AQA GCSE Biology | 8461

SPECIFICATION POINT 4.4.1.2

Rate of photosynthesis

Past-paper questions

Tier	**Foundation**
Question groups	**19**
Available paper years	**2008–2025**

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.

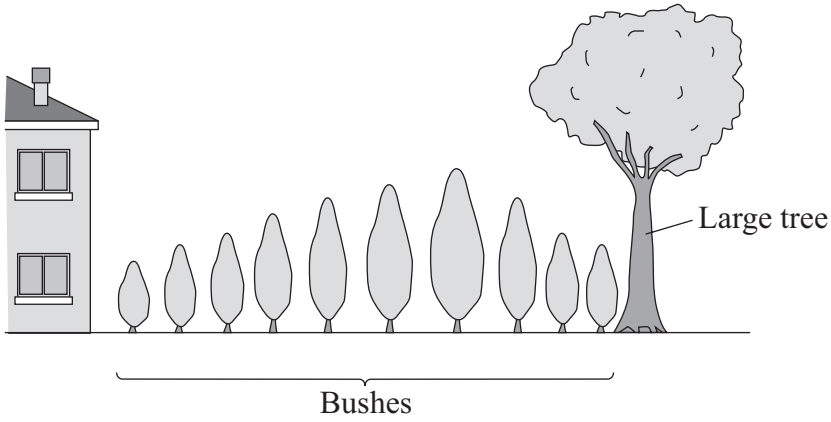
4.4.1.2 Rate of photosynthesis

Question 01

January 2008 | BLY2F | Original Q4 | Legacy

4 The diagram shows bushes in a hedge growing near to a house.

The bushes were the same species and the same age.



(a) (i) The student said, "I have noticed that the short bushes grow next to the house. I think that the more light the bushes get, the faster they will grow."

Draw lines to match each of the student's statements to the correct term.

Draw only **two** lines.

Statement	Term
The short bushes grow next to the house.	A conclusion
Plants will grow faster if they get more light.	A prediction
	An observation

(2 marks)

(ii) Complete the word equation for photosynthesis.

..... + water (+ light energy) → ..... + oxygen

(2 marks)

Question 4 continues on the next page

4.4.1.2 Rate of photosynthesis

Question 01 · continued

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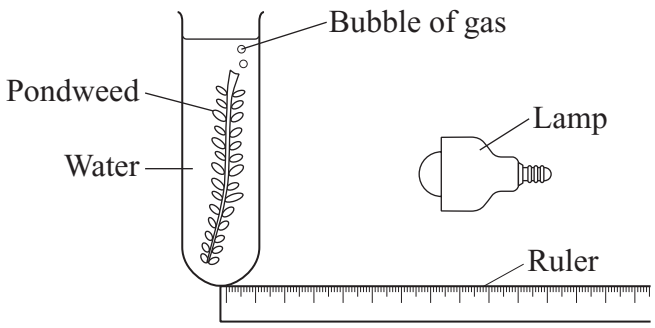
(b) The student decided to investigate the effect of light intensity on the rate of photosynthesis.

She used the apparatus shown in the diagram.



She measured the rate of photosynthesis by counting the number of gas bubbles given off each minute.

(i) Suggest how the student varied the intensity of the light received by the pondweed.

.....

.....

(1 mark)

4.4.1.2 Rate of photosynthesis

Question 01 · continued

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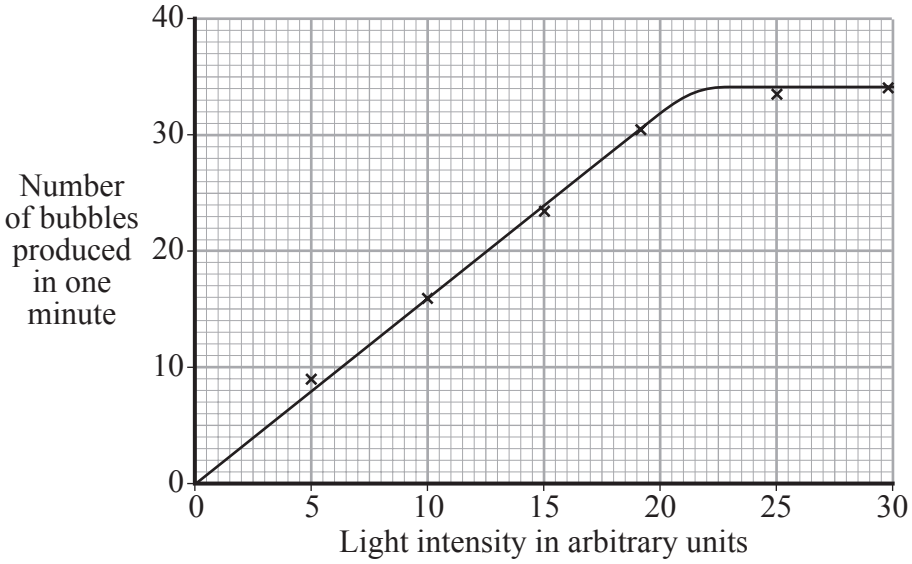
(ii) The student's results are shown on the graph.



Describe the pattern shown on the graph.

.....

.....

.....

.....

(2 marks)

(iii) This is what the student wrote for her conclusion.

"Increasing the light intensity increases the rate of photosynthesis of the pondweed."

Why was her conclusion incomplete?

.....

.....

(1 mark)

8

4.4.1.2 Rate of photosynthesis

Question 02

June 2009 | BLY2F | Original Q7 | Legacy

7 (a) (i) Complete the word equation for photosynthesis.

carbon dioxide + ... (+ light energy) → glucose + ...

(2 marks)

7 (a) (ii) Most of the carbon dioxide that a plant uses during photosynthesis is absorbed from the air.

Give **one** other source of carbon dioxide for a plant.

Draw a ring around your answer.

the soil **respiration in the plant** **osmosis in the plant** **water**

(1 mark)

A student investigated the conditions that plants need for photosynthesis.
The leaves of the plant he used had green and white parts.

Diagram 1 shows how part of one leaf was covered in black (opaque) card.
The plant was placed in a warm, sunny area and was watered well.
Eight hours later the leaf was removed from the plant and was tested for starch.

The results of the test are shown in **Diagram 2**, the shaded parts show where starch was present.

Diagram 1

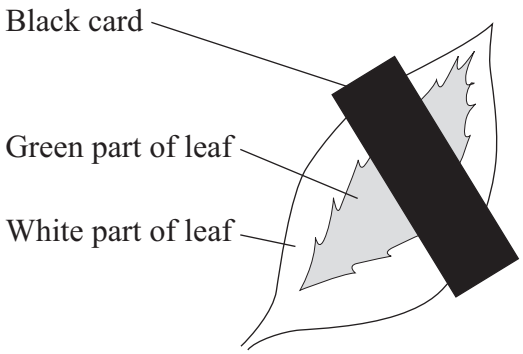
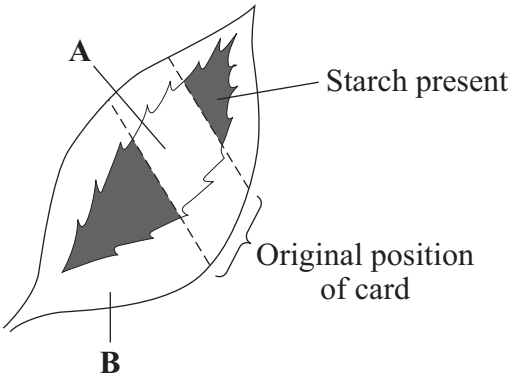


Diagram 2



4.4.1.2 Rate of photosynthesis

Question 02 · continued

for mark

7 (b) Name the **two** independent variables in this investigation.

1 .....

.....

2 .....

.....

(2 marks)

7 (c) Why was no starch found in:

7 (c) (i) the part of the leaf labelled **A**

.....

.....

(1 mark)

7 (c) (ii) the part of the leaf labelled **B**?

.....

.....

(1 mark)

7

4.4.1.2 Rate of photosynthesis

Question 03

June 2019 | BLY2F | Original Q6 | Legacy

6 This question is about photosynthesis.

6 (a) Plants make glucose during photosynthesis. Some of the glucose is changed into insoluble starch.

What happens to this starch?

Tick (✓) **one** box.

The starch is converted into oxygen. ☐

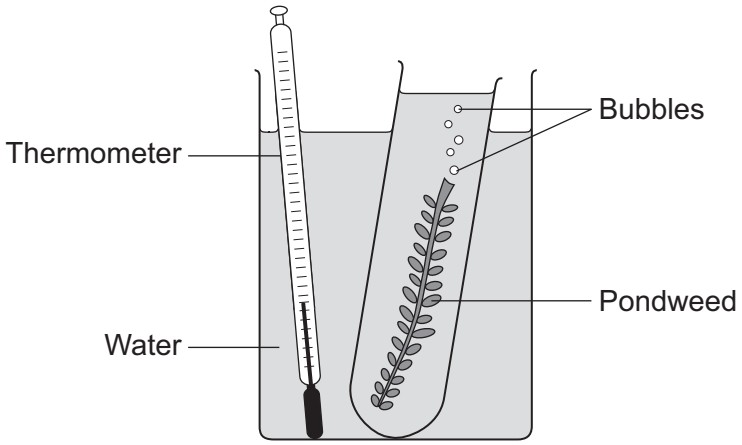
The starch is stored for later use. ☐

The starch is used to make the leaf green. ☐

(1 mark)

6 (b) A student investigated the effect of temperature on the rate of photosynthesis in pondweed.

The diagram shows the way the experiment was set up.



6 (b) (i) The student needed to control some variables to make the investigation fair.

State **two** of these variables.

1 .....

2 .....

(2 marks)

4.4.1.2 Rate of photosynthesis

Question 03 · continued

6 (b) (ii) The bubbles of gas are produced only while photosynthesis is taking place.

