Photosynthesis as an energy transfer process

Question Paper 9

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 9

Time Allowed : **52 minutes**

Score : **/ 43**

Percentage : **/100**

Grade Boundaries:

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

1 Fig. 1.1 shows the arrangement of photosystems, protein complexes containing chlorophyll molecules, on the thylakoid membrane of a plant chloroplast.

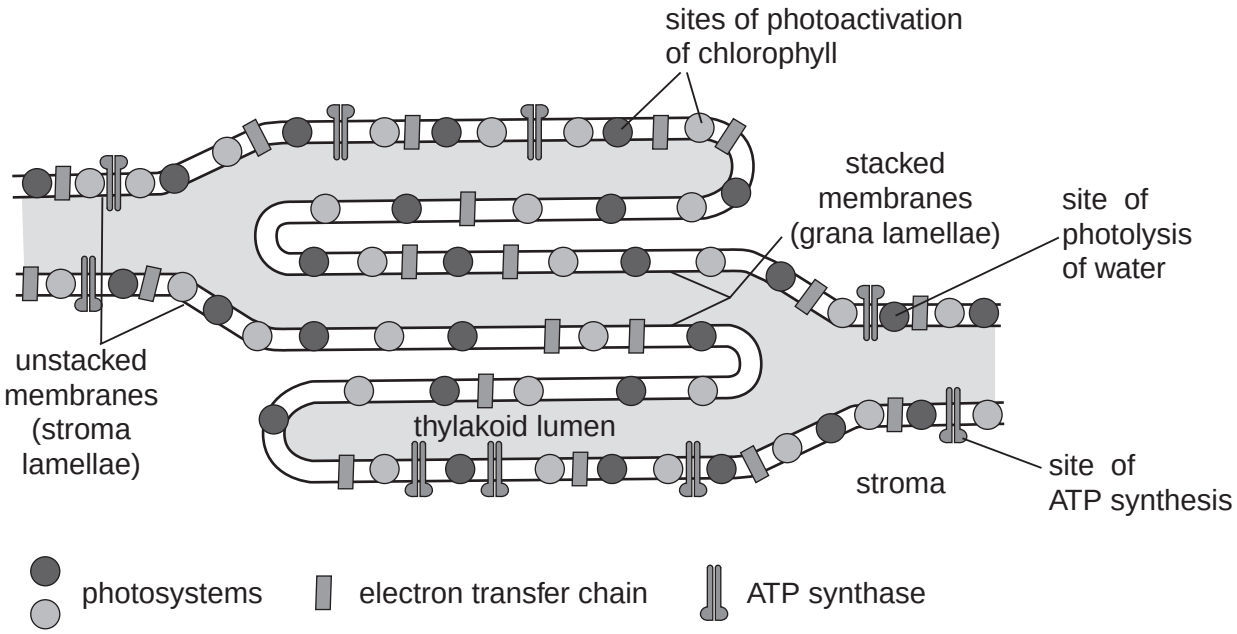

Fig. 1.1

(a) Describe the photoactivation of chlorophyll.

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(b) Explain how the photolysis of water occurs.

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(c) Outline how ATP is formed in the chloroplast.

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(d) Suggest an advantage of having photosystems, the electron transport chain and ATP synthase as part of the thylakoid membrane.

.....[1]

[Total : 10]

2 Large trees produce sun leaves on the outside of the canopy and shade leaves inside the canopy. Fig. 1.1 shows the rate of carbon dioxide uptake or production of a sun leaf and a shade leaf when exposed to increasing light intensity.

