth of plants.

0 6 . 1 Are the factors in **Table 6** biotic or abiotic?

[2 marks]

Tick **one** box for each factor.

Table 6

Factor	Biotic	Abiotic
Diseases		
Herbivores		
Temperature		
Water		

Two students investigated the effect of light intensity on the distribution of small plants.

The plants are growing under a tree in a park.

The students made the following hypothesis:

‘As you move outwards from a tree there will be more plant growth.’

0 6 . 2 Explain why the students thought their hypothesis would be correct.

[3 marks]

4.4.1.2 Rate of photosynthesis

Question 02 · continued

0 6 . 3 The students used two pieces of equipment.

Give the scientific name of each piece of equipment.

[2 marks]

A square frame measuring 0.5 m × 0.5 m _____

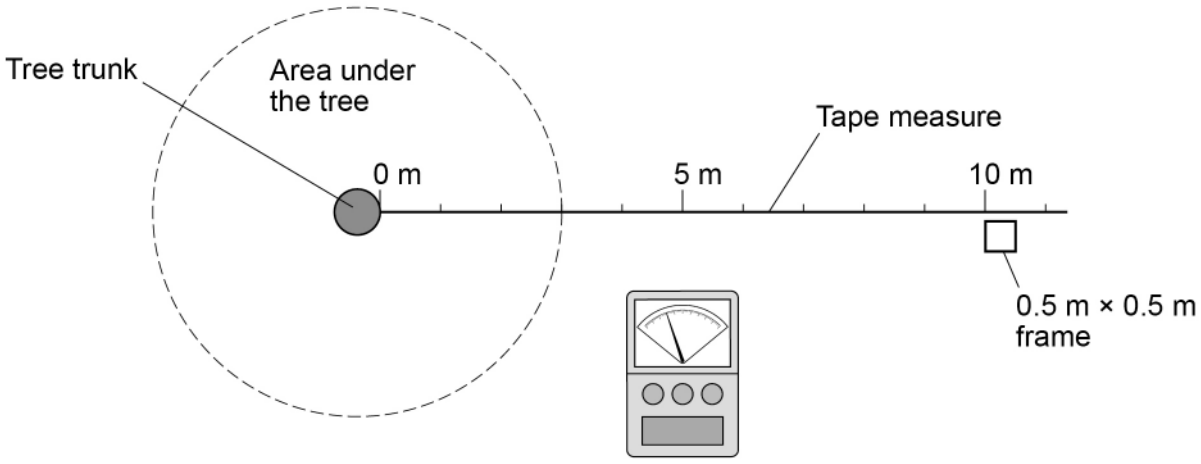
An electronic device to measure light intensity _____

This is the method used.

1. Fix one end of a tape measure at the base of the tree.
2. Fix the other end of the tape measure 11 metres from the tree.
3. At 0 metres put the square frame on the ground.
4. Identify all the plant species growing inside the frame.
5. Estimate and record the percentage cover of each plant species.
6. Measure the light intensity inside the frame.
7. Put the square frame on the ground every 2 metres along the tape to 10 metres.
8. Repeat steps 4 – 6 in every frame.

Figure 9 shows the equipment in this investigation.

Figure 9



0 6 . 4 Calculate the total area sampled.

[1 mark]

_____

_____

Total area sampled = _____ m^2

4.4.1.2 Rate of photosynthesis

Question 02 · continued

0 6 . 5 The whole investigation was done as quickly as possible on the same day.

Suggest **one** reason why.

[1 mark]

0 6 . 6 Give **one** way the investigation could be improved.

[1 mark]

Table 7 shows the results.

Table 7

	Distance from tree in metres					
	0	**2**	**4**	**6**	**8**	**10**
Percentage cover of grass	15	50	35	16	15	15
Percentage cover of plantain	0	5	10	40	25	30
Percentage cover of daisy	0	0	0	4	20	10
Percentage cover of clover	1	10	25	40	40	45
Total percentage cover of plants	16	65	70	100	100	100
Light intensity in arbitrary units	37	59	150	175	>200	>200

0 6 . 7 Which plant species in **Table 7** will only grow at high light intensity?

[1 mark]

4.4.1.2 Rate of photosynthesis

Question 02 · continued

0 6 . 8 What conclusion can be made about the relationship between light intensity and the total percentage cover of plants?

Use data from **Table 7** in your answer.

[2 marks]

0 6 . 9 Light intensity might **not** be the cause of this pattern of plant distribution.

Suggest **one** different factor that may cause these results.

Give **one** reason for your answer.

