

1 In some countries forests are cleared by burning. This produces carbon dioxide and ash.

(a) Outline the environmental effects of an increase in carbon dioxide in the atmosphere as a result of burning forests.

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(b) The ash helps crops to grow because it is rich in minerals, such as magnesium ions, but it is deficient in nitrate ions.

Explain why nitrate ions and magnesium ions are important for plants.

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(c) When mineral ions from soils are washed into streams and rivers there is often a rapid growth of algae.

(i) State the name of the effect that is caused by adding mineral ions to streams and rivers.

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(ii) These streams and rivers often have low concentrations of dissolved oxygen.
Explain why.

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(d) Untreated domestic sewage contains organic waste as well as dissolved minerals.

Outline how sewage is treated so that the water may be recycled as drinking water.

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[Total: 14]

- 2 Fanwort, *Cabomba caroliniana*, is an aquatic plant often used to provide oxygen in fish tanks.

Some students investigated the effect of temperature on the rate of photosynthesis of *C. caroliniana*. The apparatus that they used is shown in Fig. 2.1.

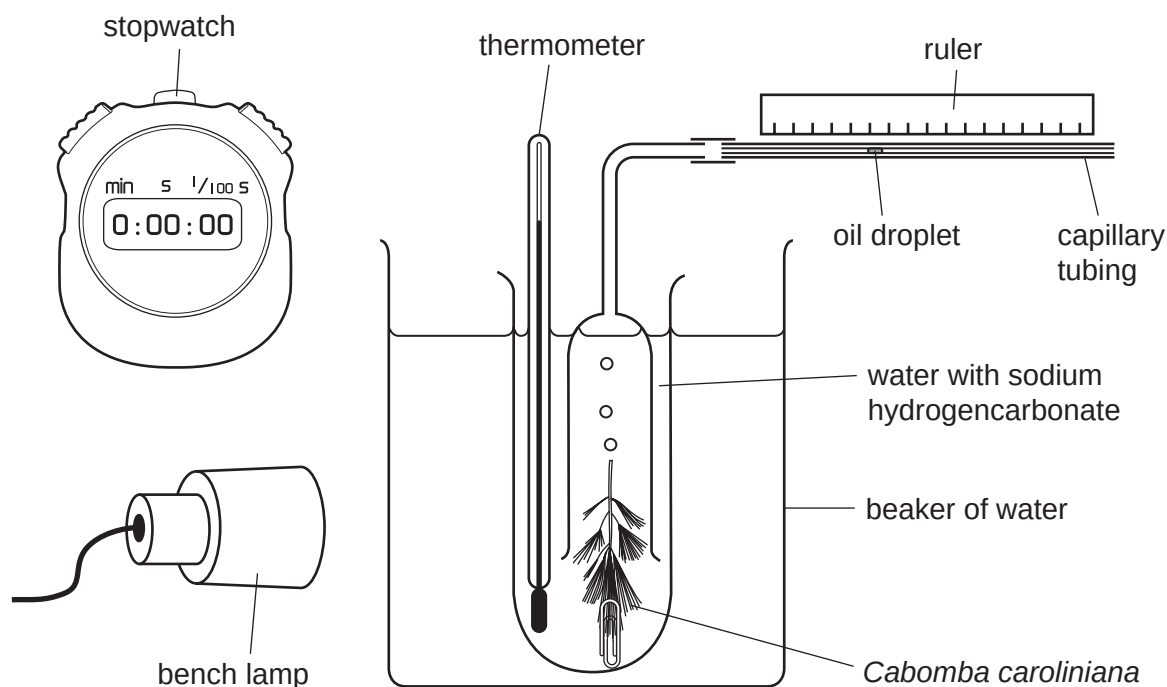


Fig. 2.1

(a) Explain why:

- (i) the lamp was kept at the same distance from the *C. caroliniana* throughout the investigation;

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- (ii) the water was enriched with carbon dioxide by adding sodium hydrogencarbonate.

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The students determined the rate of photosynthesis by measuring the movement of the oil droplet along the glass tubing.

Their results are shown in Table 2.1.