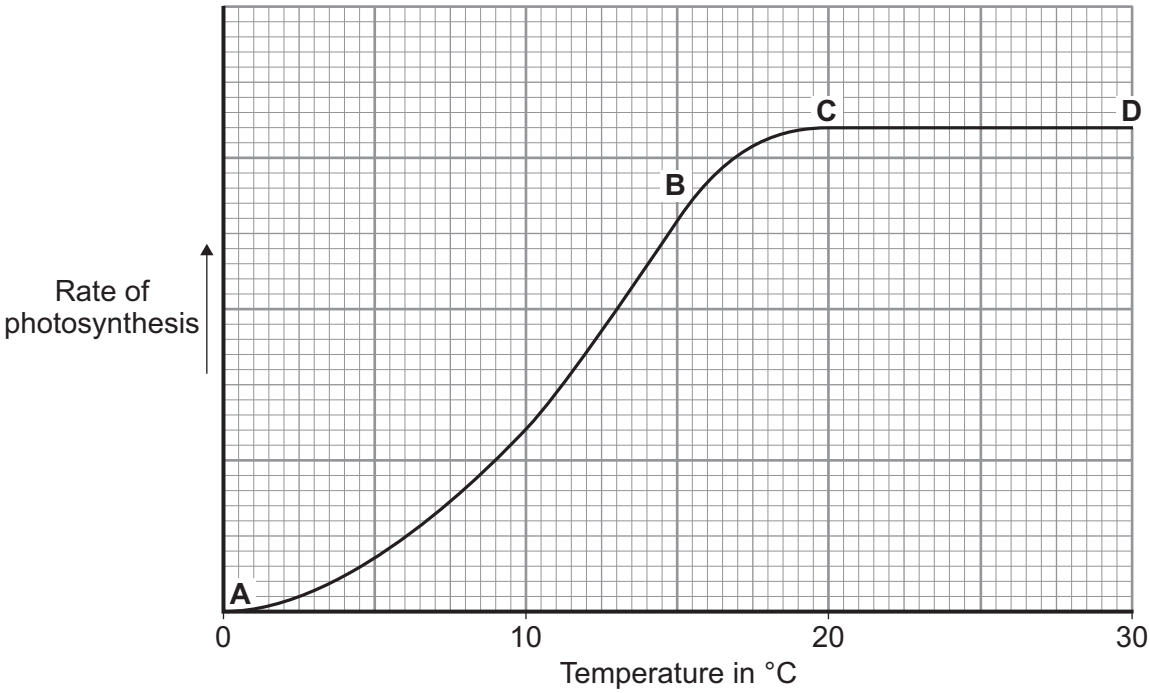
What **two** measurements would the student make to calculate the rate of photosynthesis?

1 .....

2 .....

(2 marks)

6 (c) The graph shows the effect of temperature on the rate of photosynthesis.



6 (c) (i) Name the factor that limits the rate of photosynthesis between the points labelled **A** and **B** on the graph.

.....

(1 mark)

6 (c) (ii) Suggest which factor, carbon dioxide, oxygen or water, might limit the rate of photosynthesis between the points labelled **C** and **D** on the graph.

.....

(1 mark)

7

4.4.1.2 Rate of photosynthesis

Question 04

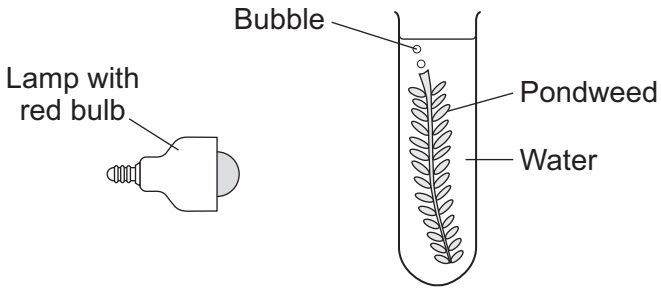
January 2011 | BLY2F | Original Q7 | Legacy

7 A group of pupils investigated the way in which the colour of light affects photosynthesis.

The pupils:

- put a piece of pondweed into a test tube of water
- shone light from a lamp with a red light bulb onto the pondweed
- counted the bubbles of gas produced by the pondweed every minute for three minutes.

The diagram shows the experiment.



The pupils repeated their experiment using a yellow light bulb, a green light bulb and a blue light bulb.

7 (a) (i) What was the independent variable in the investigation?

.....

(1 mark)

7 (a) (ii) To make the investigation fair the pupils needed to control some variables.

Suggest **one** variable that the pupils should have controlled during their investigation.

.....

(1 mark)

7 (a) (iii) It is better to count the bubbles every minute for three minutes than to count all the bubbles in three minutes.

Why?

.....

.....

(1 mark)

4.4.1.2 Rate of photosynthesis

Question 04 · continued

7 (b) The table shows the pupils' results.

Colour of bulb	Number of bubbles produced in one minute			
	1st minute	2nd minute	3rd minute	Mean
Red	24	19	21	21
Yellow	18	14	15	16
Green	6	4	3	4
Blue	32	34	32	33

Algae are tiny organisms that photosynthesise.
In natural light algae grow very quickly on the sides of a fish tank.
The algae make it difficult to see the fish.

7 (b) (i) What would be the best colour of light bulb to illuminate the fish tank to reduce the growth of algae?

Use the results in the table to help you to decide.

Draw a ring around **one** answer.

red **yellow** **green** **blue**

(1 mark)

7 (b) (ii) Explain why the colour you have chosen is the best.

.....

.....

.....

.....

(2 marks)

6

4.4.1.2 Rate of photosynthesis

Question 05

June 2012 | BL2FP | Original Q6 | Legacy

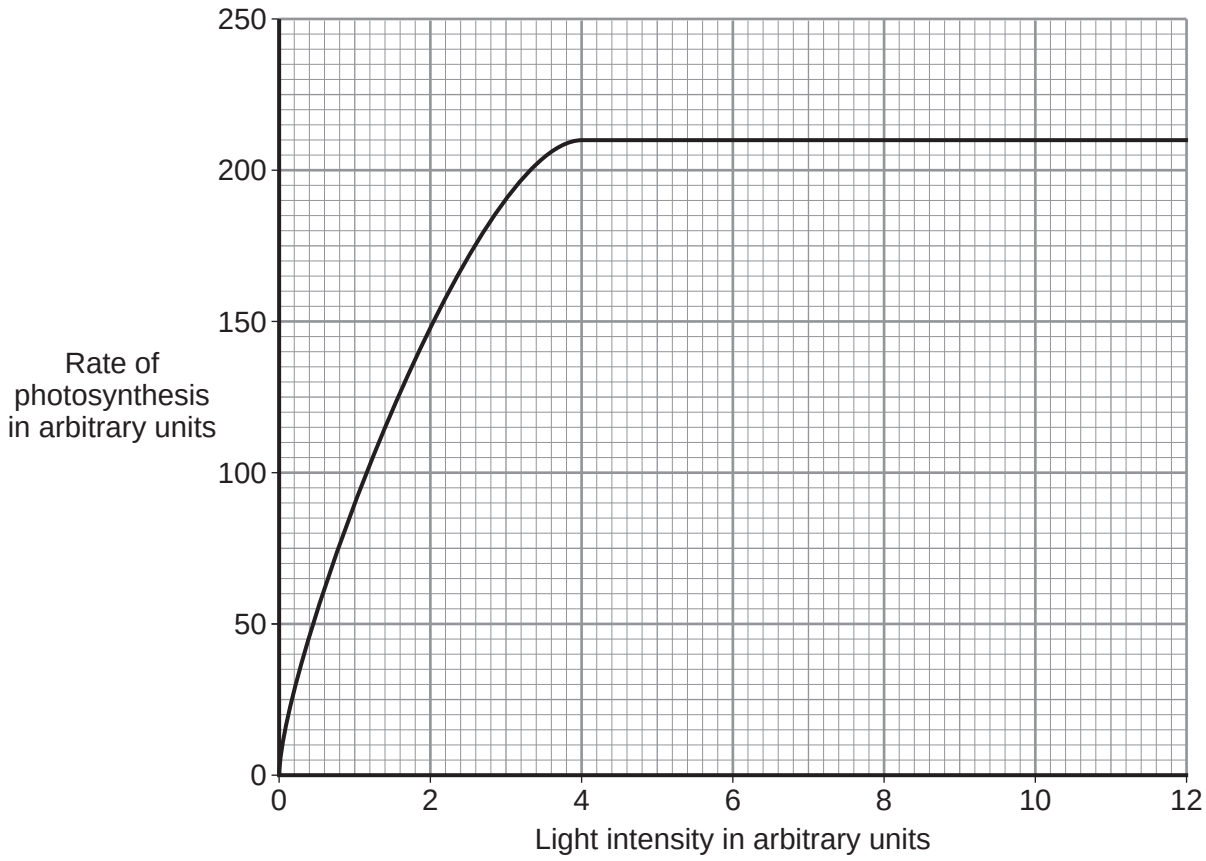
6 (a) Complete the equation for photosynthesis.

Carbon dioxide + ... $\xrightarrow{\text{light energy}}$ ..... + oxygen

(2 marks)

6 (b) A farmer grew tomato plants in a greenhouse.

The graph shows the effect of light intensity on the rate of photosynthesis in the tomato plants growing in the greenhouse.



6 (b) (i) At which light intensity was light a limiting factor for photosynthesis?

Tick (✓) **one** box.

1 arbitrary unit ☐

4 arbitrary units ☐

10 arbitrary units ☐

(1 mark)

4.4.1.2 Rate of photosynthesis

Question 05 · continued

6 (b) (ii) What was the highest rate of photosynthesis?

..... arbitrary units

(1 mark)

6 (b) (iii) The farmer wants to increase the rate of photosynthesis in his tomato plants.

Apart from light intensity, name **one** factor that the farmer could change to increase the rate of photosynthesis in his tomato plants.

.....

