



GCSE Biology

Photosynthesis

Question Paper

Time available: 65 minutes

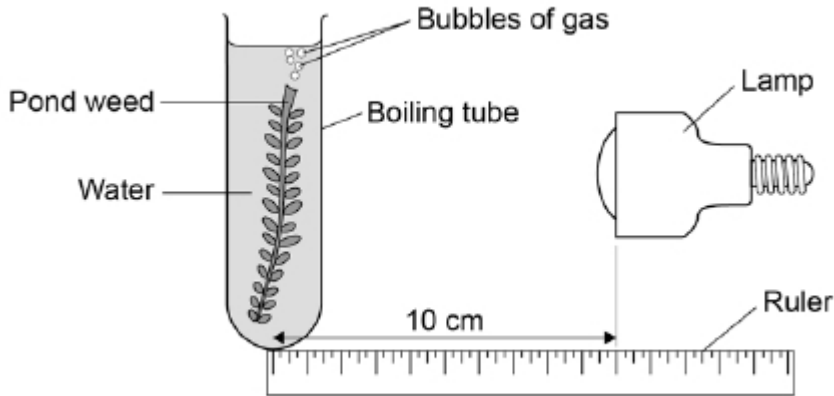
Marks available: 59 marks

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1.

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

The diagram shows the apparatus the student used.



This is the method used.

1. Set up the apparatus as shown in the diagram above.
2. Place the lamp 10 cm from the pondweed.
3. Turn the lamp on and count the number of bubbles produced in one minute.
4. Repeat with the lamp at different distances from the pondweed.

(a) Complete the hypothesis for the student's investigation.

'As light intensity increases, _____
_____.'

(1)

(b) What was the independent variable in this investigation?

Tick **one** box.

Light intensity

Number of bubbles produced

Temperature

Time

(1)

- (c) The teacher suggests putting the boiling tube into a beaker of water during the investigation.

Suggest why this would make the results more valid.

(1)

Table 1 shows the student's results.

Table 1

| Distance of lamp from pondweed in cm | Number of bubbles produced per minute | | | |
|--------------------------------------|---------------------------------------|---------|---------|------|
| | Trial 1 | Trial 2 | Trial 3 | Mean |
| 10 | 67 | 66 | 69 | 67 |
| 20 | 61 | 64 | 62 | 62.3 |
| 30 | 53 | 51 | 52 | X |
| 40 | 30 | 32 | 31 | 31 |
| 50 | 13 | 15 | 15 | 14 |

- (d) Calculate value X in Table 1.

X = _____ bubbles per minute

(1)

- (e) State **one** error the student has made when completing the results at 20 cm.

(1)

(f) What evidence in **Table 1** shows that the data is repeatable?

Tick **one** box.

The number of bubbles decreases as distance decreases.

The numbers of bubbles at each distance are similar.

The student calculated a mean for each distance.

The student did the experiment three times.

(1)

Another student investigated the effect of the colour of light on the rate of photosynthesis.