Table 2.1

temperature / °C	distance travelled by the droplet / mm per minute			
	1		3	mean
17		3	3	3.7
21		15	11	12.0
23		10	15	15.0
25		15	15	20.0
30		40	30	40.0
45		3	5	4.3
50		0	1	0.7

(b) Describe the effect of temperature on the **rate of photosynthesis** of *C. caroliniana*.

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(c) Photosynthesis is a chemical process catalysed by enzymes.

Explain how the results shown in Table 2.1 support the idea that enzymes are involved in photosynthesis.

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(d) *C. caroliniana* originally grew only in Latin America.

This plant has escaped into the wild in Australia where its rapid growth has reduced the biodiversity of many streams and rivers.

Suggest why the growth of *C. caroliniana* in Australia is far greater than in Latin America.

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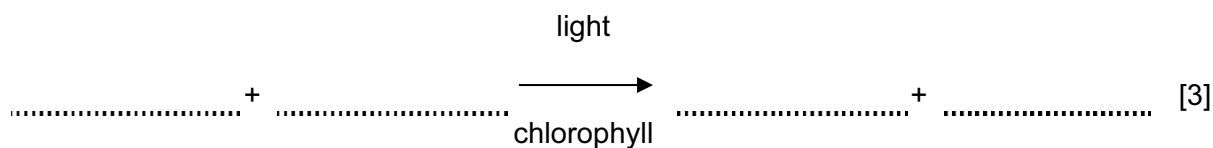
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[Total: 13]

- 3 (a) Complete the balanced chemical equation for photosynthesis.



A student investigated the effect of increasing the concentration of carbon dioxide on the rate of photosynthesis of *Cabomba*, an aquatic plant.

Fig. 4.1 shows the apparatus that the student used.

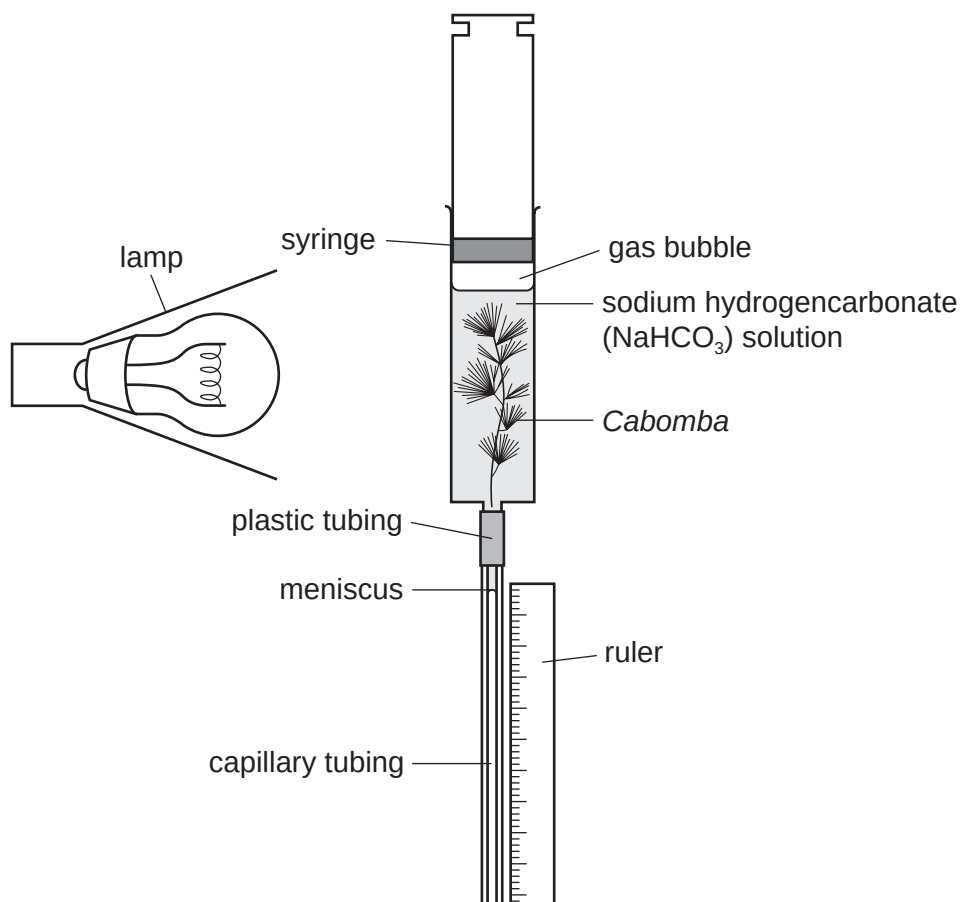


Fig. 4.1

The concentration of carbon dioxide in the water surrounding the plant was changed by adding different concentrations of sodium hydrogencarbonate solution to the water.