(1 mark)

5

Turn over for the next question

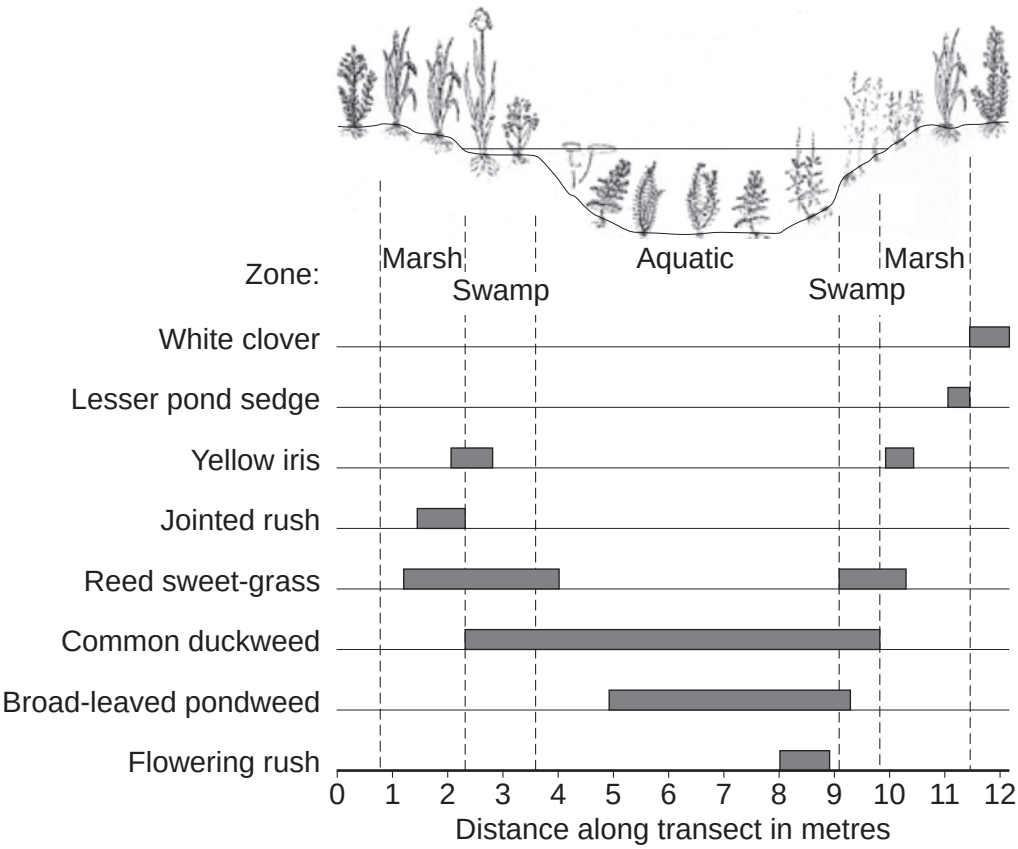
4.4.1.2 Rate of photosynthesis

Question 06

June 2012 | BL2FP | Original Q8 | Legacy

8 Some students investigated the distribution of some of the plants growing in and around a shallow stream. They sampled along a transect line.

The diagram shows their results.



8 (a) (i) Name the **one** species that grew only in the driest conditions.

.....

(1 mark)

8 (a) (ii) Only **one** species grew in the marsh, the swamp and in the aquatic zones.

Which species?

.....

(1 mark)

8 (a) (iii) Duckweed grows floating in water. What evidence is there for this in the students' results?

.....

.....

(1 mark)

4.4.1.2 Rate of photosynthesis

Question 06 · continued

8 (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Describe how you would use a $\frac{1}{2}$-metre × $\frac{1}{2}$-metre quadrat frame and a 30-metre tape measure to obtain data similar to the data shown in the diagram.

You should include details of how you would make sure that you would obtain valid results.

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(6 marks)

9

4.4.1.2 Rate of photosynthesis

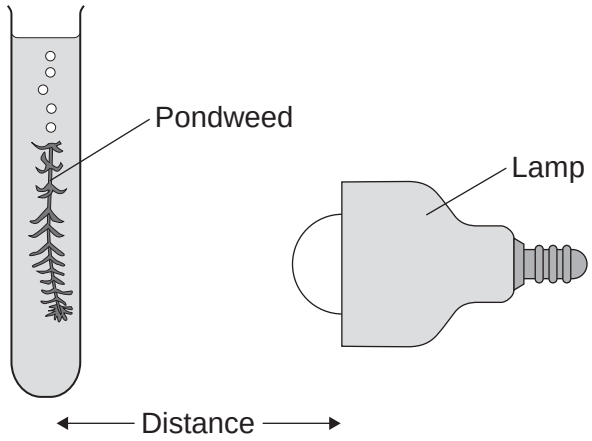
Question 07

January 2013 | BL2FP | Original Q7 | Legacy

7 Some students investigated the effect of light intensity on the rate of photosynthesis.

They used the apparatus shown in **Diagram 1**.

Diagram 1



The students:

- placed the lamp 10 cm from the pondweed
- counted the number of bubbles of gas released from the pondweed in 1 minute
- repeated this for different distances between the lamp and the pondweed.

7 (a) The lamp gives out heat as well as light.

What could the students do to make sure that heat from the lamp did **not** affect the rate of photosynthesis?

.....

.....

(1 mark)

4.4.1.2 Rate of photosynthesis

Question 07 · continued

7 (b) The table shows the students' results.

Distance in cm	Number of bubbles per minute
10	84
15	84
20	76
40	52
50	26

7 (b) (i) At distances between 15cm and 50cm, light was a limiting factor for photosynthesis.

What evidence is there for this in the table?

.....

.....

(1 mark)

7 (b) (ii) Give **one** factor that could have limited the rate of photosynthesis when the distance was between 10cm and 15cm.

.....

(1 mark)

Question 7 continues on the next page

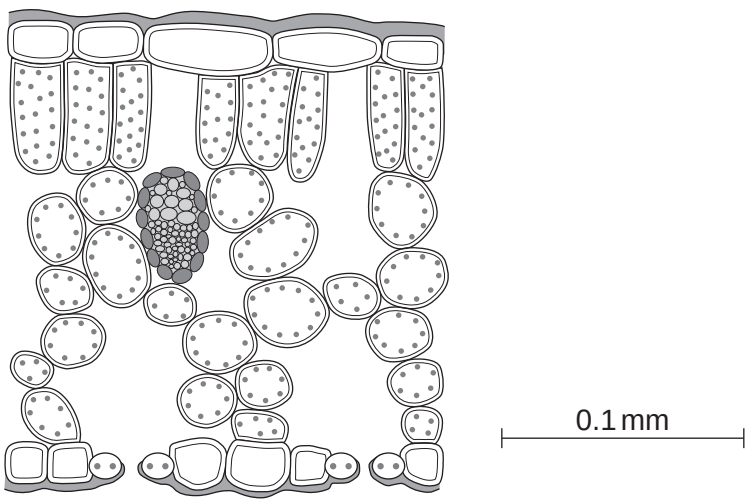
4.4.1.2 Rate of photosynthesis

Question 07 · continued

7 (c) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Diagram 2 shows a section through a plant leaf.

Diagram 2



Describe the structure of the leaf and the functions of the tissues in the leaf.

You should use the names of the tissues in your answer.

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4.4.1.2 Rate of photosynthesis

Question 08

June 2014 | BL2FP | Original Q6 | Legacy

6 (a) A student carried out the following investigation using a plant with variegated leaves.
A variegated leaf has green and white stripes.

The student:

- left the plant in the dark for 3 days to remove the starch
- fixed two pieces of card to a leaf on the plant
- left the plant in the light for 2 days
- removed the leaf from the plant
- tested the leaf for starch.

Figure 9 shows how the two pieces of card were attached to the leaf.

Figure 9

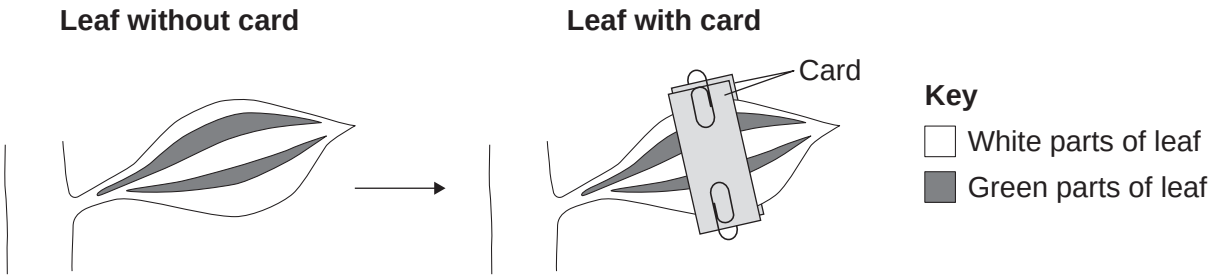
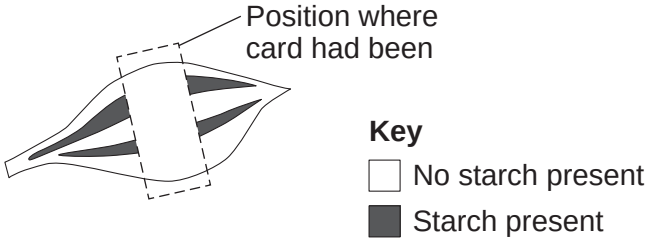


Figure 10 shows the same leaf after 2 days in the light.
The leaf has been tested for starch.

Figure 10



Give **two** conclusions from this investigation.

Tick (✓) **two** boxes.

