Photosynthesis as an energy transfer process

Question Paper 1

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Photosynthesis
Sub Topic	Photosynthesis as an energy transfer process
Booklet	Theory
Paper Type	Question Paper 1

Time Allowed : **63 minutes**

Score : **/ 52**

Percentage : **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 Fig. 5.1 is a light micrograph of some unicellular photosynthetic organisms called *Chlamydomonas*.

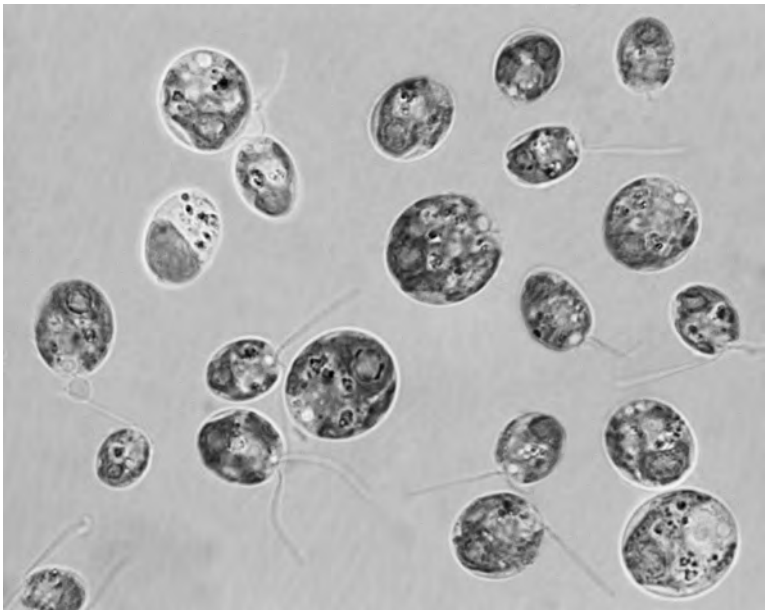

Fig. 5.1

(a) *Chlamydomonas* moves through water.

Explain why the light microscope rather than the electron microscope is used to observe the movement of *Chlamydomonas*.

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.....[2]

(b) *Chlamydomonas* live in water and obtain minerals, such as magnesium ions, from the water.

(i) State **one** role of magnesium ions in photosynthetic organisms.

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.....[1]

(ii) State two properties of water which make it possible for organisms such as *Chlamydomonas* to live in water.

1 .....

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2 .....

..... [2]

(c) Explain why multicellular organisms require transport systems while unicellular organisms, such as *Chlamydomonas*, do not.

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.....[4]

(d) Some plants, such as the banana plant, *Musa acuminata*, produce fruit. The banana fruit has a high content of carbohydrate.

Describe how sugars are transported in phloem sieve tubes from source to sink in plants such as *M. acuminata*.

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.....[5]

[Total: 14]

2 **(a)** Fig. 1.1 shows a section through part of a dicotyledonous leaf of the tea plant *Camellia sinensis*.

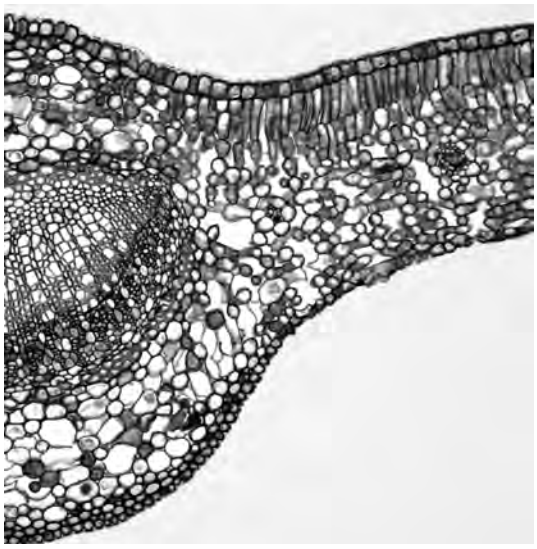

Fig. 1.1

On Fig. 1.1, use label lines and letters to label each of the following parts:

X – xylem tissue
P – palisade mesophyll tissue. [2]

(b) The leaves of *C. sinensis* have a large surface area and are thin.