The student recorded the time taken for the meniscus to travel 50 mm down the tubing.

The rate of photosynthesis was calculated as:

$$\text{rate of photosynthesis} = \frac{1000}{t}$$

where t = time taken in seconds for the meniscus to travel 50 mm.

The student's results are shown in Table 4.1.

Table 4.1

concentration of sodium hydrogencarbonate solution / mol per dm ³	t, time taken for meniscus to travel 50 mm / s	rate of photosynthesis (1000/t)
0.00		
0.01		
0.02		
0.05	350	2.86
0.07	201	
0.10	199	5.03

- (b) Calculate the rate of photosynthesis for the concentration of sodium hydrogencarbonate solution of 0.07 mol per dm³.

Write your answer in Table 4.1. [1]

- (c) (i) Explain why the lamp must be kept at a fixed distance from the syringe.

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- (ii) Explain what caused the meniscus to move down the capillary tubing.

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(d) Fig. 4.2 is a partially completed graph of the student's results.

Complete the graph by labelling the axes, adding the missing point and drawing a suitable line.

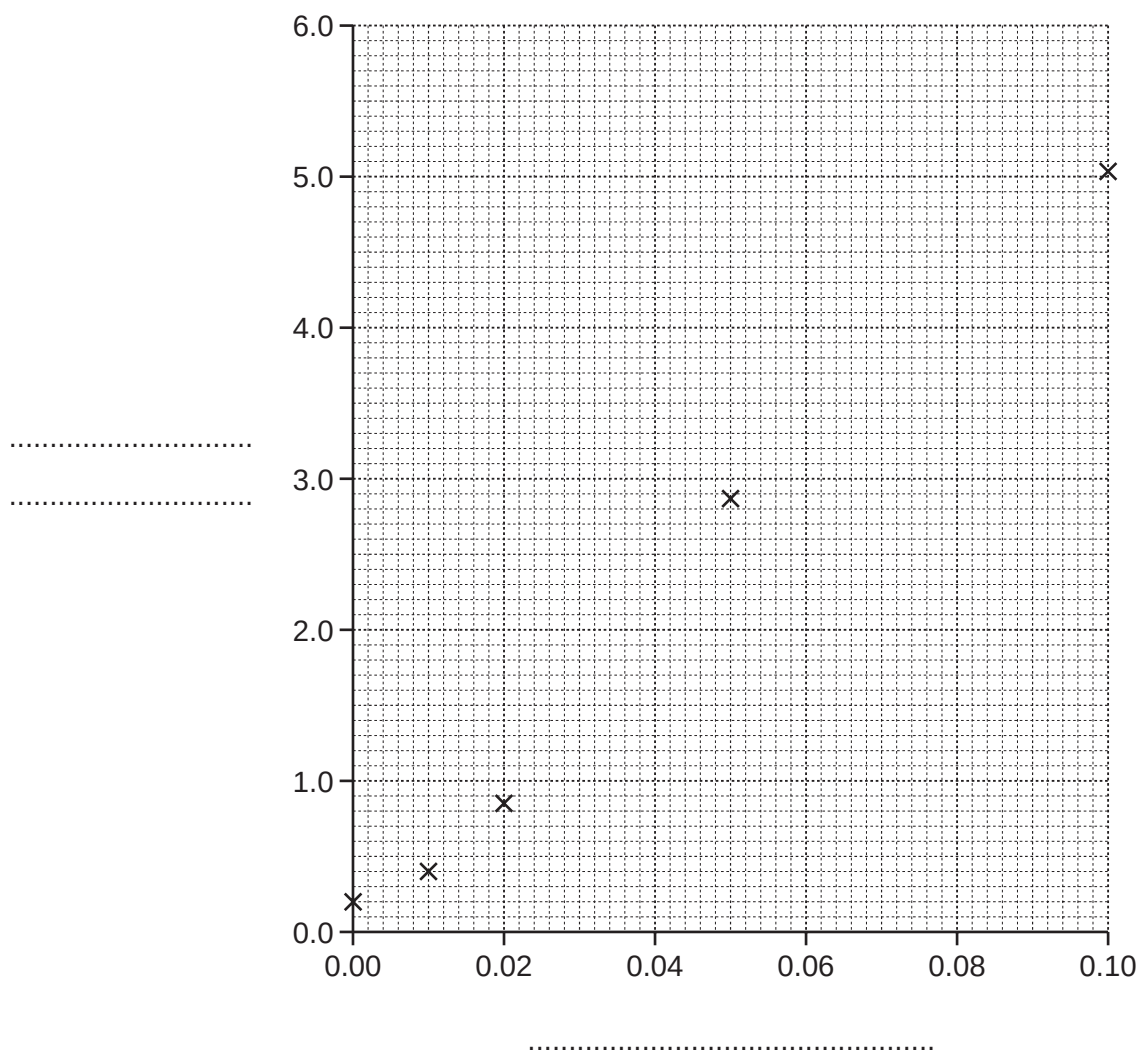


Fig. 4.2

[3]

- You will gain credit for using the data in the table and the graph to answer the question.

[Total: 16]

- 4 (a) Write a balanced equation for photosynthesis using symbols.

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Plants that live in water are called hydrophytes.

Fig. 5.1 shows a cross-section of a leaf of the hydrophyte, *Nuphar lutea*. The leaves of *N. lutea* float on the surface of water.