[2 marks]

Carbon dioxide is needed for photosynthesis. ☐

Chlorophyll is needed for photosynthesis. ☐

Light is needed for photosynthesis. ☐

Water is needed for photosynthesis. ☐

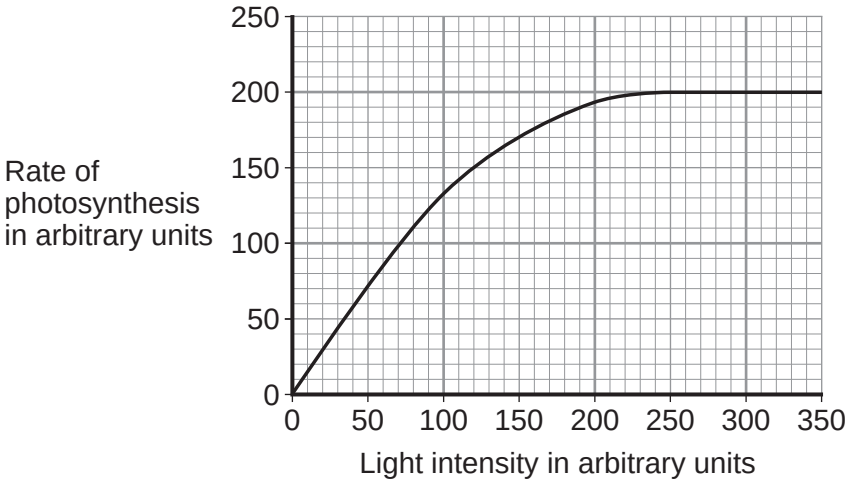
4.4.1.2 Rate of photosynthesis

Question 08 · continued

6 (b) Scientists investigated the effect of light intensity on the rate of photosynthesis.

Figure 11 shows the scientists' results.

Figure 11



Describe the effect of increasing light intensity on the rate of photosynthesis.
You should include numbers from **Figure 11** in your description.

[3 marks]

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6 (c) At a light intensity of 250 arbitrary units, light is **not** a limiting factor of photosynthesis.

6 (c) (i) What is the evidence for this in **Figure 11**?

[1 mark]

.....

.....

6 (c) (ii) Give **two** factors that could be limiting the rate of photosynthesis at a light intensity of 250 arbitrary units.

[2 marks]

1 .....

2 .....

8

4.4.1.2 Rate of photosynthesis

Question 09

June 2015 | BL2FP | Original Q4 | Legacy

4 Photosynthesis uses carbon dioxide to make glucose.

4 (a) (i) Complete the equation for photosynthesis.

[2 marks]

carbon dioxide + ... $\xrightarrow{\text{energy}}$ glucose + ...

4 (a) (ii) What type of energy does a plant use in photosynthesis?

[1 mark]

.....

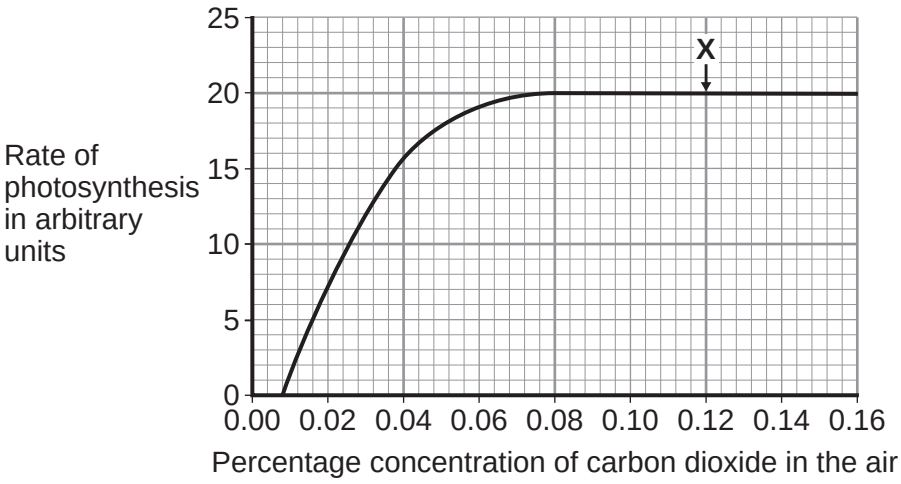
4 (a) (iii) Which part of a plant cell absorbs the energy needed for photosynthesis?

[1 mark]

.....

4 (b) **Figure 3** shows the effect of the concentration of carbon dioxide on the rate of photosynthesis in tomato plants at 20 °C.

Figure 3



4 (b) (i) What is the maximum rate of photosynthesis of the tomato plants shown in **Figure 3**?

[1 mark]

..... arbitrary units

4 (b) (ii) At point **X** on **Figure 3**, carbon dioxide is **not** a limiting factor of photosynthesis.

Suggest **one** factor that is limiting the rate of photosynthesis at point **X**.

[1 mark]

.....

4.4.1.2 Rate of photosynthesis

Question 09 · continued

4 (c) A farmer plans to grow tomatoes in a large greenhouse.

The concentration of carbon dioxide in the atmosphere is 0.04%.
The farmer adds carbon dioxide to the greenhouse so that its concentration is 0.08%.

4 (c) (i) Why does the farmer use 0.08% carbon dioxide?

[1 mark]

Tick (✓) **one** box.

- To increase the rate of growth of the tomato plants ☐
- To increase the rate of respiration of the tomato plants ☐
- To increase water uptake by the tomato plants ☐

4 (c) (ii) Why does the farmer **not** use a concentration of carbon dioxide higher than 0.08%?

[2 marks]

Tick (✓) **two** boxes.

- Because it would cost more money than using 0.08% ☐
- Because it would decrease the temperature of the greenhouse ☐
- Because it would not increase the rate of photosynthesis of the tomato plants any further ☐
- Because it would increase water loss from the tomato plants ☐

9

4.4.1.2 Rate of photosynthesis

Question 10

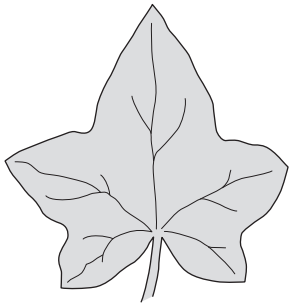
June 2015 | BL2FP | Original Q8 | Legacy

8 **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

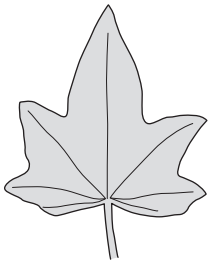
Ivy plants can grow up trees and walls.

Figure 8 shows two ivy leaves. One leaf is from an ivy plant growing up a tree in the centre of a shady woodland area. The other leaf is from an ivy plant growing up a tree in a sunny area at the edge of the woodland.

Figure 8



Ivy leaf from shady woodland area (centre of woodland)



Ivy leaf from sunny area (edge of woodland)

A student makes the following hypothesis.

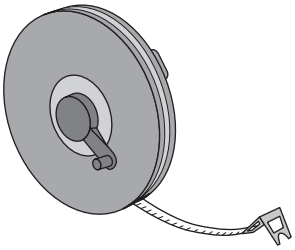
"The size of ivy leaves decreases as light intensity increases."

How would you use the apparatus shown in **Figure 9** to test this hypothesis?

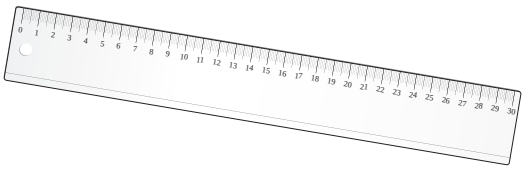
You should include details of how you would make sure the results are valid.

[6 marks]

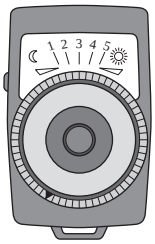
Figure 9



100 m tape measure



Ruler



Light meter

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4.4.1.2 Rate of photosynthesis

Question 11

June 2016 | BL2FP | Original Q8 | Legacy

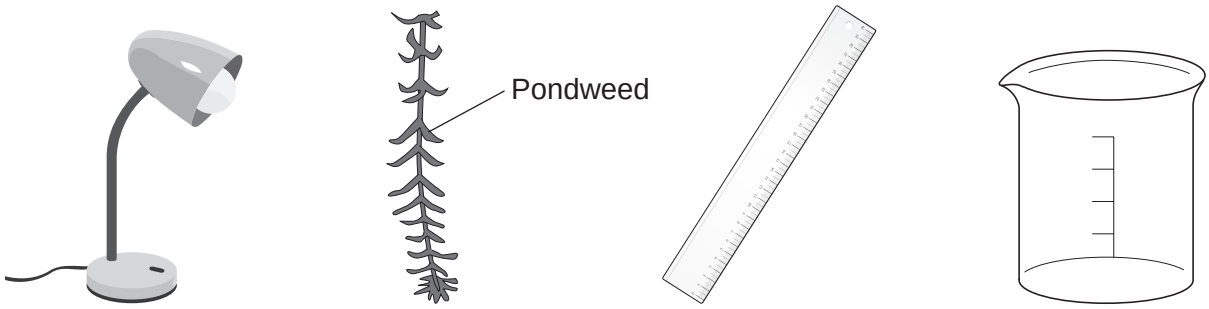
8 **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Light intensity, carbon dioxide concentration and temperature are three factors that affect the rate of photosynthesis.

How would you investigate the effect of **light intensity** on the rate of photosynthesis?

Figure 9 shows some of the apparatus you might use.

Figure 9



Not to scale

You should include details of:

- how you would set up the apparatus and the materials you would use
- the measurements you would make
- how you could make this a fair test.

[6 marks]

4.4.1.2 Rate of photosynthesis

Question 12

June 2019 | 8461/1F | Original Q9

0 9 This question is about photosynthesis.