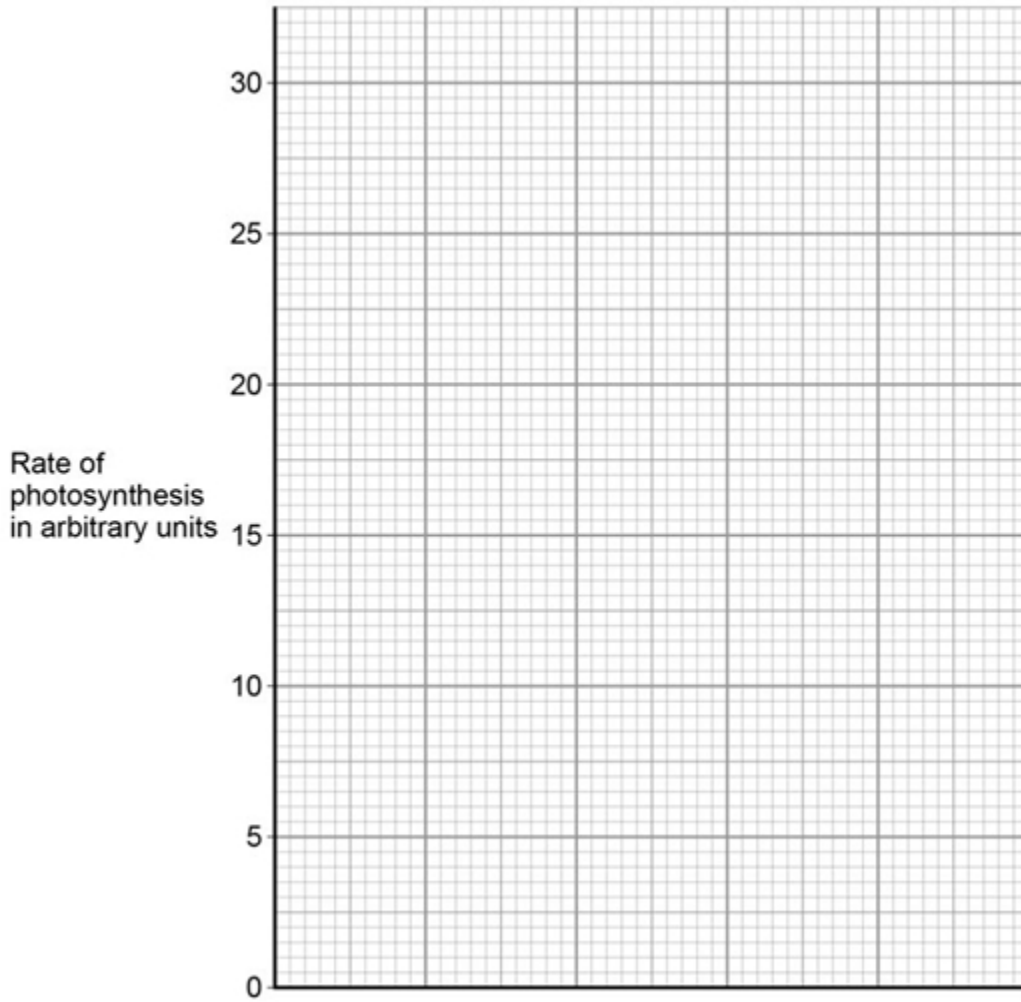
The results are shown in **Table 2**.

Table 2

| Colour of light | Rate of photosynthesis in arbitrary units |
|------------------------|--|
| Blue | 24 |
| Green | 4 |
| Red | 17 |
| Yellow | 8 |

(g) Plot the data from **Table 2** on the graph.

You should label the x-axis.



(3)

(h) Give **two** conclusions from the graph above.

1. _____

2. _____

(2)

(i) The glucose produced in photosynthesis can be converted into amino acids to make new proteins for the plant.

Complete the sentences.

The glucose produced in photosynthesis can also be used in other ways.

Glucose can be used in respiration to release _____ .

Glucose can be converted to cellulose to strengthen the _____ .

Glucose can be stored as _____ .

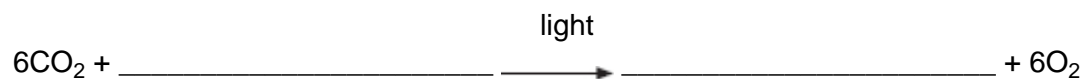
(3)

(Total 14 marks)

2.

Photosynthesis needs light.

(a) Complete the **balanced symbol** equation for photosynthesis.



(2)

(b) A green chemical indicator shows changes in the concentration of carbon dioxide (CO₂) in a solution.

The indicator solution is **green** when the concentration of CO₂ is normal.

The indicator solution turns **yellow** when the concentration of CO₂ is high.





The indicator solution turns **blue** when the concentration of CO₂ is very low or when there is no CO₂.