[2 marks]

Factor

Reason

15

4.4.1.2 Rate of photosynthesis

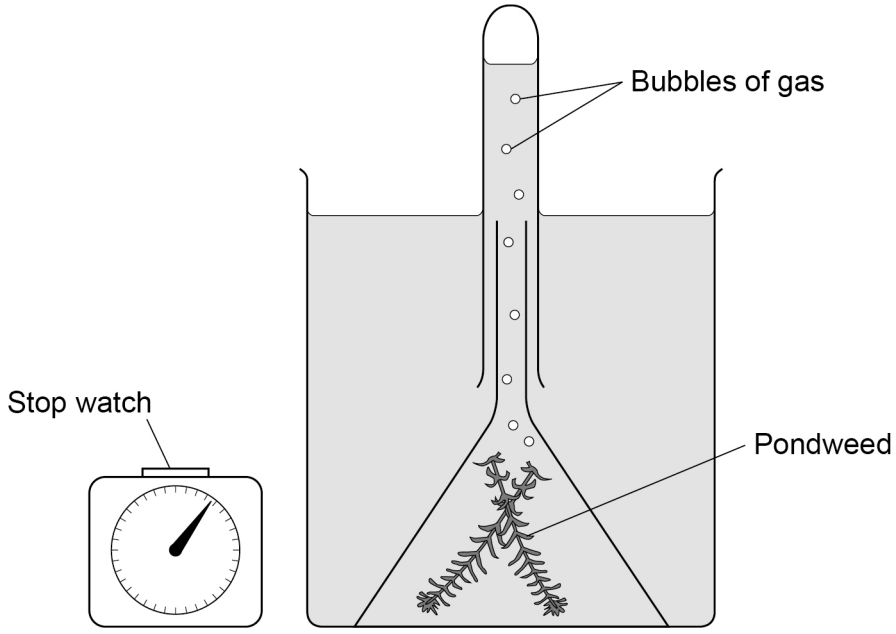
Question 03

June 2019 | 8464/B/1F | Original Q1

0 1 A student investigated the effect of light intensity on the rate of photosynthesis.

Figure 1 shows some of the apparatus used.

Figure 1



0 1 . 1 Name the gas produced by the pondweed in the light.

[1 mark]

0 1 . 2 Describe **one** way the student could change the intensity of light reaching the pondweed.

[2 marks]

4.4.1.2 Rate of photosynthesis

Question 03 · continued

0 1 . 3 Describe how the student could use the apparatus in **Figure 1** to measure the rate of photosynthesis.

[2 marks]

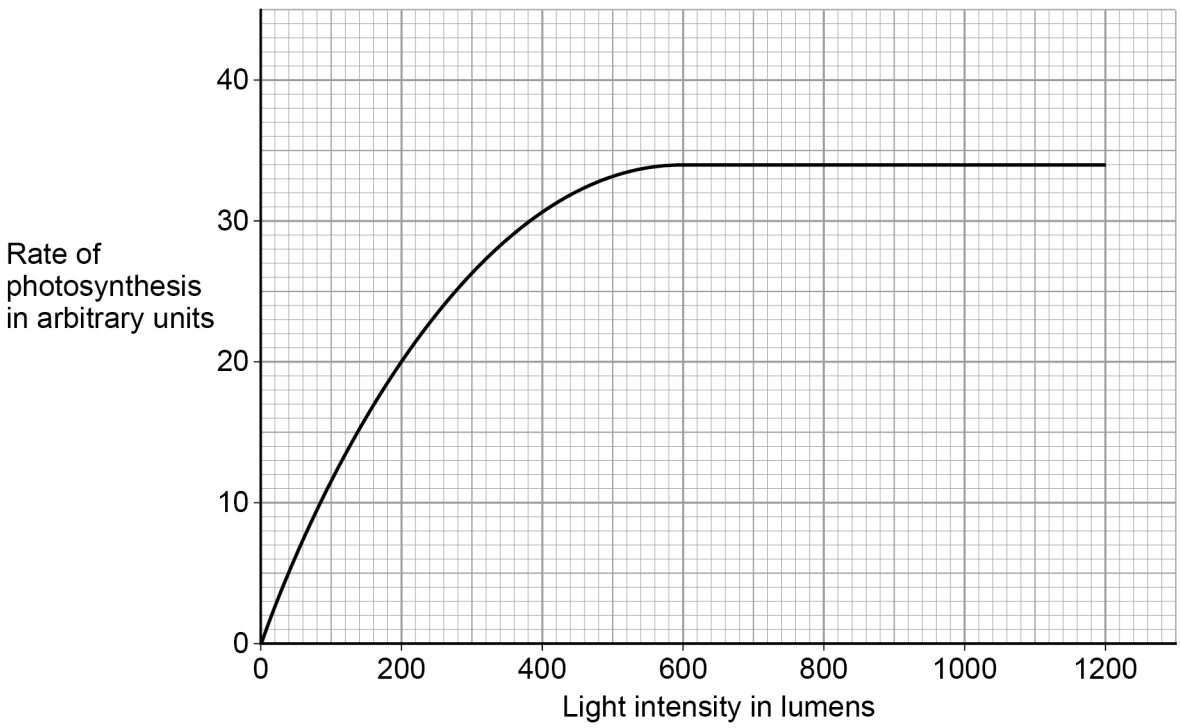
Question 1 continues on the next page

4.4.1.2 Rate of photosynthesis

Question 03 · continued

Figure 2 shows the student's results.