0 9 . 1 Complete the word equation for photosynthesis:

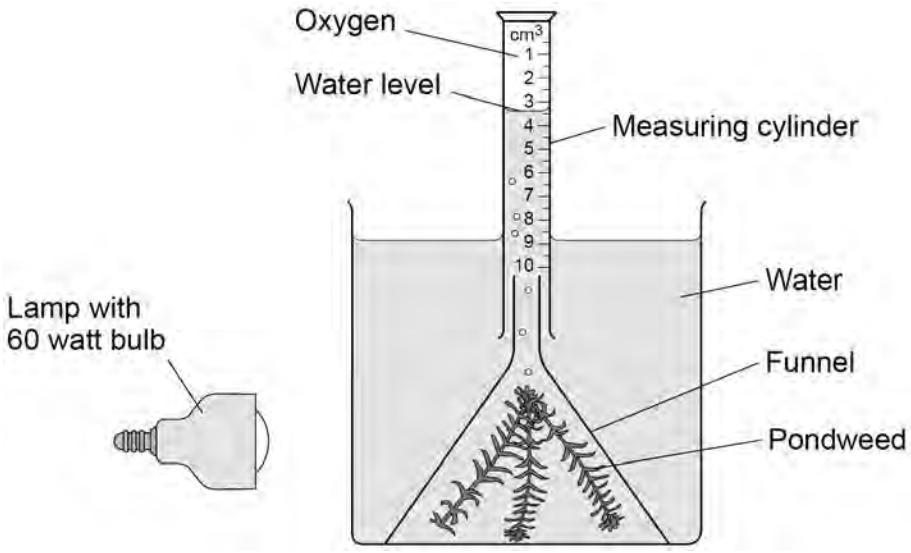
[2 marks]

_____ + _____ ⟶ _____ + oxygen

A student investigated photosynthesis using pondweed.

Figure 14 shows the apparatus the student used.

Figure 14



This is the method used.

1. Set up the apparatus as shown in **Figure 14**.
2. Switch on the lamp.
3. After 20 minutes, record the volume of oxygen collected in the measuring cylinder.
4. Repeat steps 1–3 using bulbs of different power output.

4.4.1.2 Rate of photosynthesis

Question 12 · continued

0 9 . 2 What was the independent variable in the investigation?

[1 mark]

Tick (✓) **one** box.

- Power output of bulb ☐
- Rate of photosynthesis ☐
- Time to collect oxygen ☐
- Volume of oxygen collected ☐

0 9 . 3 Suggest **two** ways the method could be improved so the results would be more valid.

[2 marks]

1 _____

_____

2 _____

_____

Question 9 continues on the next page

4.4.1.2 Rate of photosynthesis

Question 12 · continued

Table 9 shows the student's results.

Table 9

Power output of bulb in watts	Volume of oxygen collected in 20 minutes in cm^3	Rate of photosynthesis in cm^3/hour
60	0.5	1.5
100	0.8	2.4
150	1.1	**X**
200	1.2	3.6
250	1.2	3.6

0 9 . 4 Calculate value **X** in **Table 9**.

[1 mark]

X = _____ cm^3/hour

4.4.1.2 Rate of photosynthesis

Question 12 · continued

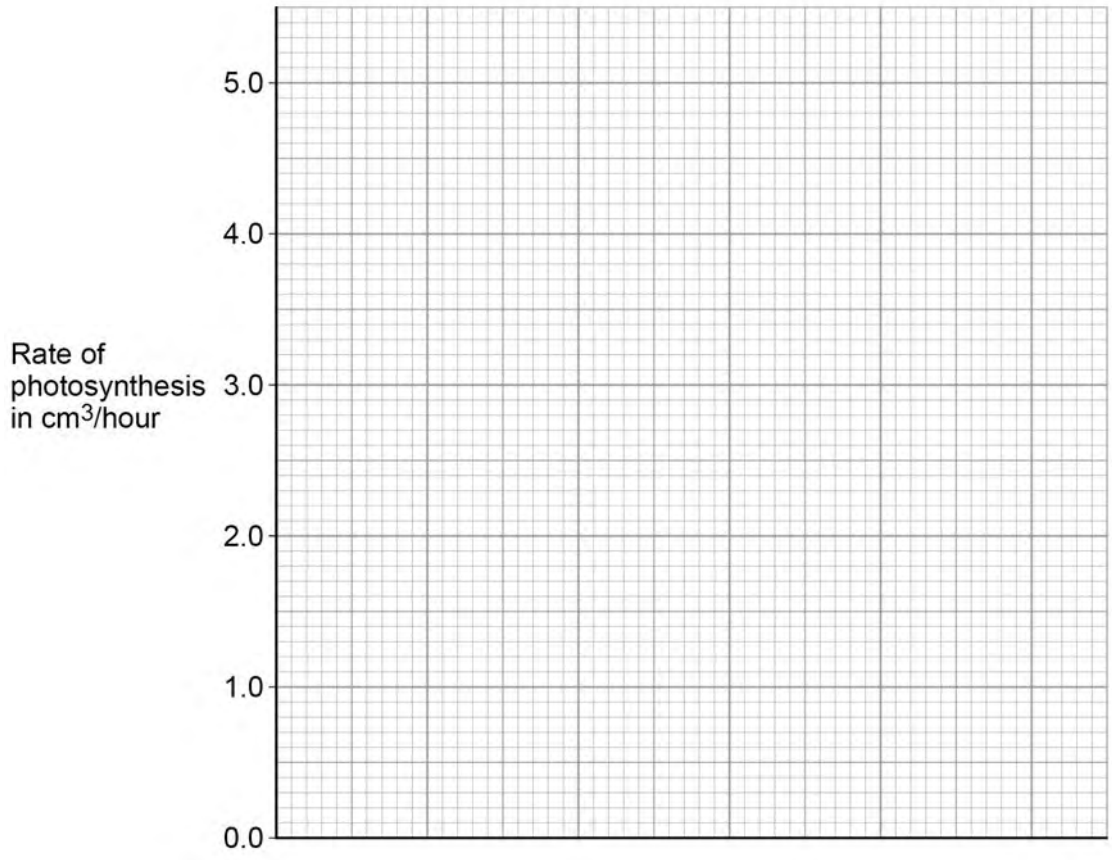
0 9 . 5 Complete **Figure 15**.

[4 marks]

You should:

- label the x-axis
- use a suitable scale
- plot the data from **Table 9** and your answer to Question **09.4**
- draw a line of best fit.

Figure 15



0 9 . 6 Determine the expected rate of photosynthesis with a bulb of power output 75 watts.

Use **Figure 15**.

[1 mark]

Rate of photosynthesis at 75 watts = _____ cm^3/hour

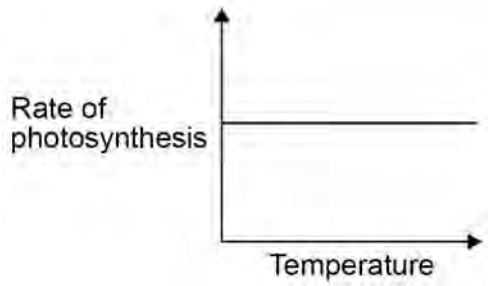
4.4.1.2 Rate of photosynthesis

Question 12 · continued

0 9 . 7 Which graph shows the effect of temperature on the rate of photosynthesis?

[1 mark]

Tick (✓) **one** box.



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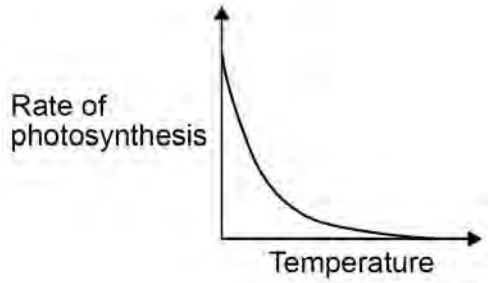

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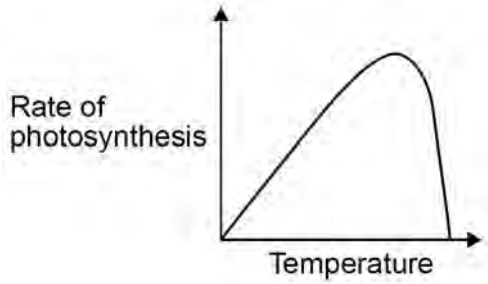

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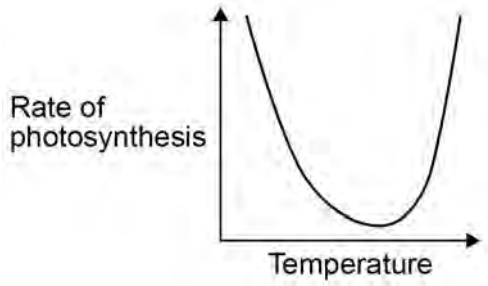


☐

12

4.4.1.2 Rate of photosynthesis

Question 13

November 2020 | 8461/1F | Original Q7

0 7 This question is about photosynthesis.

0 7 . 1 Complete the word equation for photosynthesis.

[2 marks]

_____ + _____ → _____ + oxygen

0 7 . 2 Describe how energy for the photosynthesis reaction is gained by plants.

[2 marks]

Students investigated the effect of temperature on the rate of photosynthesis.

The students shone light from a lamp onto pondweed and measured the volume of oxygen produced per hour.

Table 3 shows the results.

Table 3

Temperature in °C	Rate of photosynthesis in cm^3/hour			
	Test 1	Test 2	Test 3	Mean
20	18.5	19.3	19.5	**X**
25	32.6	34.1	32.9	33.2
30	41.9	45.2	44.9	44.0
35	38.6	39.8	44.0	40.8
40	23.1	20.5	22.4	22.0
45	1.9	14.2	2.2	2.1

4.4.1.2 Rate of photosynthesis

Question 13 · continued

0 7 . 3 Calculate mean value **X**.

[2 marks]

X = _____ cm^3/hour

The students identified one anomalous result in **Table 3**.

0 7 . 4 Draw a ring around the anomalous result in **Table 3**.

[1 mark]

0 7 . 5 Suggest **one** possible cause of the anomalous result.

[1 mark]

0 7 . 6 How did the students deal with the anomalous result?

[1 mark]

0 7 . 7 Give **one** factor the students should have kept constant in this investigation.

[1 mark]

4.4.1.2 Rate of photosynthesis

Question 13 · continued

Table 3 is repeated below.

Table 3

Temperature in °C	Rate of photosynthesis in cm^3/hour			
	Test 1	Test 2	Test 3	Mean
20	18.5	19.3	19.5	**X**
25	32.6	34.1	32.9	33.2
30	41.9	45.2	44.9	44.0
35	38.6	39.8	44.0	40.8
40	23.1	20.5	22.4	22.0
45	1.9	14.2	2.2	2.1

0 7 . 8 Why did the rate of photosynthesis decrease from 35 °C to 45 °C?

