1 **(a)** Fig. 3.1 is an electron micrograph of a chloroplast from a tobacco leaf.

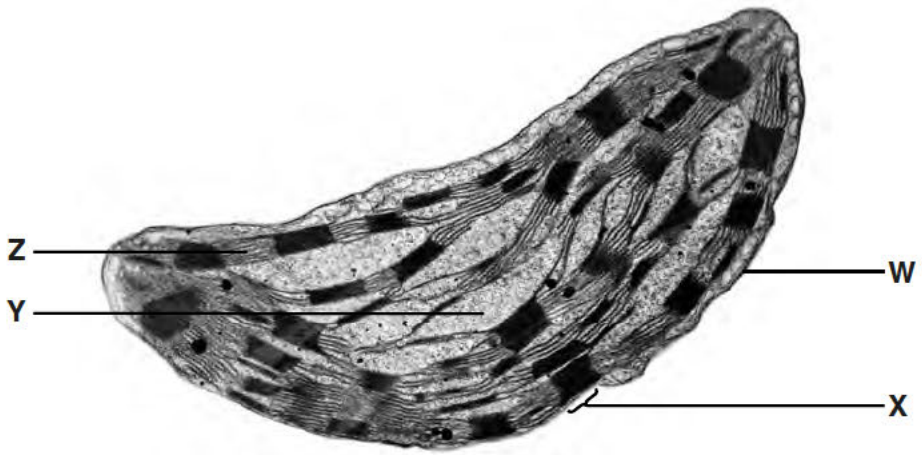


Fig. 3.1

(i) Identify the structures labelled **W** to **Z**.

W .....

X .....

Y .....

Z ..... **[4]**

(ii) In addition to the structures seen in Fig. 3.1, a chloroplast also contains DNA and ribosomes.

Suggest the role of DNA and ribosomes **in this organelle**.

.....

.....

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.....

.....

..... **[2]**

(b) The table below contains statements that refer to the light-dependent stage of photosynthesis.

Complete the table, indicating with the letters **C**, **N** or **B**, whether each statement applies to:

- cyclic photophosphorylation only (**C**)

  or

- non-cyclic photophosphorylation only (**N**)

  or

- both cyclic and non-cyclic photophosphorylation (**B**)

The first one has been completed for you.

statement	letter
ATP is produced	**B**
an electron leaves photosystem I	
electrons are passed along an electron carrier chain	
electrons leave both photosystem I and photosystem II	
an electron from a water molecule replaces the electron lost from the photosystem	
the same electron returns to the photosystem	

[5]

[Total: 11]

2 A student carried out an experiment to investigate the effect of light intensity on the rate of photosynthesis in an aquatic plant, using the apparatus shown in Fig. 2.1.

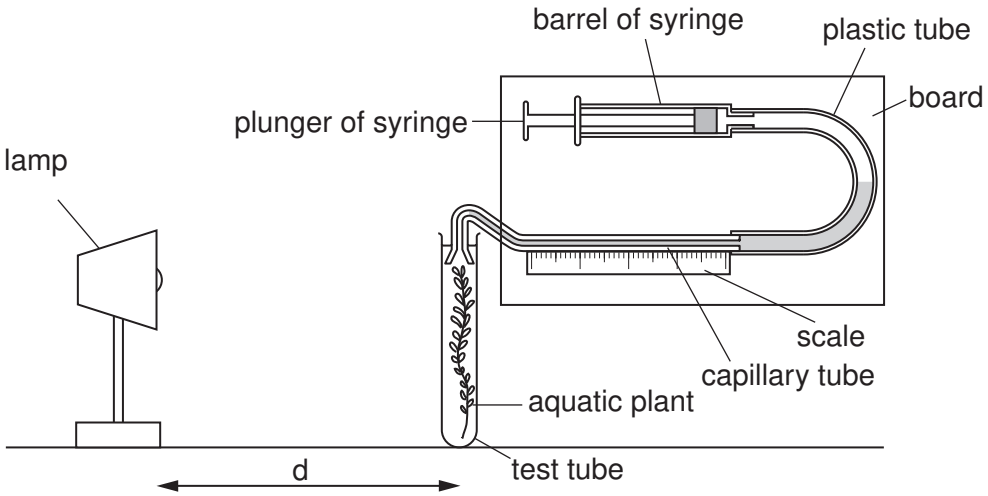


Fig. 2.1

The student decided to measure the rate of photosynthesis by measuring the gas produced over a five minute period. The gas collected in the capillary tube.