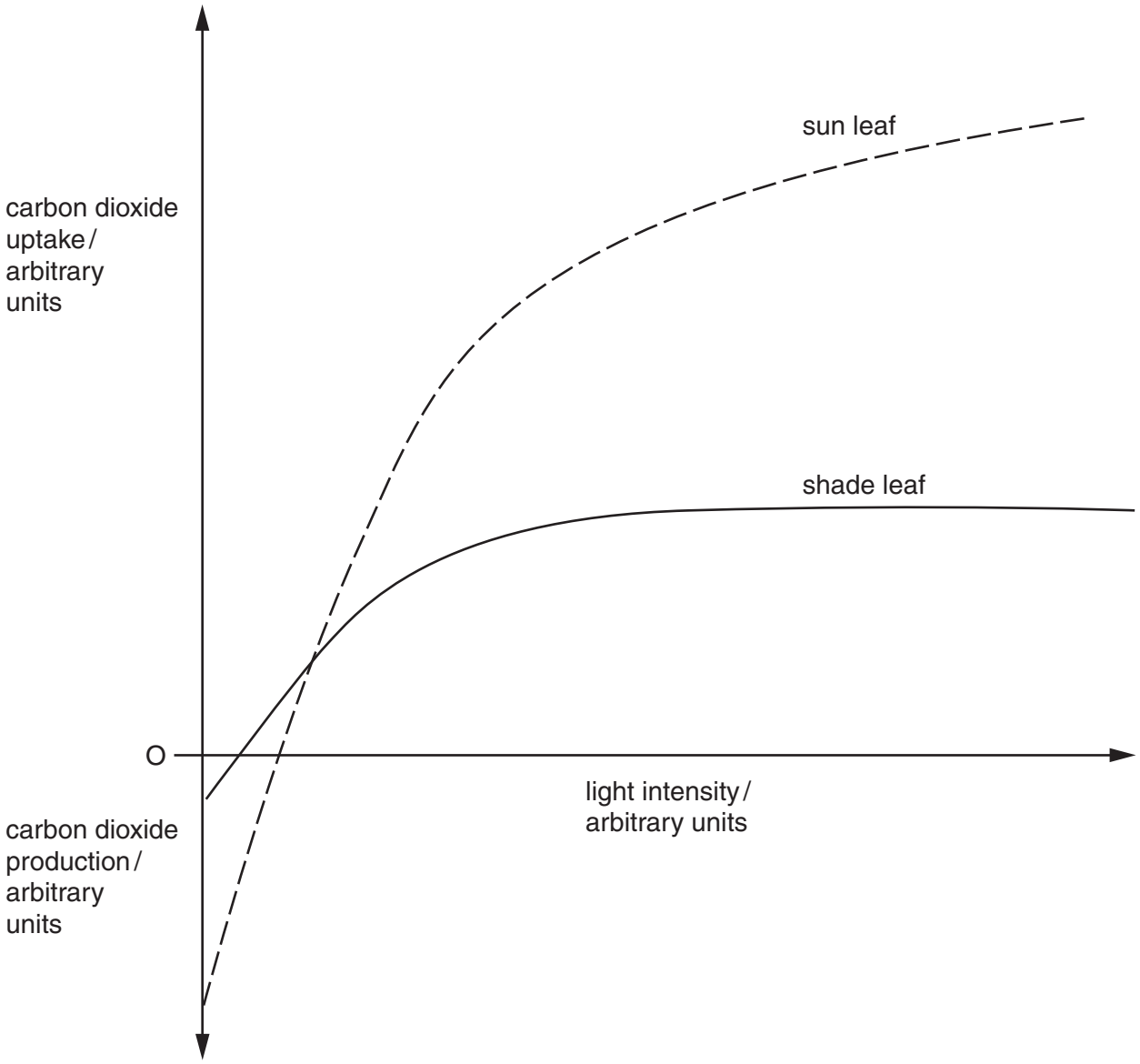

Fig. 1.1

(a) With reference to Fig. 1.1, describe three ways in which the sun and shade leaf differ in their response to increasing light intensity.

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(b) Explain why the carbon dioxide uptake levels off in the shade leaf as the light intensity increases.

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(c) The results shown in Fig. 1.1 were taken at a temperature of 20 °C.

Describe briefly how increasing the temperature to 25 °C would affect the results in the sun leaf.

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[Total : 9]

3 Fig. 1.1 shows the changes in concentration of a 3C compound, glycerate phosphate, GP, and a 5C compound, ribulose bisphosphate, RuBP, extracted from samples taken from actively photosynthesising green algae in an experimental chamber when the light source was turned off.

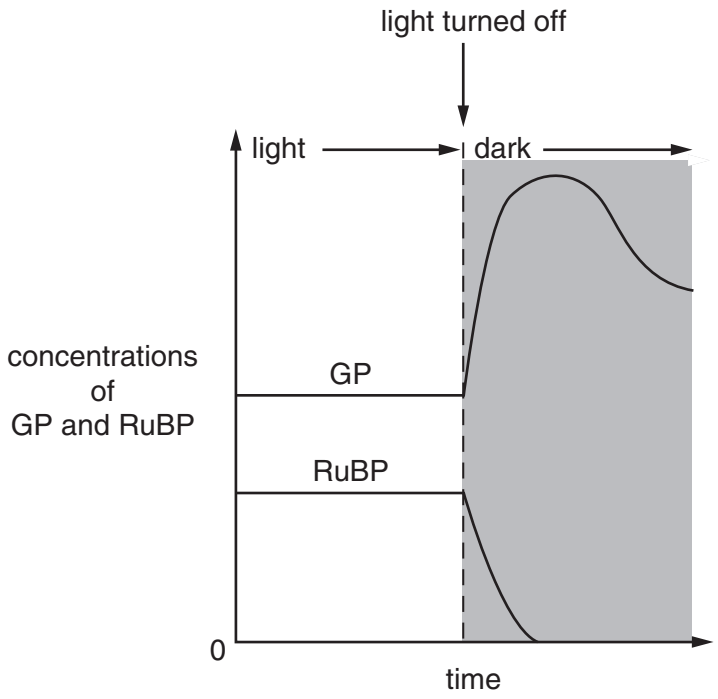

Fig. 1.1

(a) With reference to Fig. 1.1, describe what happens after the light source was turned off to the concentration of

(i) GP;

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(ii) RuBP.