[1 mark]

4.4.1.2 Rate of photosynthesis

Question 13 · continued

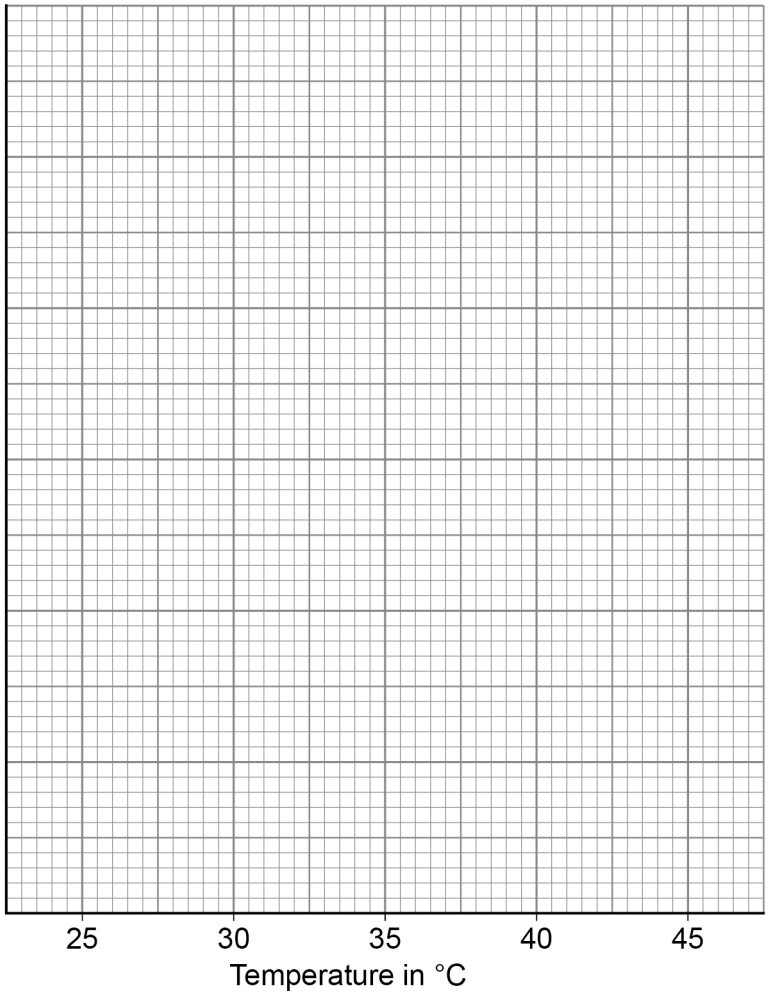
0 7 . 9 Complete **Figure 10** using data from **Table 3**.

You should:

- label the y-axis
- use a suitable scale for the y-axis
- plot the mean data from **Table 3** for temperatures from 25 °C to 45 °C
- draw a line of best fit.

[5 marks]

Figure 10



16

4.4.1.2 Rate of photosynthesis

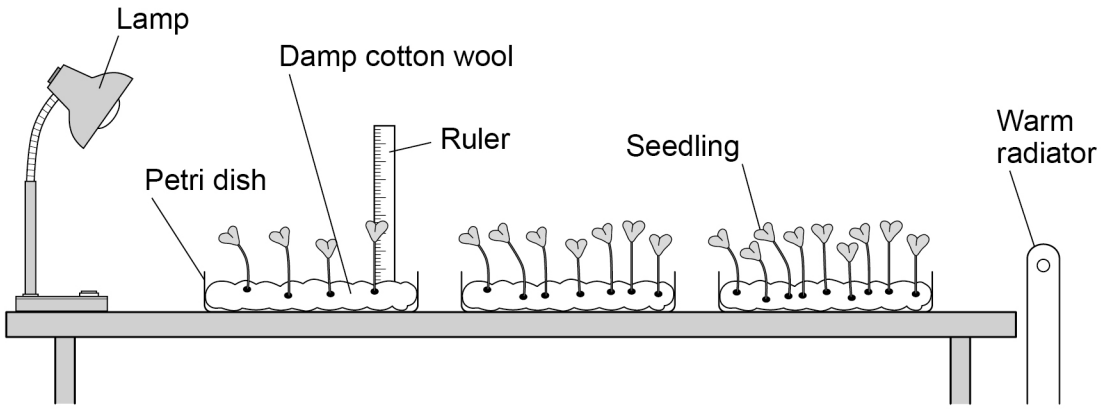
Question 14

November 2020 | 8461/2F | Original Q2

0 2 A student investigated the effect of light intensity on the growth of seedlings.

Figure 2 shows the equipment.

Figure 2



0 2 . 1 Which **two** improvements should the student make to the investigation?

[2 marks]

Tick (✓) **two** boxes.

- Give more water to the seedlings nearest the lamp ☐
- Leave some of the seedlings for a few more days ☐
- Open a window to let more air in ☐
- Put all the dishes the same distance from the radiator ☐
- Use equal numbers of seedlings in each dish ☐

4.4.1.2 Rate of photosynthesis

Question 14 · continued

0 2 . 2 What is the dependent variable in the investigation?

[1 mark]

Tick (✓) **one** box.

The height of the seedlings ☐

The mass of cotton wool ☐

The temperature of the room ☐

0 2 . 3 In each dish the seedlings compete with each other.

Give **two** factors the seedlings compete for.

[2 marks]

1 _____

_____

2 _____

_____

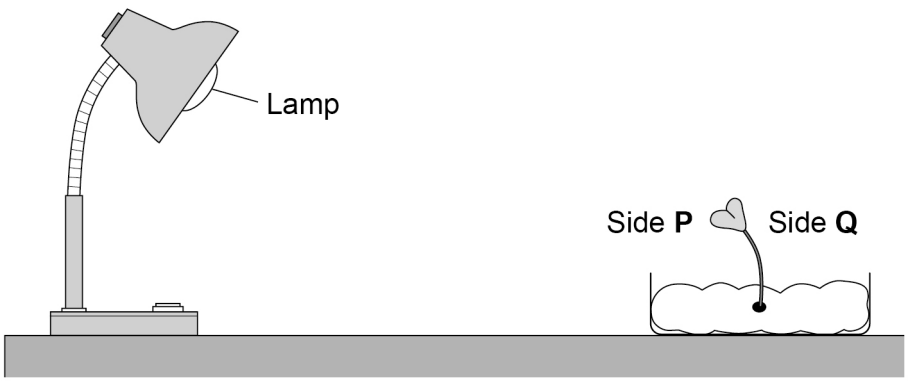
Question 2 continues on the next page

4.4.1.2 Rate of photosynthesis

Question 14 · continued

Figure 3 shows a seedling growing towards a lamp.

Figure 3



0 2 . 4 What happened to the growth of the seedling on side **P** compared with the growth on side **Q**?

[1 mark]

Tick (✓) **one** box.

Side **P** has grown less than side **Q** ☐

Side **P** has grown more than side **Q** ☐

Side **P** has grown the same as side **Q** ☐

4.4.1.2 Rate of photosynthesis

Question 14 · continued

0 2 . 5 Plant responses are called tropisms.

Which tropism causes the seedling to grow towards light?

[1 mark]

Tick (✓) **one** box.

- Geotropism ☐
- Gravitropism ☐
- Phototropism ☐

0 2 . 6 Which hormone causes the seedling to grow towards the light?

[1 mark]

Tick (✓) **one** box.

- Auxin ☐
- Insulin ☐
- Testosterone ☐

8

4.4.1.2 Rate of photosynthesis

Question 15

November 2021 | 8461/1F | Original Q2

0 2 Viruses cause disease.

0 2 . 1 What name is given to microorganisms that cause disease?

[1 mark]

Tick (✓) **one** box.

- Pathogens ☐
- Predators ☐
- Prokaryotes ☐

0 2 . 2 How do viruses cause the symptoms of disease?

[1 mark]

Tick (✓) **one** box.

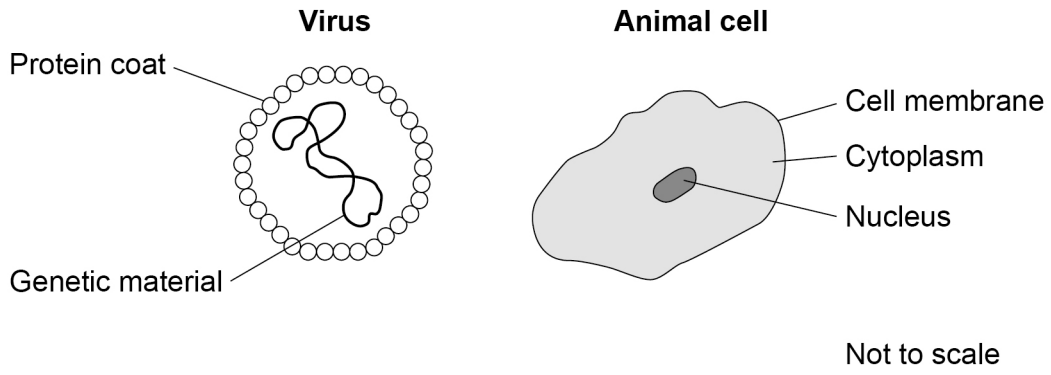
- Viruses engulf white blood cells, destroying them. ☐
- Viruses produce antibodies that damage tissues. ☐
- Viruses reproduce inside cells, damaging them. ☐

4.4.1.2 Rate of photosynthesis

Question 15 · continued

Figure 4 shows a virus and an animal cell.

Figure 4



0 2 . 3 Suggest **one** reason why viruses are **not** classed as cells.

[1 mark]

A vaccine can protect humans from a viral disease.

0 2 . 4 What does the vaccine contain?

[1 mark]

Tick (✓) **one** box.