Figure 2



0 1 . 4 What was the maximum rate of photosynthesis?

[1 mark]

Maximum rate = _____ arbitrary units

4.4.1.2 Rate of photosynthesis

Question 03 · continued

0 1 . 5 At which light intensity was light a limiting factor?

[1 mark]

Tick (✓) **one** box.

200 lumens ☐

600 lumens ☐

1200 lumens ☐

0 1 . 6 Light intensity can affect the rate of photosynthesis.

Give **one** other factor that can affect the rate of photosynthesis.

[1 mark]

_____

8

4.4.1.2 Rate of photosynthesis

Question 04

November 2021 | 8464/B/1F | Original Q5

0 5 Plants absorb light for photosynthesis.

0 5 . 1 Which is the equation for photosynthesis?

[1 mark]

Tick (✓) **one** box.

$C_6H_{12}O_6 + 6\,O_2 \rightarrow 6\,CO_2 + 6\,H_2O$ ☐

$6\,CO_2 + 6\,H_2O \rightarrow C_6H_{12}O_6 + 6\,O_2$ ☐

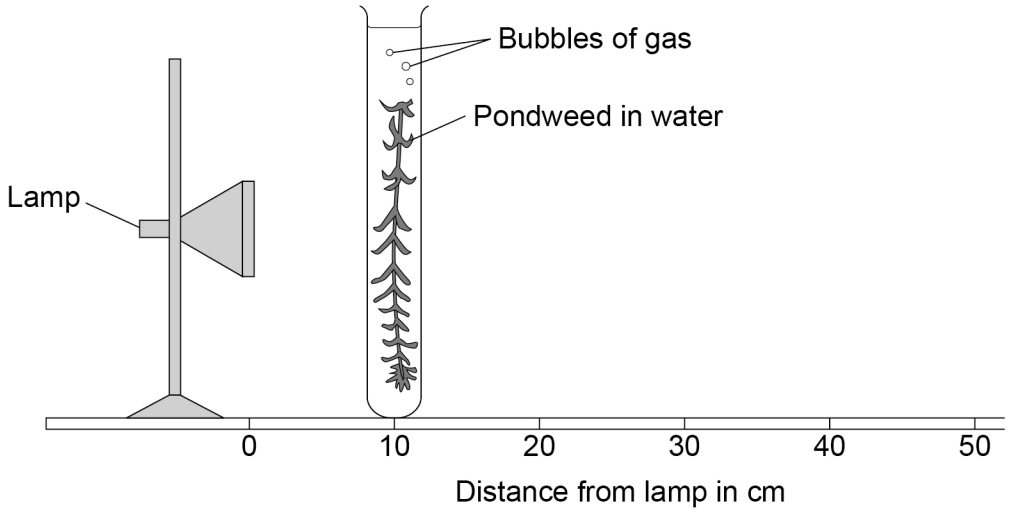
$6\,H_2O + 6\,O_2 \rightarrow C_6H_{12}O_6 + 6\,CO_2$ ☐

$6\,O_2 + 6\,CO_2 \rightarrow C_6H_{12}O_6 + 6\,H_2O$ ☐

A student investigated the effect of light intensity on the rate of photosynthesis.

Figure 6 shows the apparatus.

Figure 6



4.4.1.2 Rate of photosynthesis

Question 04 · continued

This is the method used.

1. Set up the apparatus as shown in **Figure 6**.
2. Place the pondweed 10 cm away from the lamp.
3. Switch on the lamp.
4. Record the number of bubbles of gas produced in 5 minutes.
5. Repeat steps 2 to 4 with the pondweed at different distances from the lamp.

0 5 . 2 What was the independent variable in this investigation?

[1 mark]

Tick (✓) **one** box.

- Distance of the pondweed from the lamp ☐
- Length of the piece of pondweed ☐
- Number of bubbles of gas produced ☐
- Time taken to collect the gas ☐

Question 5 continues on the next page

4.4.1.2 Rate of photosynthesis

Question 04 · continued

The lamp gets warm when it is on. This causes the temperature of the water to increase.

0 5 . 3 Explain how an increase in temperature would affect the results of this investigation.

[2 marks]

0 5 . 4 Suggest **one** way the investigation could be improved so the temperature of the water does **not** increase.

[1 mark]

0 5 . 5 Suggest **two** improvements to the investigation so the results would be more valid.

Do **not** refer to controlling the temperature of the water.

[2 marks]

1

2

4.4.1.2 Rate of photosynthesis

Question 04 · continued

Table 2 shows the results.