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(b) Explain, with reference to the Calvin cycle, the reasons for these observed changes in

(i) GP;

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.....[2]

(ii) RuBP.

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(c) State the two products of photophosphorylation that drive the Calvin cycle.

1. .....

2. .....[2]

[Total : 9]

4 Maize, *Zea mays*, is a major cereal food crop. Unlike most crop plants, maize seed is produced by hybridisation between two different inbred parental strains.

(a) **(i)** Explain why this is done.

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(ii) Suggest **one** disadvantage of producing seed in this way.

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(b) In the light-independent stage of photosynthesis, the enzyme rubisco catalyses the combination of carbon dioxide with ribulose bisphosphate, RuBP. When the carbon dioxide concentration within the leaf is very low, rubisco tends to combine oxygen, rather than carbon dioxide, with RuBP. This process is called photorespiration. It reduces carbon dioxide assimilation and therefore reduces crop yields.

Photorespiration is most likely to happen in hot, dry conditions.

(i) Suggest **why** photorespiration is most likely to take place in hot, dry conditions.

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(ii) Explain how the leaf anatomy of a maize plant reduces photorespiration, even in hot, dry conditions.

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(c) It is expected that the carbon dioxide concentration in the atmosphere will increase in the future, which would be expected to increase rates of photosynthesis in many crop plants.

Investigations were carried out into the effect of increased carbon dioxide concentration on the rate of photosynthesis in maize.

- Maize plants were grown in open-air trials, in the same field and were exposed to the same changes in the weather.
- 50% of the plants were exposed to a normal carbon dioxide concentration.
- 50% of the plants were exposed to an increased carbon dioxide concentration.
- The rate of photosynthesis was measured as the net assimilation rate of carbon dioxide.
- Measurements were made at three-hourly intervals between 0700 hours and 1900 hours on three different days.

The results are shown in Fig. 4.1.

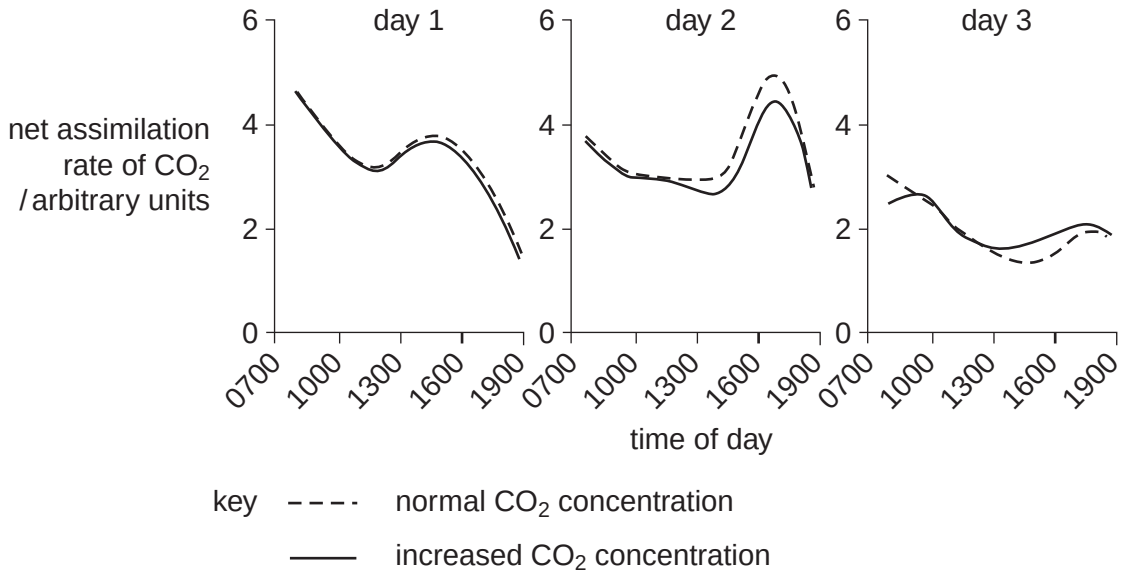

Fig. 4.1

(i) Suggest an explanation for the lack of effect of carbon dioxide concentration on the rate of photosynthesis in maize plants, shown by these results.

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(ii) Suggest **one** explanation for the changes in the rate of photosynthesis between 0700 hours and 1900 hours on day 1.

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[Total: 15]