- A toxic form of a virus ☐
- A weakened form of a virus ☐
- An active form of a virus ☐

Question 2 continues on the next page

4.4.1.2 Rate of photosynthesis

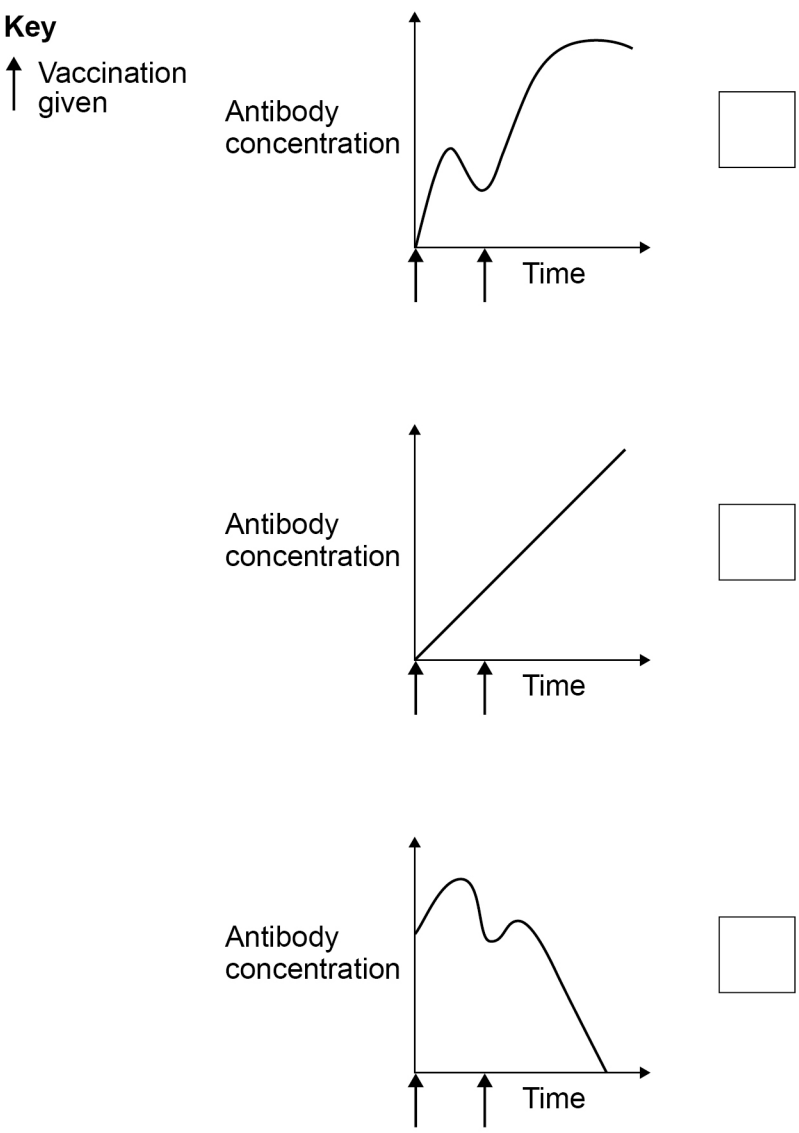
Question 15 · continued

In some cases, a first vaccination needs to be followed by a second vaccination some time later.

0 2 . 5 Which graph shows how the concentration of antibodies in a person's blood changes after the first and second vaccinations?

[1 mark]

Tick (✓) **one** box.



4.4.1.2 Rate of photosynthesis

Question 15 · continued

Tobacco mosaic virus (TMV) causes disease in plants.

TMV affects the rate of photosynthesis in plants.

0 2 . 6 Which part of a plant shows discolouration caused by TMV?

[1 mark]

Tick (✓) **one** box.

Flower ☐

Leaf ☐

Root ☐

Question 2 continues on the next page

4.4.1.2 Rate of photosynthesis

Question 15 · continued

Table 1 shows the rate of photosynthesis in four different tobacco plants.

Table 1

Tobacco plant	Level of TMV infection in plant	Rate of photosynthesis in arbitrary units
A	None	15
B	Mild	13
C	Medium	7
D	High	3

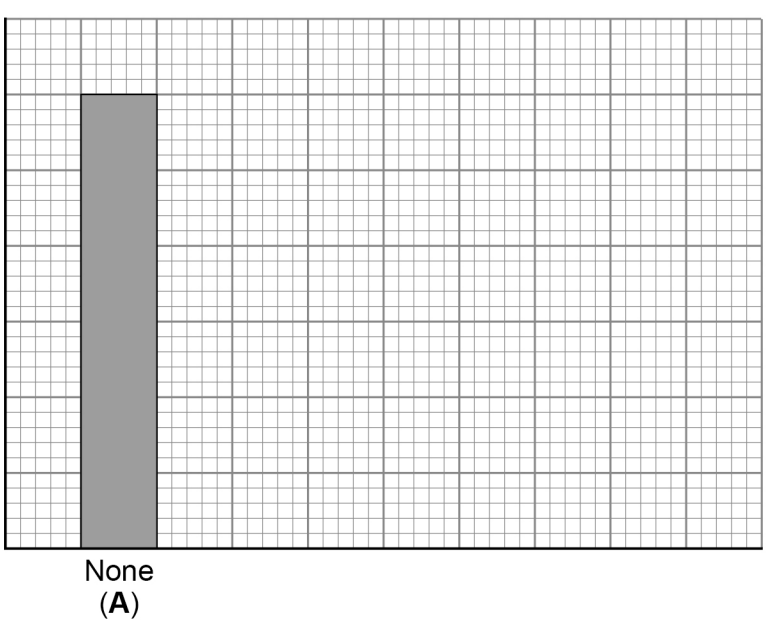
0 2 . 7 Complete **Figure 5**.

You should:

- label the y-axis
- add the correct scale to the y-axis
- plot the data from **Table 1**
- label each bar.

[5 marks]

Figure 5



4.4.1.2 Rate of photosynthesis

Question 15 · continued

0 2 . 8 What conclusion can be made from the data in **Table 1**?

[1 mark]

0 2 . 9 Explain why a high level of TMV infection reduces growth in a plant.

[2 marks]

14

Turn over for the next question

4.4.1.2 Rate of photosynthesis

Question 16

June 2022 | 8461/1F | Original Q3

0 3 A scientist investigated the rate of photosynthesis of one type of tomato plant.

The tomato plants were grown in a greenhouse.

Table 2 shows the results.

Table 2

Percentage (%) concentration of carbon dioxide in the air	Rate of photosynthesis in arbitrary units
0.00	0
0.02	5
0.04	16
0.06	19
0.08	20
0.10	20
0.12	20

0 3 . 1 Give **two** control variables the scientist should have used in the investigation.

[2 marks]

1 _____

2 _____

0 3 . 2 Which range of carbon dioxide concentrations caused the rate of photosynthesis to change the most?

[1 mark]

Tick (✓) **one** box.

From 0.00% to 0.02% ☐

From 0.02% to 0.04% ☐

From 0.04% to 0.06% ☐

From 0.06% to 0.08% ☐

4.4.1.2 Rate of photosynthesis

Question 16 · continued

0 3 . 3 How could the scientist have improved the validity of the results?

[1 mark]

Tick (✓) **one** box.

Repeat each reading three times and calculate a mean. ☐

Use concentrations of carbon dioxide above 0.12%. ☐

Use different tomato plants for each concentration. ☐

0 3 . 4 Explain the change in the rate of photosynthesis when the concentration of carbon dioxide increased between 0.00% to 0.08%.

[2 marks]

0 3 . 5 A farmer decided **not** to use a concentration of carbon dioxide higher than 0.08% to grow tomato plants.

Suggest **two** reasons for the farmer's decision.

Use information from **Table 2** and your own knowledge.

[2 marks]

1

2

8

4.4.1.2 Rate of photosynthesis

Question 17

June 2023 | 8461/1F | Original Q3

0 3 Photosynthesis produces oxygen.

0 3 . 1 Complete the word equation for photosynthesis.

Choose answers from the box.

[3 marks]

carbon dioxide	**fat**	**glucose**
nitrogen	**protein**	**water**

_____ + _____ → _____ + oxygen

0 3 . 2 Explain how oxygen is used in cells.

[2 marks]

4.4.1.2 Rate of photosynthesis

Question 17 · continued

A student investigated the effect of light from different coloured light bulbs on photosynthesis.

The student:

- used pondweed in a beaker of water
- used different coloured light bulbs in a lamp
- counted the number of bubbles of oxygen the pondweed produced in 2 minutes for each colour of light bulb.

0 3 . 3 Give **one** hazard the student would need to consider when using the apparatus in this investigation.

Give the risk the hazard would cause.

[2 marks]

Hazard _____

_____

Risk _____

_____

0 3 . 4 The student needed to keep the temperature of the water in the beaker the same throughout the investigation.

Describe how the student could keep the temperature of the water the same.

[1 mark]

_____

_____

0 3 . 5 The beaker of water contained the pondweed.

Explain why the temperature of the water in the beaker needed to be kept the same throughout the investigation.

[2 marks]

_____

_____

_____

_____

4.4.1.2 Rate of photosynthesis

Question 17 · continued

Table 3 shows the results.

Table 3

Colour of light bulb	Number of bubbles of oxygen produced in 2 minutes
Blue	46
Green	8
Red	38
Yellow	29

0 3 . 6 Which colour of light caused the highest rate of photosynthesis in the pondweed?

[1 mark]

Tick (✓) **one** box.

- Blue ☐
- Green ☐
- Red ☐
- Yellow ☐

0 3 . 7 What is the best way to display the data in **Table 3**?

[1 mark]

Tick (✓) **one** box.

- Bar graph ☐
- Line graph ☐
- Scatter graph ☐

4.4.1.2 Rate of photosynthesis

Question 17 · continued

0 3 . 8 The student wanted to measure the **volume** of oxygen the pondweed produced in 2 minutes.