Table 2

Distance of pondweed from the lamp in cm	Number of bubbles of gas produced in 5 minutes
10	120
20	56
30	31
40	16
50	10

0 5 . 6 Calculate the rate of photosynthesis when the pondweed was 40 cm from the lamp.

Give the rate of photosynthesis as the number of bubbles of gas produced per minute.

[1 mark]

Rate = _____ bubbles of gas produced per minute

0 5 . 7 Give **one** conclusion that can be made from **Table 2**.

[1 mark]

4.4.1.2 Rate of photosynthesis

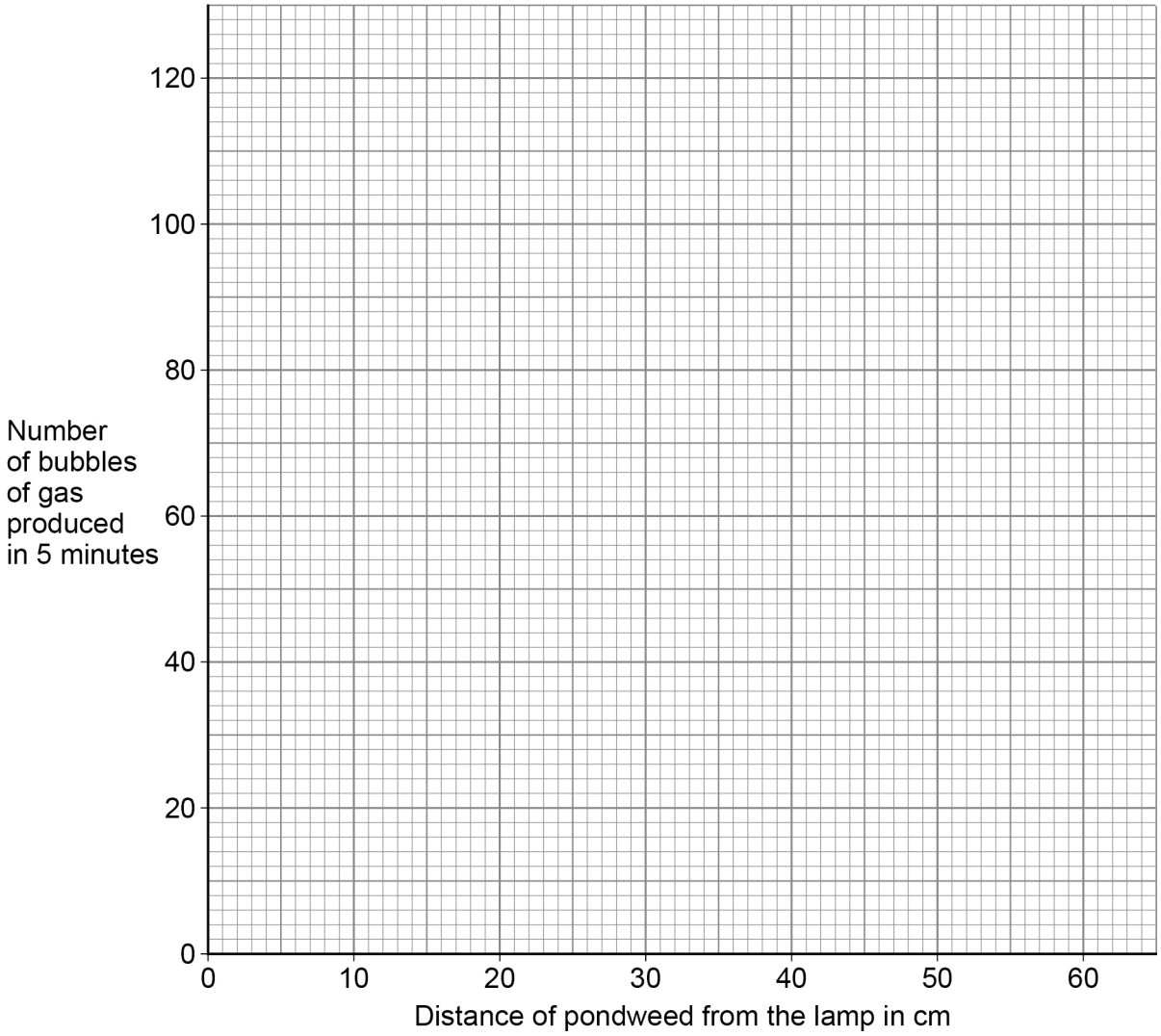
Question 04 · continued

0 5 . 8 Plot the data from **Table 2** on **Figure 7**.

Draw a line of best fit.

[3 marks]

Figure 7



0 5 . 9 Predict the number of bubbles that would be produced in 5 minutes if the pondweed was 60 cm from the lamp.

Use **Figure 7**.