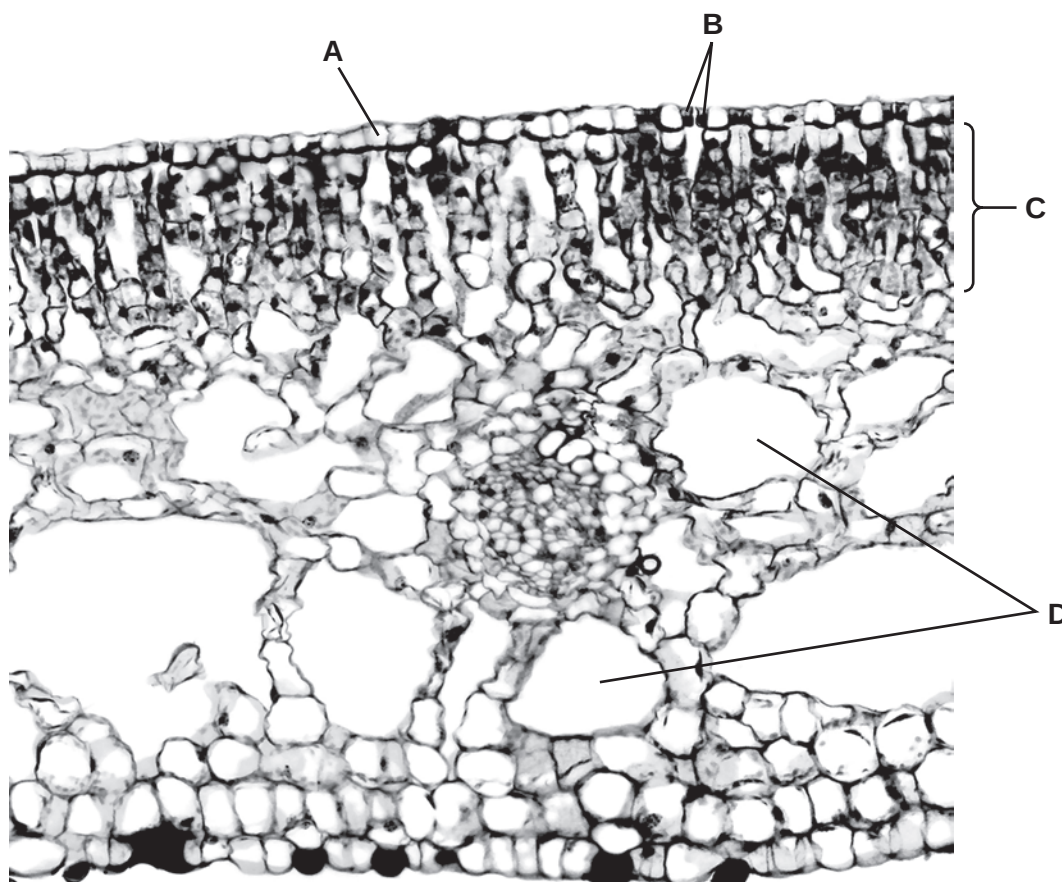


Fig. 5.1

- (b) Complete Table 5.1 by describing the function of each feature.
The function for feature **A** has already been completed.

Table 5.1

feature	f
A	transparent to allow light to penetrate into the leaf
B	
C	
D	

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- (c) State **and** explain **one** way in which the leaves of *N. lutea* are adapted to their environment.

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- (d) A student investigated how magnesium affects the growth of duckweed, *Spirodela polyrhiza*.

He prepared dishes each containing 30 plants of *S. polyrhiza*. Each dish contained a growth medium with different concentrations of a magnesium salt.

Fig. 5.2 shows one of the dishes.