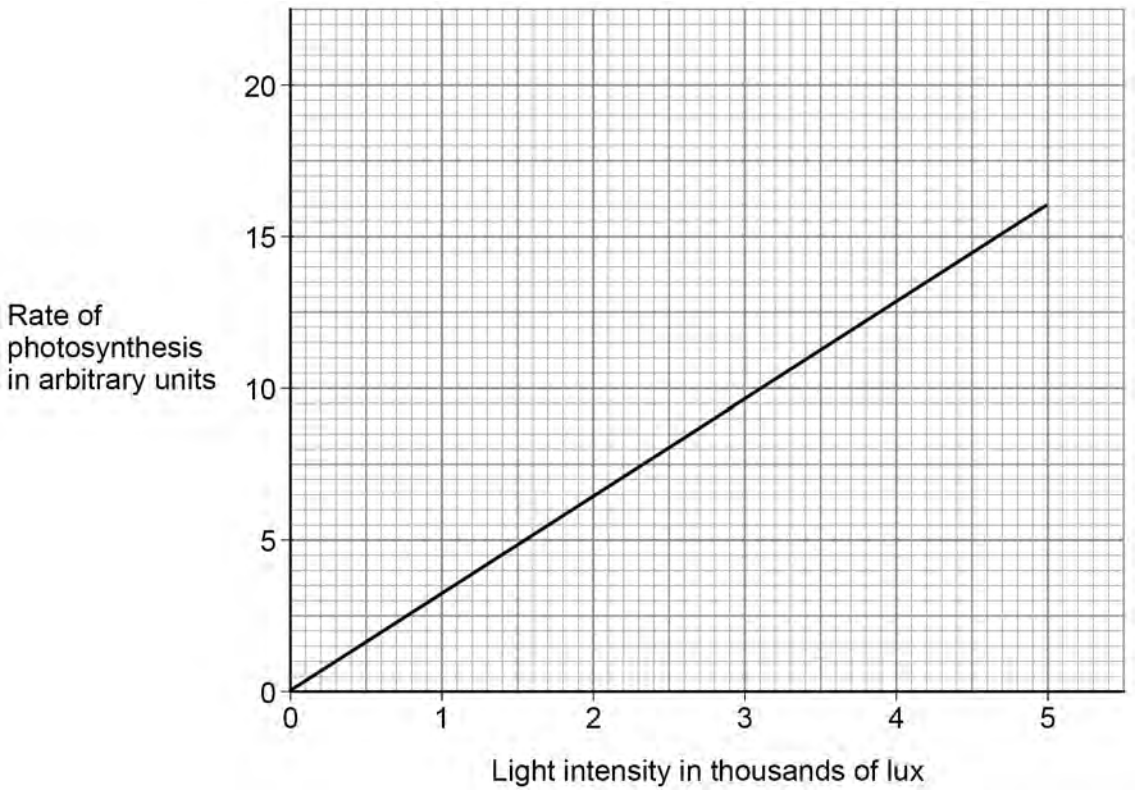
Name **one** piece of apparatus the student could use to measure the volume of oxygen.

[1 mark]

0 3 . 9 Another student investigated the effect of light intensity on the rate of photosynthesis.

Figure 1 shows the results.

Figure 1



Describe what **Figure 1** shows about the relationship between light intensity and the rate of photosynthesis.

[2 marks]

15

4.4.1.2 Rate of photosynthesis

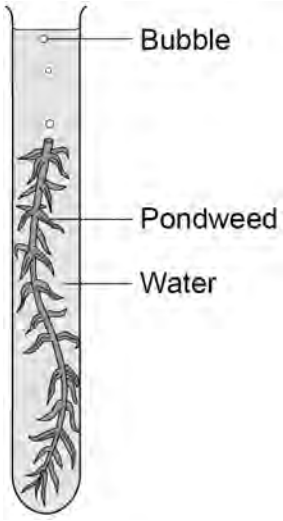
Question 18

June 2025 | 8461/1F | Original Q2

0 2 A student investigated the effect of temperature on the rate of photosynthesis in pondweed.

Figure 2 shows how the student set up the apparatus.

Figure 2



This is the method used.

1. Prepare six tubes of pondweed as shown in **Figure 2**.
2. Place one tube into each of six water baths set at different temperatures.
3. Wait two minutes.
4. Measure the time taken for each piece of pondweed to release 10 bubbles.

0 2 . 1 What is the independent variable in the investigation?

[1 mark]

Tick (✓) **one** box.

Length of pondweed ☐

Temperature of pondweed ☐

Volume of water ☐

Question 2 continues on the next page

4.4.1.2 Rate of photosynthesis

Question 18 · continued

Table 2 shows the results.

Table 2

Temperature in °C	Time taken for pondweed to release 10 bubbles in seconds
10	84
20	43
30	27
40	25
50	33
60	77

0 2 . 2 Complete the sentences.

Choose answers from the box.

[2 marks]

cellulose	**chlorophyll**	**nitrogen**	**oxygen**	**water**

Photosynthesis by the pondweed releases bubbles of _____.

The green substance needed for photosynthesis is called _____.

0 2 . 3 Describe the effect of increasing temperature on the time taken for the pondweed to release 10 bubbles.

[2 marks]

_____

_____

_____

_____

4.4.1.2 Rate of photosynthesis

Question 18 · continued

0 2 . 4 Calculate the rate of photosynthesis at **50 °C**.

Use the equation:

$$\text{rate of photosynthesis in bubbles per second} = \frac{10}{\text{time taken to release 10 bubbles in seconds}}$$

Use **Table 2**.

Give your answer to 1 decimal place.

[3 marks]

Rate of photosynthesis (1 decimal place) = _____ bubbles per second

0 2 . 5 Which temperature had the fastest rate of photosynthesis?

[1 mark]

Tick (✓) **one** box.

- 20 °C ☐
- 30 °C ☐
- 40 °C ☐
- 50 °C ☐

Question 2 continues on the next page

Table 2 is repeated below.

Table 2

Temperature in °C	Time taken for pondweed to release 10 bubbles in seconds
10	84
20	43
30	27
40	25
50	33
60	77

0 2 . 6 The student repeated the investigation at 80 °C.

What would be the time taken for the pondweed to release 10 bubbles at 80 °C?

[1 mark]

Tick (✓) **one** box.

Less than 77 seconds ☐

Exactly 77 seconds ☐

More than 77 seconds ☐

4.4.1.2 Rate of photosynthesis

Question 18 · continued

0 2 . 7 Which **two** factors could affect the rate of photosynthesis in this investigation?

[2 marks]

Tick (✓) **two** boxes.

- Concentration of carbon dioxide ☐
- Light intensity ☐
- Size of boiling tube ☐
- Size of bubbles ☐
- Type of stopwatch ☐

12

Turn over for the next question

4.4.1.2 Rate of photosynthesis

Question 19

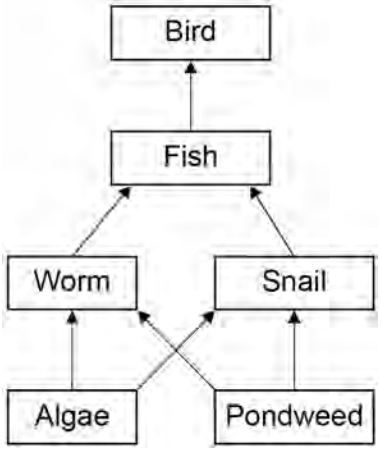
June 2025 | 8461/2F | Original Q6

0 6 Different species in a habitat may depend on each other for food.

Several food chains may be linked together to form a food web.

Figure 10 shows a food web in a lake.

Figure 10



0 6 . 1 Most organisms in the food web get their energy by eating other organisms.

Where does the pondweed get energy from?

[1 mark]

Tick (✓) **one** box.

- Carbon dioxide ☐
- Mineral ions ☐
- Sunlight ☐
- Water ☐

4.4.1.2 Rate of photosynthesis

Question 19 · continued

0 6 . 2 Name **one** organism from **Figure 10** that is a primary consumer.

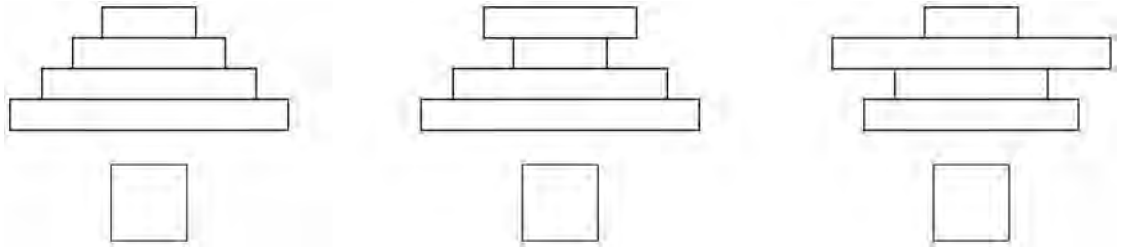
[1 mark]

0 6 . 3 There are four trophic levels in **Figure 10**.

Which is the correct pyramid of biomass for the food web in **Figure 10**?

[1 mark]

Tick (✓) **one** box.



0 6 . 4 One of the food chains in **Figure 10** is:

algae → worm → fish → bird

10% of the biomass in each trophic level is transferred to the next trophic level.

What percentage of the biomass in the algae is transferred to the fish?

[1 mark]

Tick (✓) **one** box.

10% ☐ 1% ☐ 0.1% ☐

Question 6 continues on the next page

4.4.1.2 Rate of photosynthesis

Question 19 · continued

0 6 . 5 What are **two** ways that **energy** is lost from organisms in the food chain?

[2 marks]

Tick (✓) **two** boxes.

- Diffusion ☐
- Faeces ☐
- Movement ☐
- Osmosis ☐
- Photosynthesis ☐

0 6 . 6 Scientists counted the number of fish, snails and worms in a sample taken from the lake.

Table 3 shows the results.

Table 3

	Tally	Number of organisms in the sample
Fish	|||	
Snails	𝍸 𝍸 ||	
Worms	𝍸 𝍸 𝍸 𝍸 |||	

Complete **Table 3**.

[2 marks]

8