[1 mark]

Number of bubbles produced in 5 minutes = _____

13

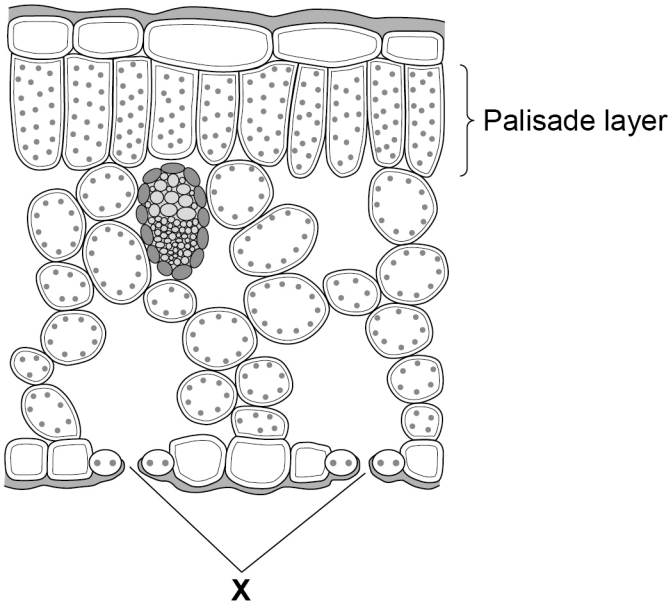
4.4.1.2 Rate of photosynthesis

Question 05

June 2022 | 8464/B/1F | Original Q2

0 2 **Figure 2** shows a section through a leaf.

Figure 2



0 2 . 1 Give **one** way that the palisade layer is adapted for photosynthesis.

[1 mark]

0 2 . 2 Gases pass into and out of the leaf through small pores in the surface of the leaf.

What are the small pores labelled **X** called?

[1 mark]

Tick (✓) **one** box.

Guard cells ☐

Stomata ☐

Xylem vessels ☐

0 2 . 3 A student viewed a section of a leaf using a microscope.

The student measured the length of one of the palisade cells.

The cell image measured 28 mm in length when viewed at a magnification of ×400

Calculate the real length of the palisade cell in millimetres (mm).

Use the equation:

$$\text{real length} = \frac{\text{image length}}{\text{magnification}}$$

[3 marks]

Real length = _____ mm

Convert the real length of the cell from millimetres to micrometres (μm).

1 mm = 1000 μm

Real length = _____ μm

0 2 . 4 Carbon dioxide can move into and out of cells.

What is the process by which carbon dioxide can move into and out of cells?

[1 mark]

Tick (✓) **one** box.

- Active transport ☐
- Diffusion ☐
- Osmosis ☐

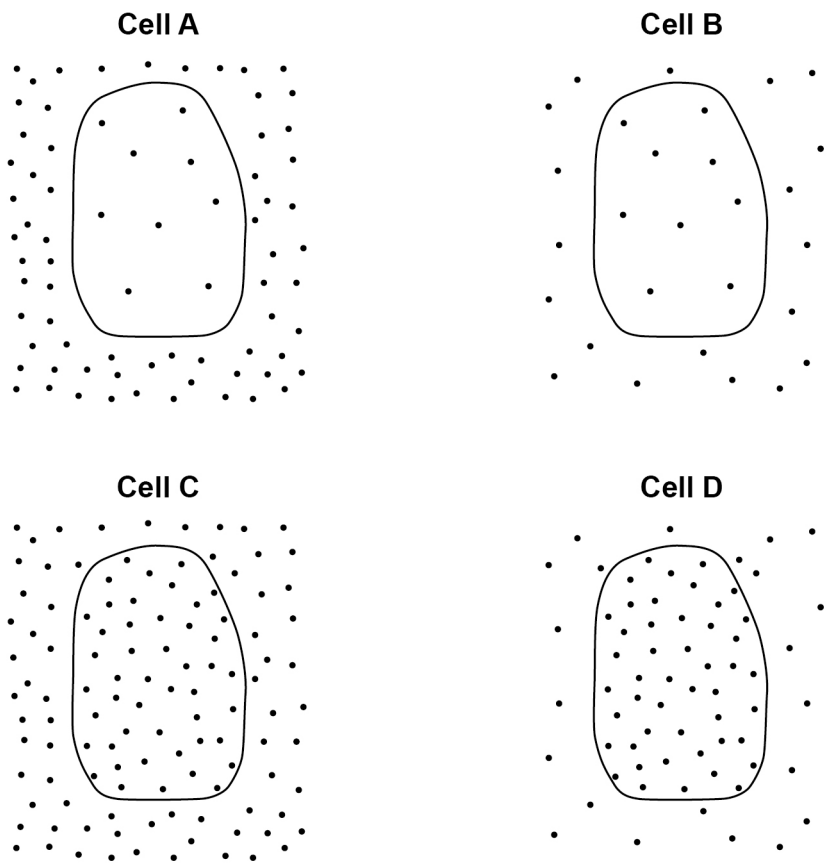
4.4.1.2 Rate of photosynthesis

Question 05 · continued

Figure 3 shows a diagram of four cells.