The indicator solution does not harm aquatic organisms.

Students investigated the balance of respiration and photosynthesis using an aquatic snail and some pondweed.

The students set up four tubes, **A**, **B**, **C** and **D**, as shown in the table below.

The colour change in each tube, after 24 hours in the light, is recorded.

| Tube A | Tube B | Tube C | Tube D |
|--|--|---|--|
|  |  |  |  |
| Indicator solution only | Indicator solution + pondweed | Indicator solution + snail | Indicator solution + pondweed + snail |
| Stays green | Turns blue | Turns yellow | Stays green |

(i) What is the purpose of **Tube A**?

(1)

(ii) Explain why the indicator solution in **Tube C** turns yellow.

(2)

(iii) Predict the result for **Tube D** if it had been placed in the dark for 24 hours and **not** in the light.

Explain your prediction.

Prediction _____

Explanation _____

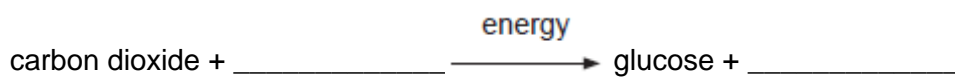
(3)

(Total 8 marks)

3.

Photosynthesis uses carbon dioxide to make glucose.

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



(2)

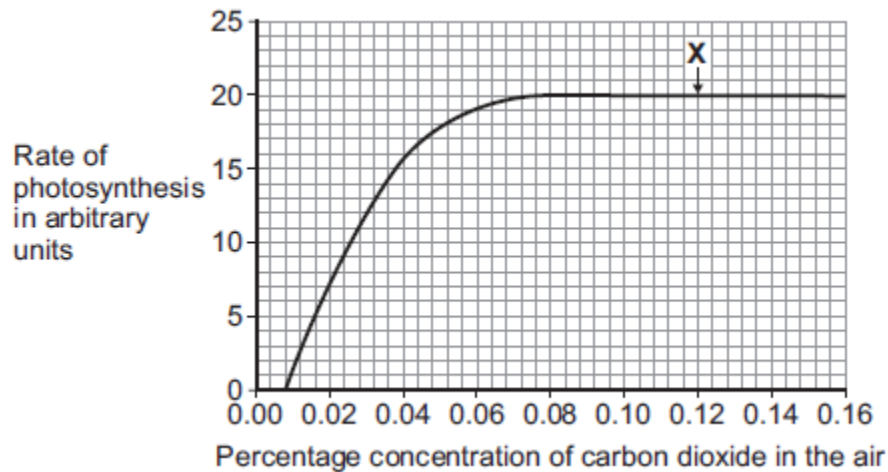
(ii) What type of energy does a plant use in photosynthesis?

(1)

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

(1)

- (b) The graph shows the effect of the concentration of carbon dioxide on the rate of photosynthesis in tomato plants at 20 °C.



- (i) What is the maximum rate of photosynthesis of the tomato plants shown in the graph?

_____ arbitrary units

(1)

- (ii) At point **X**, carbon dioxide is **not** a limiting factor of photosynthesis.

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

(1)

- (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%.

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

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

(1)

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

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

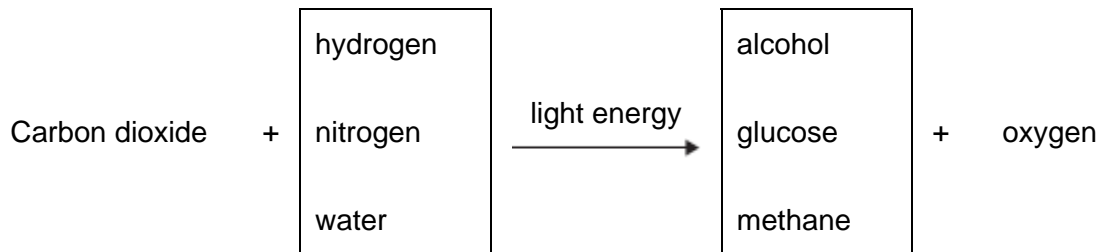
Because it would increase water loss from the tomato plants

(2)

(Total 9 marks)

4.

