

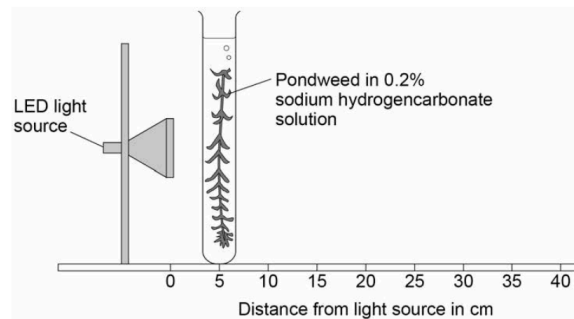
Rate of photosynthesis (required practical)

Q1. (2018)

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

Figure 5 shows the apparatus used.

Figure 5



Sodium hydrogencarbonate solution releases carbon dioxide gas for the pondweed.

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 1 minute.
3. Repeat with the pondweed at 10 cm and at 20 cm from the light source.

A)

0 3 . 3

Counting the number of bubbles produced in 1 minute is **not** an accurate way to measure the rate of photosynthesis.

Suggest **two** ways the method could be improved to measure the rate of photosynthesis more accurately.

[2 marks]

- 1 _____

- 2 _____

B)

0 3 . 4

The LED light source does **not** get hot.

Explain why it is important that the pondweed remains at a constant temperature.

[2 marks]

C)

0 3 . 5

Light intensity can be calculated using the inverse square law:

$$I \propto \frac{1}{d^2}$$

Where I is light intensity and d is the distance of the pondweed from the light source.

The student placed the pondweed at 5, 10 and 20 cm from the light source.

Explain how light intensity changes as the distance of the pondweed from the light source is doubled.

You **must** include calculations in your answer.

[3 marks]

D)

0 3 . 6 The student's results are shown in **Table 1**

Table 1

Distance of the pondweed from the light source in cm	Number of bubbles produced in 1 minute
5	129
10	31
20	8

Predict how many bubbles of gas would be produced in 1 minute if the pondweed was placed 40 cm from the light source.

Give a reason for your prediction.

[2 marks]

E)

0 3 . 7 Describe how the student could change the method to investigate the effect of carbon dioxide concentration on the rate of photosynthesis.

You should include:

- how to change the independent variable
- **two** control variables.

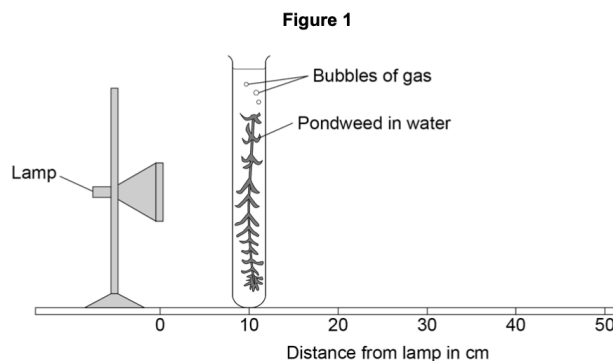
Use **Figure 5** on page 9 to help you answer this question.

[3 marks]

Q2. (2021)

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

Figure 1 shows the apparatus.



This is the method used.

1. Set up the apparatus as shown in **Figure 1**.
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.

A)

0 1 . 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

☐

B)

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

0 1 . 3 Explain how an increase in temperature would affect the results of this investigation. [2 marks]

C)

0 1 . 4 Suggest **one** way the investigation could be improved so the temperature of the water does **not** increase.

[1 mark]

D)

0 1 . 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 _____

E)

Table 1 shows the results.

Table 1

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 1 . 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

F)

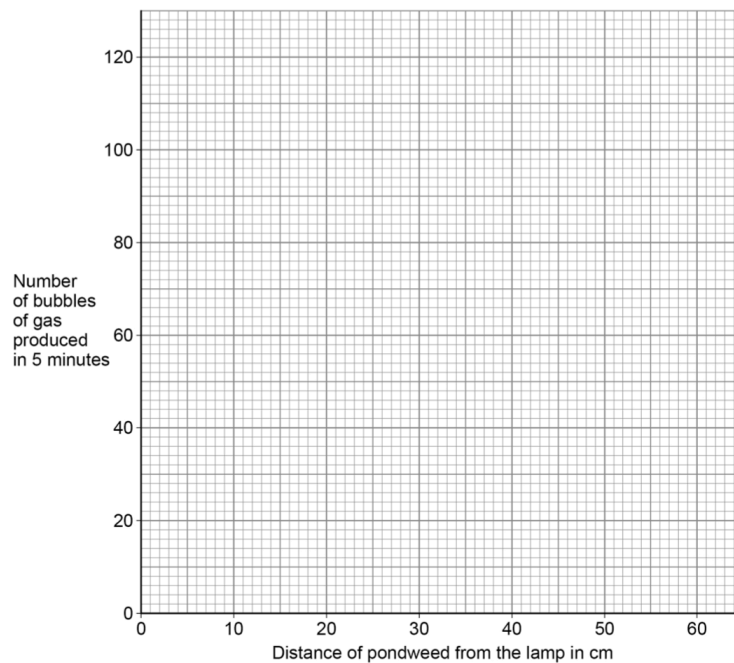
0 1 . 7 Give **one** conclusion that can be made from Table 1.