Each cell is surrounded by carbon dioxide molecules.

Figure 3



Key

• Carbon dioxide molecule

0 2 . 5 Which cell will carbon dioxide move into at the fastest rate?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Reason _____

_____

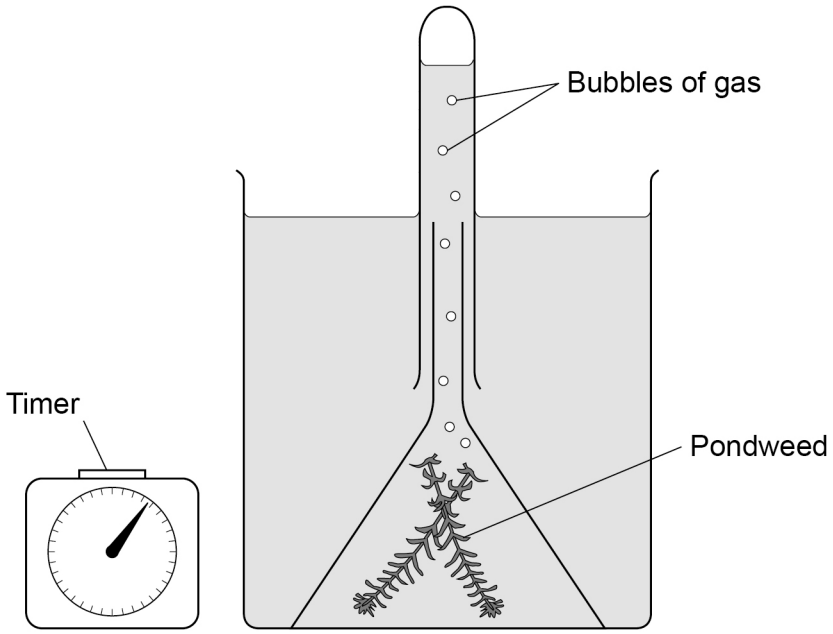
4.4.1.2 Rate of photosynthesis

Question 05 · continued

A student investigated the effect of different colours of light on the rate of photosynthesis.

Figure 4 shows some of the apparatus the student used.

Figure 4



The student placed the apparatus in blue light, then in green light and then in red light.

The student measured the rate of photosynthesis in each colour of light.

0 2 . 6 What **two** measurements should the student make to calculate the **rate** of photosynthesis?

[2 marks]

1 _____

2 _____

Question 2 continues on the next page

4.4.1.2 Rate of photosynthesis

Question 05 · continued

0 2 . 7 Give **two** variables the student should keep the same in this investigation.

[2 marks]

1 _____

_____

2 _____

_____

Table 2 shows the results.

Table 2

Colour of light	Rate of photosynthesis in arbitrary units
Blue	9
Green	1
Red	8

4.4.1.2 Rate of photosynthesis

Question 05 · continued

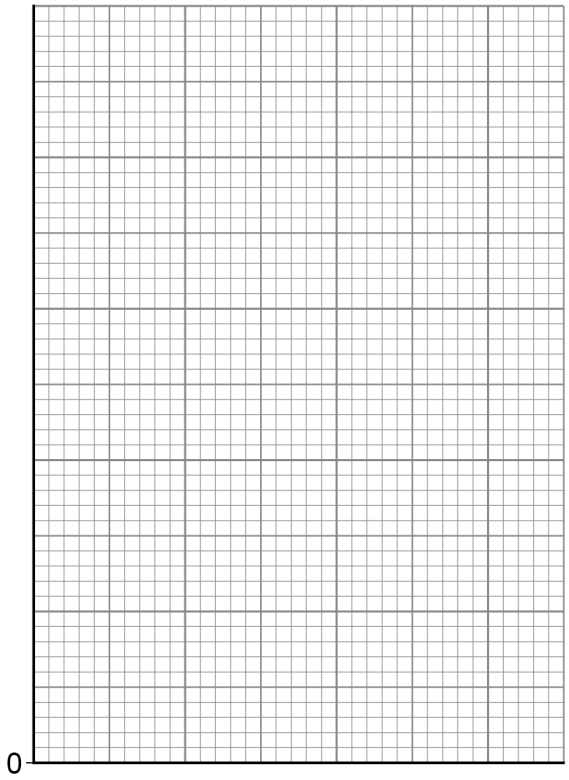
0 2 . 8 Complete **Figure 5**.

You should:

- label the y-axis
- use a suitable scale
- plot the data from **Table 2** as a bar chart
- label each bar.

[4 marks]

Figure 5



0 2 . 9 Look at **Table 2**.

What colour of light should be used to grow plants in a greenhouse?

[1 mark]

Tick (✓) **one** box.

Blue ☐ Green ☐ Red ☐

17

4.4.1.2 Rate of photosynthesis

Question 06

June 2024 | 8464/B/1F | Original Q5

0 5 This question is about photosynthesis.