Explain how each of these two features help the leaf to carry out photosynthesis.

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..... [2]

(c) The lower epidermis contains stomata.

(i) State **one** structural difference between a guard cell and other lower epidermal cells.

..... [1]

(ii) Abscisic acid has an important role in the closure of a stoma. It promotes the loss of potassium ions from guard cells.

Outline how the loss of potassium ions from guard cells will lead to the closure of a stoma.

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..... [3]

[Total: 8]

3 **(a)** Fig. 1.1 shows an electronmicrograph of a chloroplast.

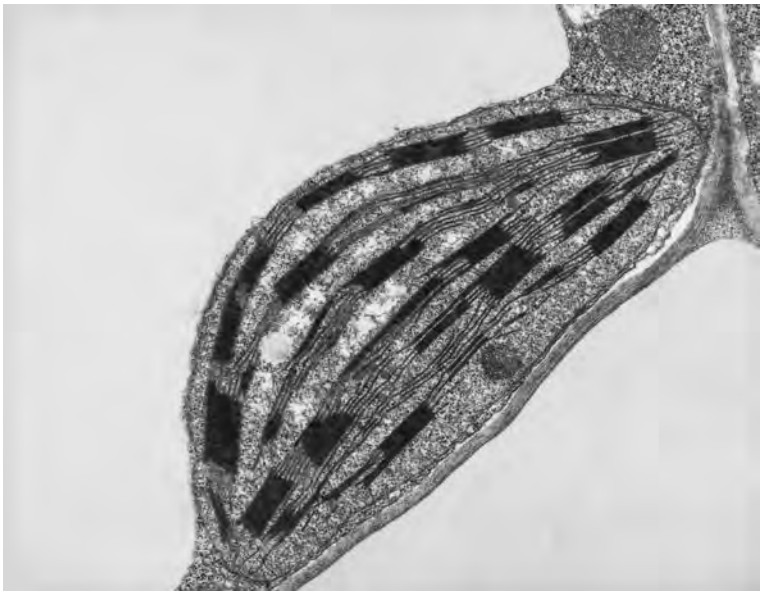

Fig. 1.1

On Fig. 1.1, use label lines and letters to label **one** place where:

L – the light-dependent stage takes place
R – the enzyme rubisco is found.

[2]

(b) Chloroplasts can move within palisade cells.

Suggest **two** advantages of chloroplast movement within palisade cells.

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..... [2]

(c) Complete the following paragraph by naming the most suitable compounds to fill in the gaps.

Rubisco is involved in the fixation of ..... by RuBP (ribulose bisphosphate) in the Calvin cycle. The resulting six carbon compound immediately splits to give two molecules of glycerate-3-phosphate (GP). GP is converted to triose phosphate (TP) using ..... and ..... produced in the light-dependent stage. Some of the TP produced is used to regenerate ribulose bisphosphate so that the Calvin cycle can continue. The remaining TP may be used to synthesise other compounds including ..... which can directly enter the Krebs cycle.

[4]

[Total: 8]

4 **(a)** The unicellular green alga, *Chlorella*, a photosynthetic protoctist, was originally studied for its potential as a food source. Although large-scale production proved to be uneconomic, the many health benefits provided by *Chlorella* mean that it is now mass produced and harvested for use as a health food supplement.

Fig. 1.1 shows cells of *Chlorella*.