[1 mark]

G)

0 1 . 8 Plot the data from **Table 1** on **Figure 2**.

Draw a line of best fit.

[3 marks]**Figure 2**

H)

0 1 . 9 Predict the number of bubbles that would be produced in 5 minutes if the pondweed was 60 cm from the lamp.Use **Figure 2**.**[1 mark]**

Number of bubbles produced in 5 minutes = _____

Q3. (2022)

0 4 . 3 A student investigated the effect of different colours of light on the rate of photosynthesis at room temperature.

The student used pondweed in water.

A piece of pondweed was placed in red light, then in blue light and then in green light.

Each colour of light was the same intensity.

Describe how the student should make accurate measurements to obtain valid results for the rate of photosynthesis.

[4 marks]

Q4. (2022)

A scientist investigated the effect of different wavelengths of light on the rate of photosynthesis.

The wavelength of light determines the colour of the light.

Figure 8 shows the student's results.

Figure 9 shows the scientist's results.

Figure 8

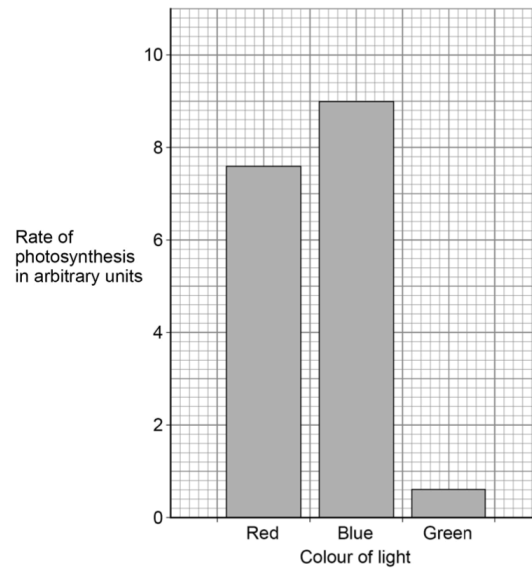
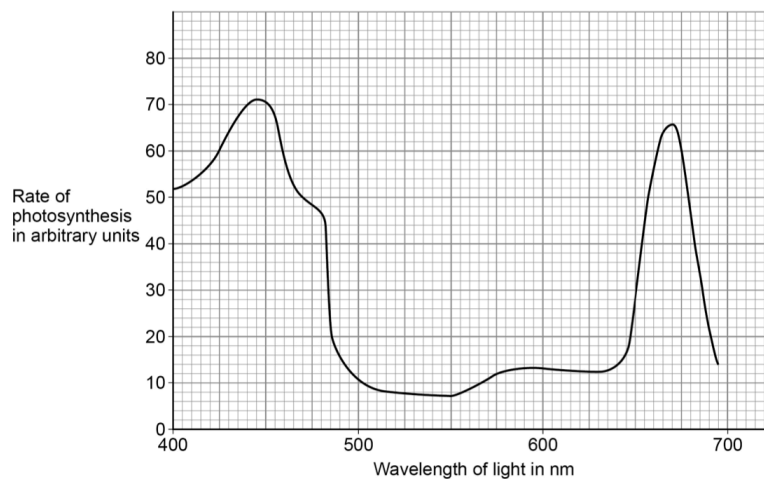


Figure 9



A)

0 4 . 4 Why are the results for the two investigations presented differently?

[2 marks]

B)

0 4 . 5 Suggest the range in wavelength of green light.

Use **Figure 8** and **Figure 9**.

[1 mark]

Range in wavelength of green light = from _____ nm to _____ nm

Q5. (2024)

A student investigated the relationship between temperature and the rate of photosynthesis.

The student measured the volume of gas produced by an aquatic plant in 1 hour.

The student collected the gas in a measuring cylinder.

Table 2 shows the results.

Table 2

Temperature in °C	Volume of gas produced in 1 hour in cm ³
10	1
15	2
20	4
25	8
30	16
35	16
40	2
45	0

A)

0 4 . 2 Describe the effect of increasing temperature on the **rate** of photosynthesis.

Use data from **Table 2**.

[3 marks]

B)

0 4 . 3 Explain why no gas was produced by the plant at 45 °C.

[2 marks]

C)

0 4 . 4 How could the student increase the accuracy of the results?

[1 mark]

Tick (✓) **one** box.

Repeat the investigation, collecting the gas for 24 hours.

☐

Repeat the investigation, measuring the volume of gas to 0.5 cm³.

☐

Repeat the investigation using a different aquatic plant.

☐

Repeat the investigation, using temperatures of 5 °C and 50 °C.

☐

Q6. (2024)

A person grows tomatoes in a greenhouse.

0	4	.	5
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 The mean temperature of the greenhouse is 15 °C.

A heater would keep the temperature of the greenhouse at 25 °C.

Suggest **two** reasons **against** using a heater set at 25 °C in the greenhouse.

Do **not** refer to cost in your answer.

[2 marks]

1 _____

2 _____