After five minutes, the length of the bubble was measured along the scale.

The light intensity was varied by altering the distance (d) between the lamp and the photosynthesising plant.

The student prepared Table 2.1 to calculate the light intensity.

Table 2.1

distance (d) from lamp to plant (cm)	light intensity $\left(\frac{1}{d^2}\right)$
4	0.0625
8	0.0156
12	0.0069
16	0.0039
20	0.0025
24	
60	0.0003

(a) **(i)** Calculate the light intensity when the lamp was 24 cm from the plant.

Show your working.

Answer = ... **[2]**

(ii) The length of the gas bubble was measured (in mm).

State what additional information would be required to calculate the **volume** of gas produced.

.....

.....

..... **[1]**

(iii) Suggest how the student supplied the aquatic plant with a source of carbon dioxide.

.....

.....

..... **[1]**

(b) Certain assumptions are made when using the apparatus shown in Fig. 2.1 to measure the rate of photosynthesis.

(i) One of these assumptions is that all of the oxygen produced by the plant during photosynthesis is collected.

Suggest why not all of the oxygen produced by the plant is collected.

.....

.....

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..... **[2]**

(ii) Another assumption is that all of the gas collected is oxygen.

Analysis of the gas collected reveals that it has the following composition:

- oxygen 50%
- nitrogen 44%
- carbon dioxide 6%

Suggest a reason for the presence of nitrogen in the gas collected.

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.....

..... **[1]**

(iii) Comment on the percentage of carbon dioxide present in the gas collected and give reasons for this figure.

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..... **[3]**

(c) Some aquatic photosynthetic organisms, for example seaweeds, contain pigments such as fucoxanthin and phycoerythrin, in addition to chlorophyll. These pigments give seaweeds a brown or red colour and are produced in larger quantities in those seaweeds that live in deeper water.

Suggest why the presence of these pigments is an advantage to seaweeds that live in deeper water.

.....

.....

.....

.....

.....

..... **[2]**

[Total: 12]

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3 **(a)** The Calvin cycle is the stage of photosynthesis during which carbon dioxide is fixed. The Calvin cycle uses the products of the light dependent stage.

(i) Name the products of the light dependent stage that are used in the Calvin cycle.

.....

..... **[2]**

(ii) Discuss the fate of triose phosphate (TP) in the Calvin cycle.

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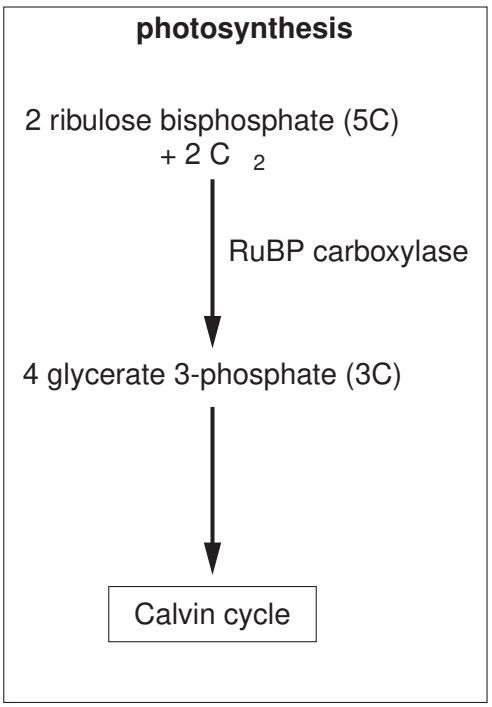
.....

.....

..... **[3]**

(b) A process known as **photorespiration** also takes place in photosynthetic cells. In this process, oxygen competes with carbon dioxide for the active site of the enzyme RuBP carboxylase (Rubisco).

Fig. 3.1 (a) and Fig. 3.1 (b) outline the processes of photosynthesis and photorespiration.