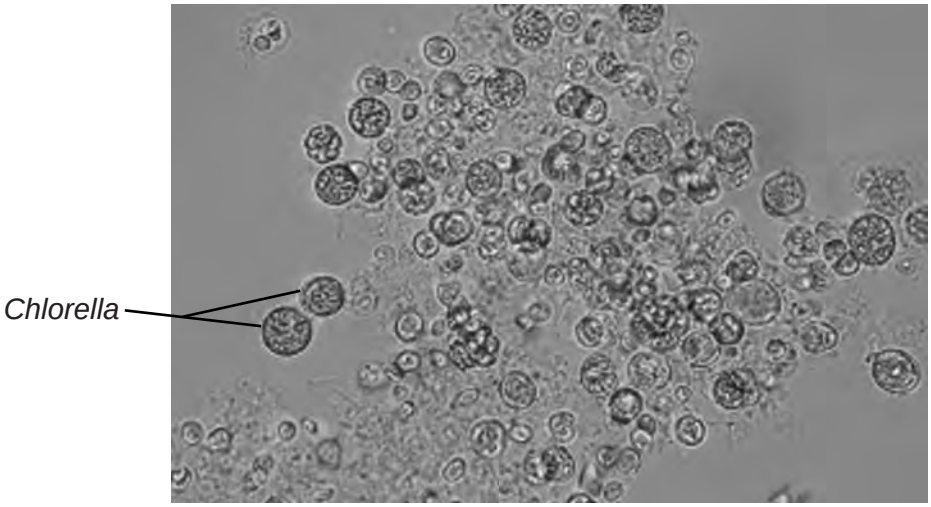

Fig. 1.1

In one study into the productivity of *Chlorella*, carbon dioxide concentration was altered to investigate its effects on the light-independent stage of photosynthesis.

- A cell suspension of *Chlorella* was illuminated using a bench lamp.
- The suspension was supplied with carbon dioxide at a concentration of 1% for 200 seconds.
- The concentration of carbon dioxide was then reduced to 0.03% for a further 200 seconds.
- The concentrations of RuBP and GP (PGA) were measured at regular intervals.
- Throughout the investigation the temperature of the suspension was maintained at 25 °C.

The results are shown in Fig. 1.2.

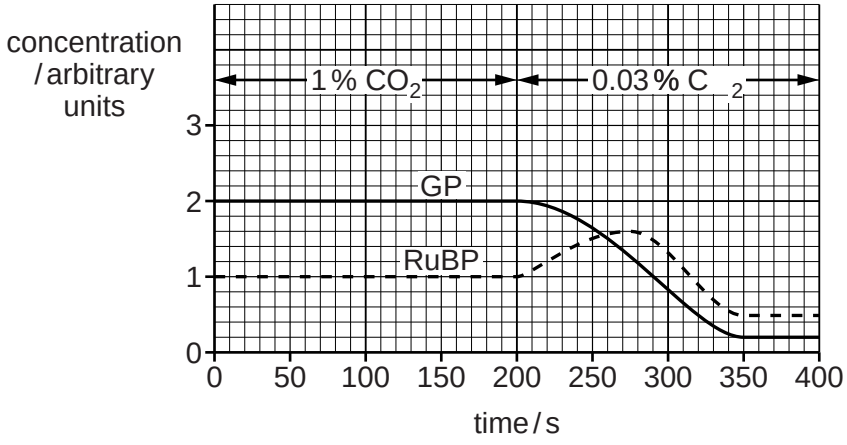

Fig. 1.2

(i) State **precisely** where in the chloroplast RuBP and GP are located.

.....[1]

(ii) Explain why the concentration of RuBP changed between 200 and 275 seconds.

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.....[2]

(iii) Calculate the rate of decrease per second in the concentration of GP between 200 and 350 seconds.

Show your working and give your answer to **two decimal places**.

answer ..... arbitrary units per second [2]

(b) Explain how the decrease in the concentration of GP leads to a decreased harvest for commercial suppliers of *Chlorella*.

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.....[2]

[Total: 7]

5 **(a)** Fig. 1.1 is an electron micrograph of a chloroplast from a maize leaf cell.