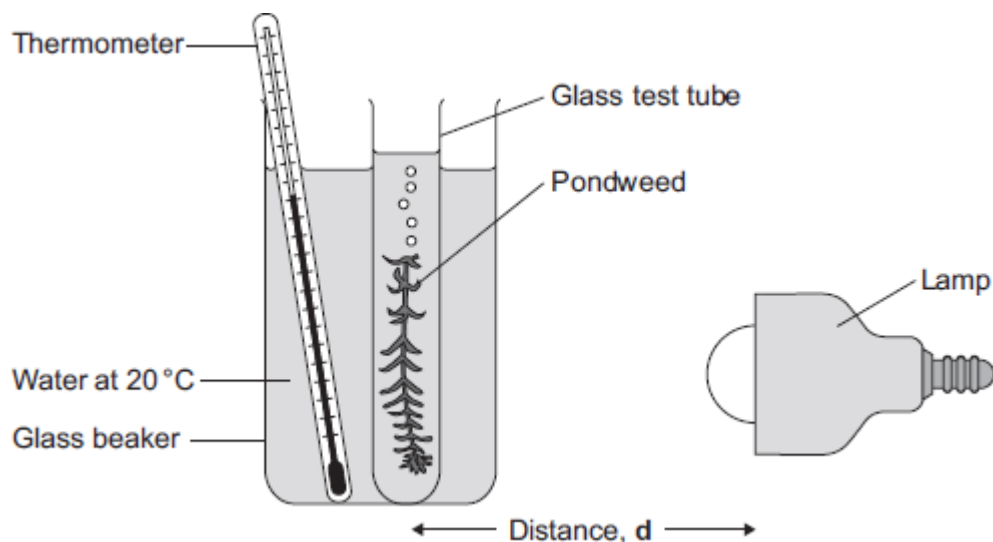
(a) Complete the equation for photosynthesis. Draw a ring around each correct answer.



(2)

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

The diagram shows the apparatus the students used.



The closer the lamp is to the pondweed, the more light the pondweed receives.

The students placed the lamp at different distances, **d**, from the pondweed.

They counted the number of bubbles of gas released from the pondweed in 1 minute for each distance.

- (b) A thermometer was placed in the glass beaker.

Why was it important to use a thermometer in this investigation?

(3)

- (c) The students counted the bubbles four times at each distance and calculated the correct mean value of their results.

The table shows the students' results.

| Distance d in cm | Number of bubbles per minute | | | | |
|----------------------------|------------------------------|----|----|----|------|
| | 1 | 2 | 3 | 4 | Mean |
| 10 | 52 | 52 | 54 | 54 | 53 |
| 20 | 49 | 51 | 48 | 52 | 50 |
| 30 | 32 | 30 | 27 | 31 | 30 |
| 40 | 30 | 10 | 9 | 11 | |