(a)

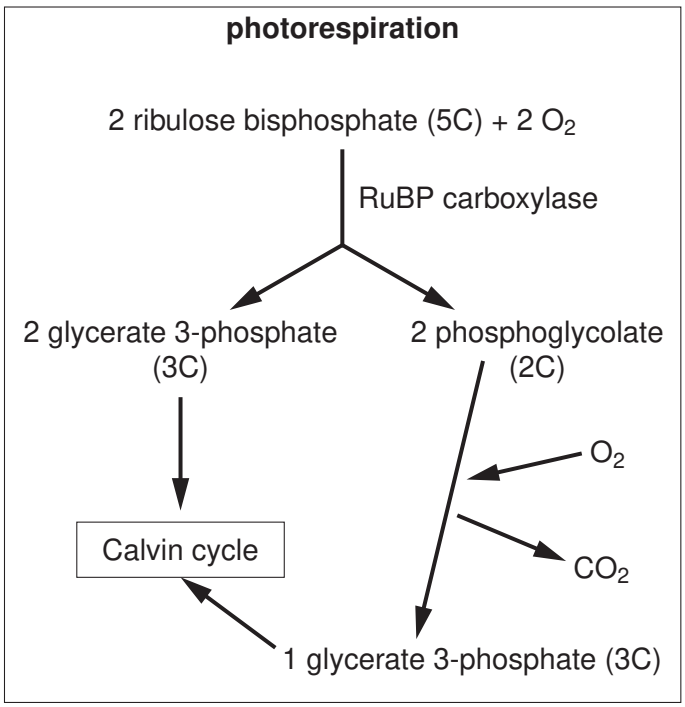


Fig. 3.1 (b)

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(i) Suggest why the process outlined in Fig. 3.1 (b) is known as photorespiration.

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..... **[2]**

(ii) Using Fig. 3.1 (a) and Fig. 3.1 (b), describe and explain the likely effect on photosynthesis of an increase in the oxygen concentration.

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..... **[3]**

(iii) Some plants, known as C_4 plants, use an enzyme called PEP carboxylase, instead of Rubisco, to fix carbon dioxide.

Suggest why these plants do **not** show photorespiration.

.....

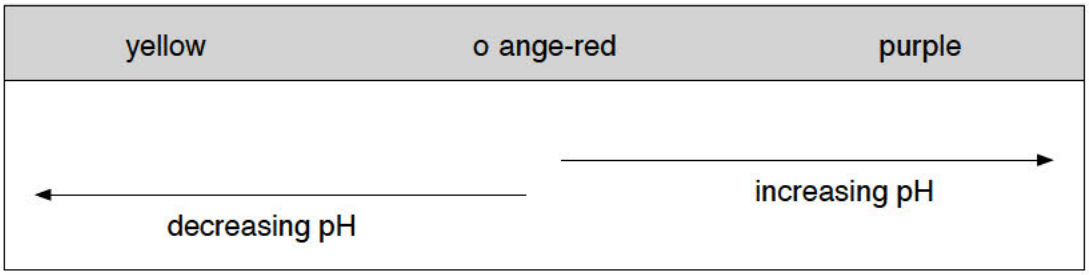
.....

..... **[1]**

[Total: 11]

4 **(a)** An experiment was carried out into the effect of different wavelengths of light on the rate of photosynthesis.

Four sealed test-tubes were set up, each containing three leaf discs from the same plant suspended above hydrogencarbonate indicator solution. This solution changes colour at different pH values, as shown below.



At the start of the experiment, the contents of all four tubes were orange-red.

Each tube was illuminated by a lamp with a coloured filter in front of it. The tubes were illuminated for the same length of time. The colour changes were noted and the results are shown in Table 5.1.

Table 5.1

colour of filter	final colour of hydrogencarbonate indicator
colourless	purple
blue	purple
green	orange-yellow
red	red

A fifth tube was set up in the same way as the other tubes. This tube was then covered in black paper before being illuminated for the same length of time. The final colour of the hydrogencarbonate indicator in this tube was yellow.

(i) State the purpose of the tube covered with black paper.

.....

..... **[1]**

(ii) State **two** precautions that need to be taken when designing and carrying out this experiment in order to obtain results from which valid conclusions can be drawn. Explain the need for each precaution.

precaution 1 .....

explanation .....

.....

precaution 2 .....

explanation .....

..... **[2]**

(iii) Name the pigment at the reaction centre of photosystems I and II.

..... **[1]**

(iv) Explain the change observed in the tube exposed to green light.

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..... **[3]**

(b) In order to maximise production, market gardeners often grow plants in glasshouses. Light conditions can be controlled along with a number of other factors.

How can factors **other than light conditions** be controlled to increase the rate of photosynthesis and maximise production?

In your answer you should explain why the rate of photosynthesis is affected by the controlled factors you have discussed.

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..... **[4]**

[Total: 11]