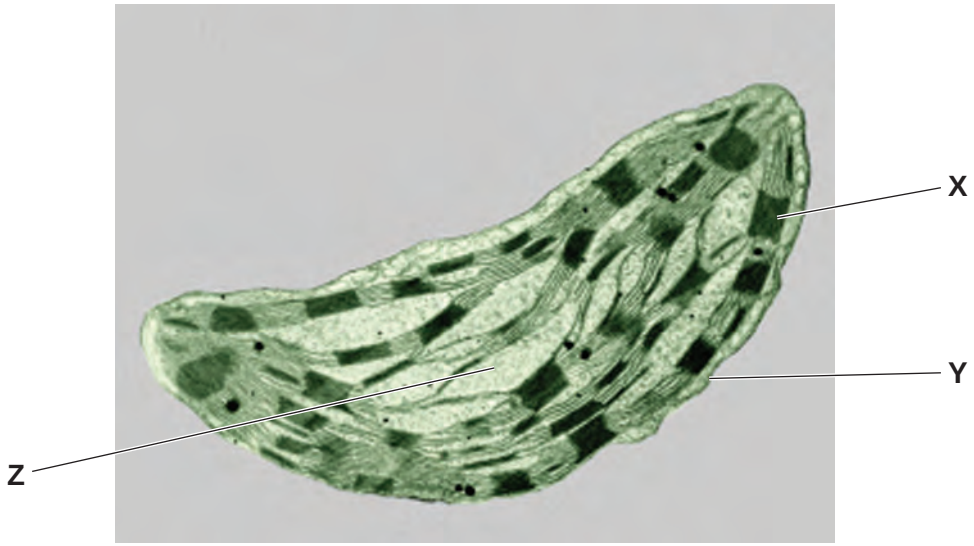

Fig. 1.1

Indicate below which of **X**, **Y** or **Z** contains:

transport proteins .....

pigments ..... [2]

(b) A chloroplast also contains DNA.

Suggest the functions of DNA in **this** organelle.

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.....[2]

(c) Changes in the atmospheric carbon dioxide concentration, light intensity and temperature alter the rate of photosynthesis. These three factors directly affect different stages of photosynthesis.

Complete the table below using a tick (✓) if the factor **directly** affects the stage or a cross (✗) if it does not affect the stage.

factor	**stage**	✓ or ✗
carbon dioxide concentration	Calvin cycle	.....
	photolysis	.....
light intensity	Calvin cycle	.....
	photolysis	.....
temperature	Calvin cycle	.....
	photolysis	.....

[3]

[Total: 7]

6 **(a)** Fig. 1.1 shows a transverse section through a dicotyledonous leaf.

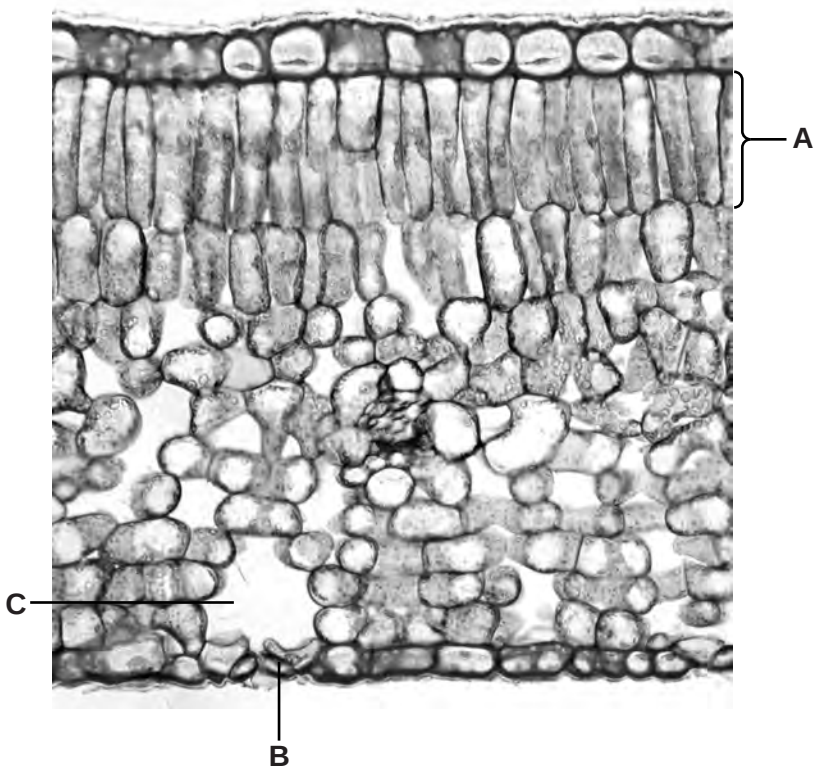

Fig. 1.1

Name **A**, **B** and **C**.

A .....

B .....

C .....

[3]

(b) The leaf is the main photosynthetic organ in most plants. For the light-independent stage of photosynthesis to occur, carbon dioxide must be present.

(i) Describe how carbon dioxide enters the leaf.

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..... [2]

(ii) Name the compound that combines with carbon dioxide in the light-independent stage in a C3 plant.

..... [1]

(iii) Outline the role of reduced NADP in the light-independent stage.

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..... [2]

[Total: 8]