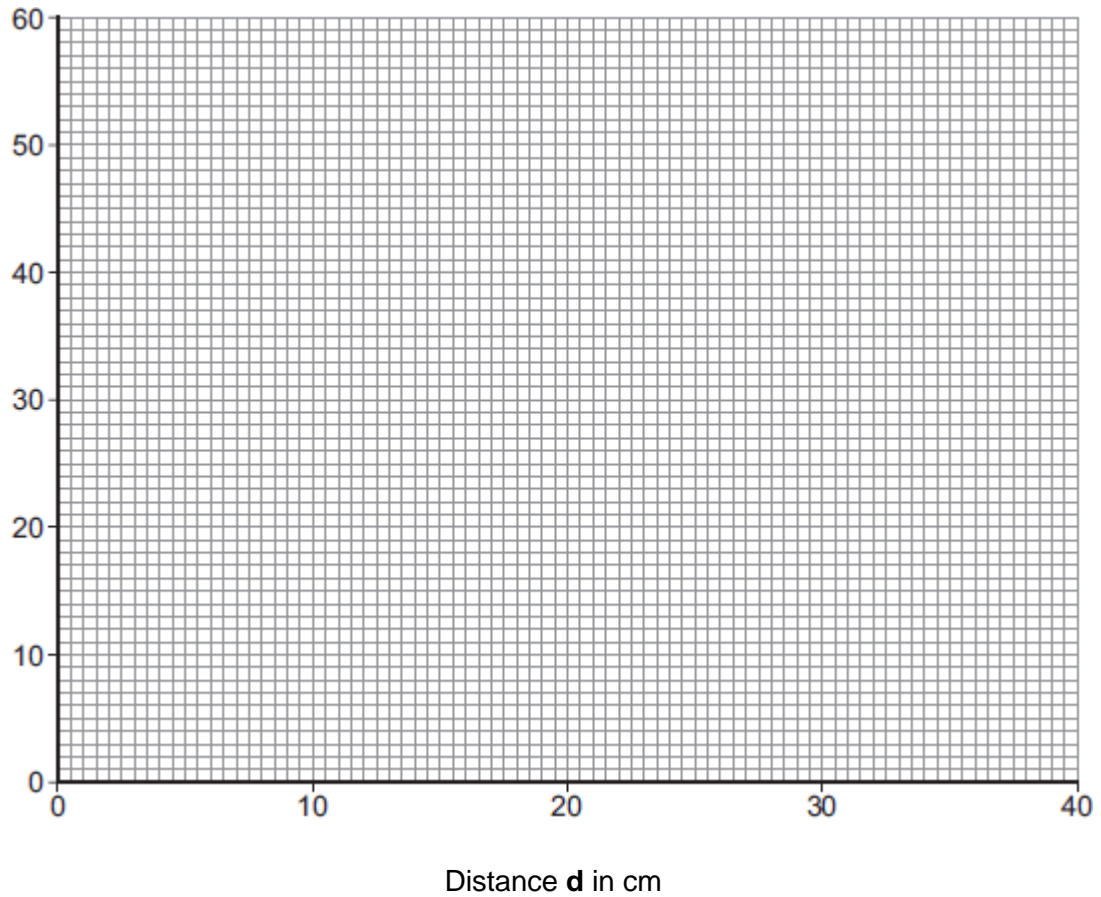
- (i) Calculate the mean number of bubbles released per minute when the lamp was 40 cm from the pondweed.

Mean number of bubbles at 40 cm = _____

(2)

(ii) On the graph paper below, draw a graph to show the students' results:

- add a label to the vertical axis
- plot the **mean values** of the number of bubbles
- draw a line of best fit.



(4)

(iii) One student concluded that the rate of photosynthesis was inversely proportional to the distance of the lamp from the plant.

Does the data support this conclusion?