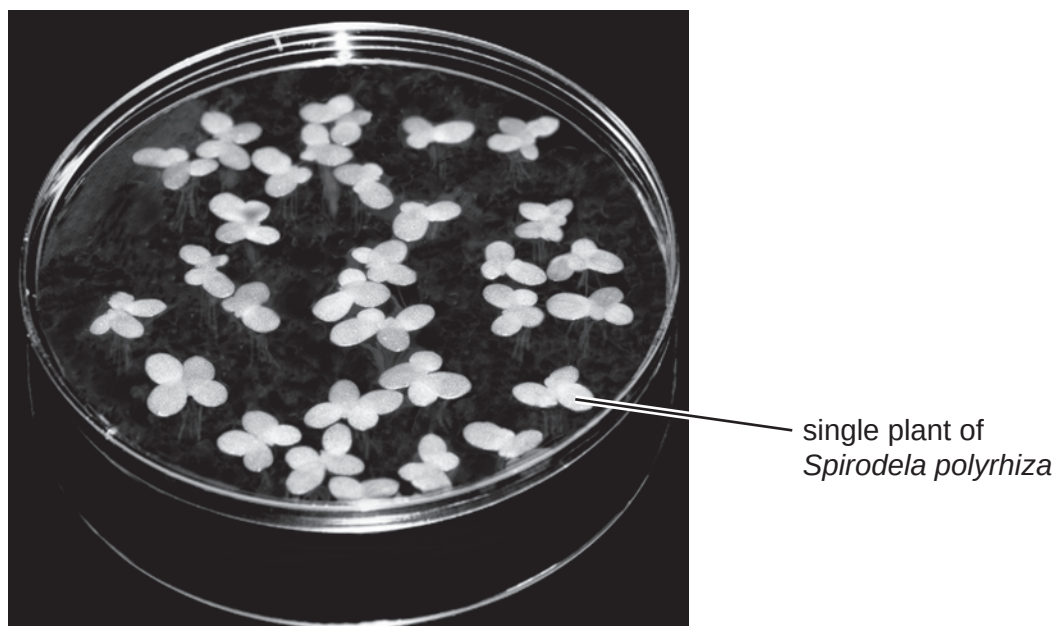


Fig. 5.2

After 33 days, the student counted the number of plants in each dish and recorded their appearance. The results are shown in Table 5.2.

Table 5.2

concentration of magnesium salt / mg per dm^3	number of plants after 33 days	appearance of leaves after 33 days
0.05	27	yellow with some green patches
0.10	64	green with yellow spots
0.15	92	green with yellow spots
0.20		green
0.25		green

- (i) Describe the effects of **decreasing** the concentration of magnesium salt on the growth of *S. polyrhiza*.

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- (ii) Explain how magnesium deficiency affects the growth and appearance of this plant.

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[Total: 14]