0 5 . 1 Complete the equation for photosynthesis.

Choose answers from the box.

[2 marks]

nitrogen	**oxygen**	**ethanol**	**water**

carbon dioxide + _____ $\xrightarrow{\text{light}}$ glucose + _____

0 5 . 2 What is the chemical formula for glucose?

[1 mark]

Tick (✓) **one** box.

CO_2 ☐ $C_6H_{12}O_6$ ☐ H_2O ☐ O_2 ☐

0 5 . 3 Give **two** ways plants use the glucose produced by photosynthesis.

[2 marks]

1 _____

_____

2 _____

_____

4.4.1.2 Rate of photosynthesis

Question 06 · continued

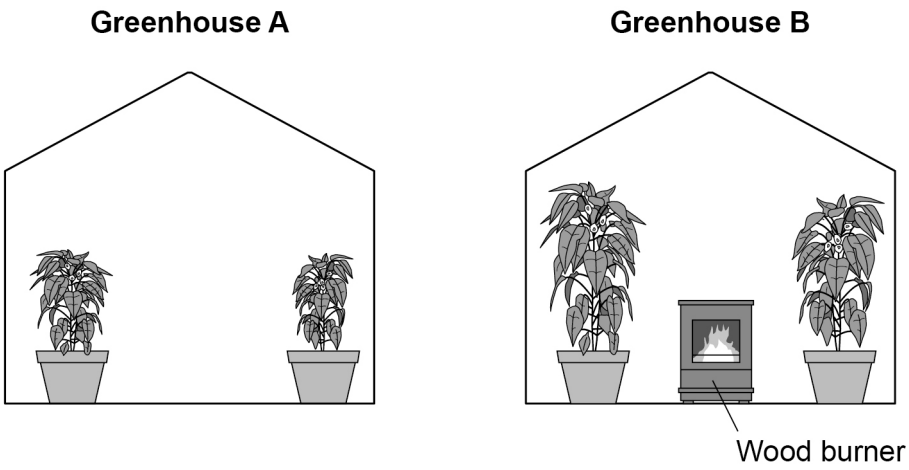
0 5 . 4 A person has two greenhouses.

In each greenhouse, the plants:

- are all the same type
- receive the same intensity of light and the same volume of water
- grow in the same type of soil.

Figure 7 shows the greenhouses.

Figure 7



The person burns logs in the wood burner in greenhouse **B**.

Explain why the plants in greenhouse **B** grow faster than the plants in greenhouse **A**.

[4 marks]

9

4.4.1.2 Rate of photosynthesis

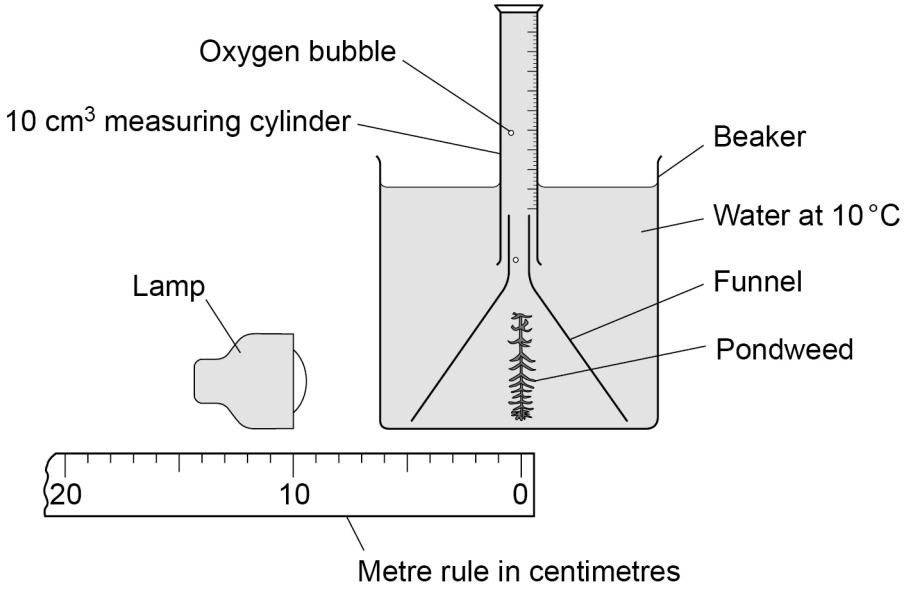
Question 07

0 2 Photosynthesis is important for plant growth.

A student used pondweed to investigate photosynthesis.

Figure 3 shows the apparatus used.

Figure 3



This is the method used.

1. Set up the apparatus as shown in **Figure 3**.
2. Switch on the lamp.
3. After 1 hour, record the volume of oxygen collected in the measuring cylinder.
4. Repeat steps 1 to 3 a further four times, placing the lamp at different distances from the pondweed.