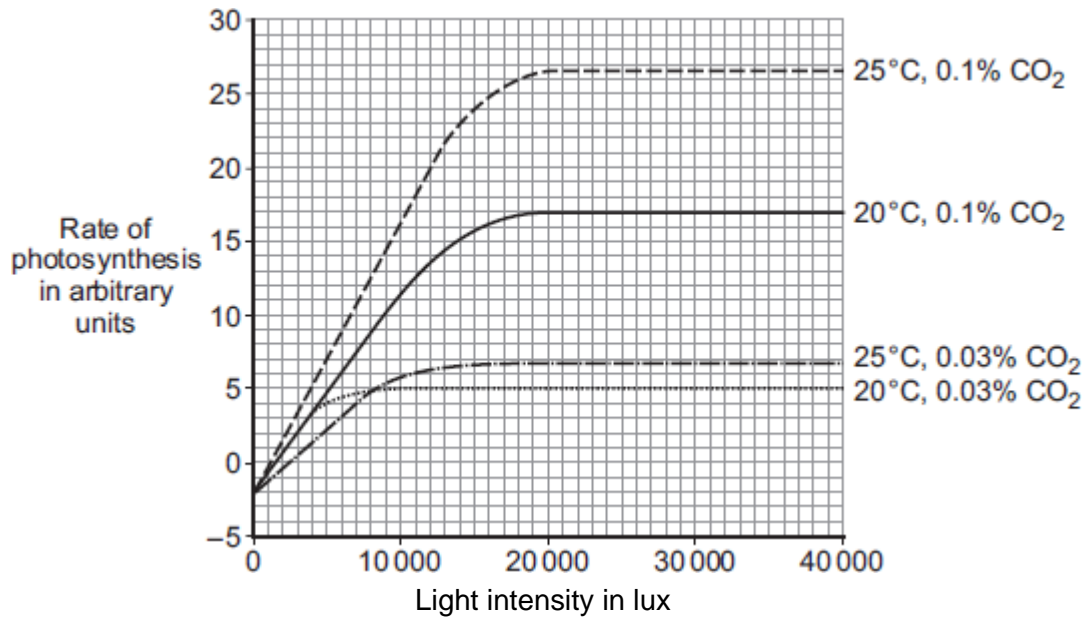
Explain your answer.

(2)

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

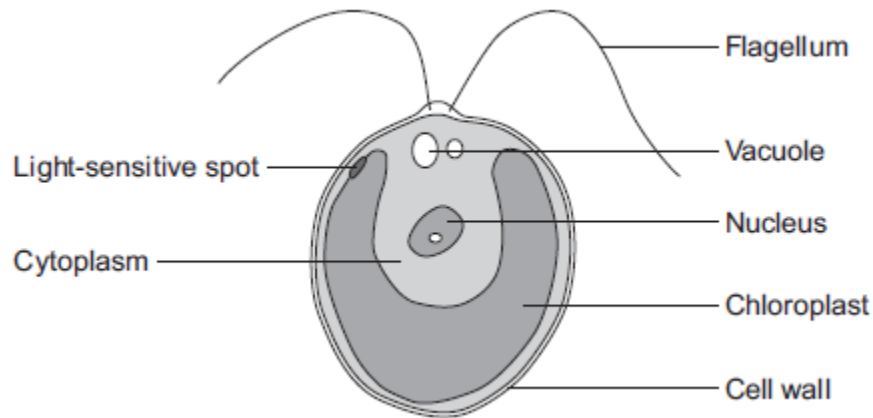
Scientists investigated the effects of these three factors on the rate of photosynthesis in tomato plants growing in a greenhouse.

The graph below shows the scientists' results.



5.

The diagram below shows a single-celled alga which lives in fresh water.



(a) Which part of the cell labelled above:

(i) traps light for photosynthesis

(1)

(ii) is made of cellulose?

(1)

(b) In the freshwater environment water enters the algal cell.

(i) What is the name of the process by which water moves into cells?

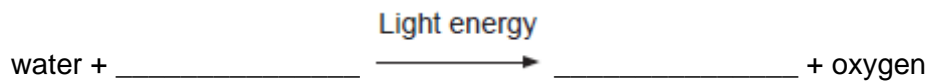
(1)

(ii) Give the reason why the algal cell does not burst.

(1)

(c) (i) The alga can photosynthesise.

Complete the **word** equation for photosynthesis.



(2)

(ii) The flagellum helps the cell to move through water. Scientists think that the flagellum and the light-sensitive spot work together to increase photosynthesis.

Suggest how this might happen.

(2)

(d) Multicellular organisms often have complex structures, such as lungs, for gas exchange.

Explain why single-celled organisms, like algae, do **not** need complex structures for gas exchange.

(3)

(Total 11 marks)