4.4.1.2 Rate of photosynthesis

Question 07 · continued

0 2 . 1 What are **two** control variables the student should use in the investigation?

[2 marks]

Tick (✓) **two** boxes.

- The distance of the lamp from the pondweed. ☐
- The length of the pondweed. ☐
- The size of the beaker. ☐
- The temperature of the water. ☐
- The volume of oxygen collected. ☐

Table 2 shows the results.

Table 2

Distance of the lamp from the pondweed in cm	Volume of oxygen in cm^3
10	
20	1.0
30	0.4
40	0.2
50	0.0

0 2 . 2 Describe the trend shown in **Table 2**.

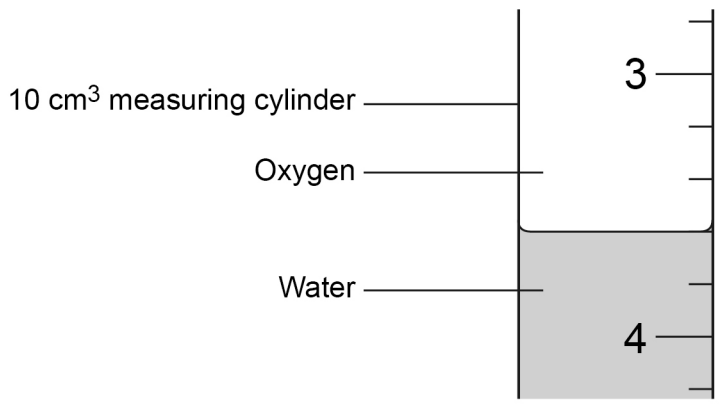
[1 mark]

4.4.1.2 Rate of photosynthesis

Question 07 · continued

0 2 . 3 **Figure 4** shows the volume of oxygen when the lamp was 10 cm from the pondweed.

Figure 4



What volume of oxygen is shown in **Figure 4**?

[1 mark]

Volume = _____ cm^3

4.4.1.2 Rate of photosynthesis

Question 07 · continued

0 2 . 4 The student repeated the investigation using a measuring cylinder with smaller intervals of 0.1 cm^3.

What did using smaller intervals improve?

[1 mark]

Tick (✓) **one** box.

Accuracy ☐

Repeatability ☐

Reproducibility ☐

0 2 . 5 The student did the investigation at 10 °C.

The student repeated the investigation at 20 °C.

Complete the sentence.

Choose the answer from the box.

[2 marks]

smaller	**the same**	**greater**

Compared to the results at 10 °C, the volumes of oxygen collected

in one hour at 20 °C would be _____.

Give a reason for your answer.

_____

_____

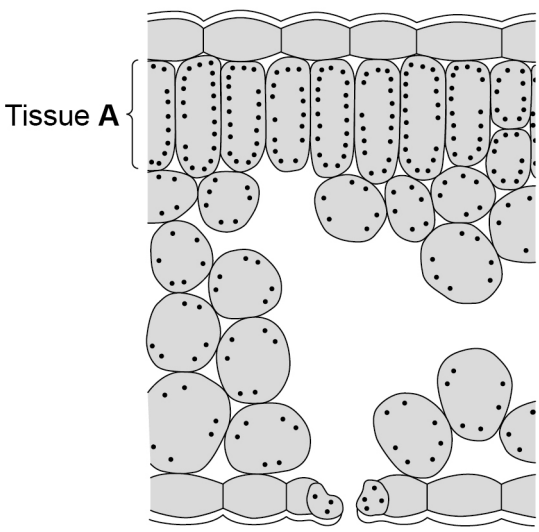
4.4.1.2 Rate of photosynthesis

Question 07 · continued

Photosynthesis is important for apple trees.

Figure 5 shows a section through the leaf of an apple tree.

Figure 5



0 2 . 6 What is tissue **A**?

[1 mark]

Tick (✓) **one** box.

Epidermis ☐

Palisade mesophyll ☐

Spongy mesophyll ☐

0 2 . 7 The cells in tissue **A** contain chloroplasts.

What is the name of the green chemical in chloroplasts?

[1 mark]

_____

4.4.1.2 Rate of photosynthesis

Question 07 · continued

Apple scab is a disease of apple trees.

Apple scab is caused by a fungus.

Figure 6 shows a leaf from an apple tree infected with apple scab fungus.

Figure 6



0 2 . 8 How could the fungal infection be removed from the tree?

[1 mark]

Tick (✓) **one** box.

Destroy the affected leaves. ☐

Spray the affected leaves with antibiotics. ☐

Use an antitoxin on the affected leaves. ☐

Question 2 continues on the next page

4.4.1.2 Rate of photosynthesis

Question 07 · continued

0 2 . 9 Infection with apple scab fungus decreases the number of chloroplasts in the leaves.

Explain why apple trees with apple scab fungus produce smaller apples than apple trees that are **not** infected.

[3 marks]

13