

Photosynthesis as an energy transfer process

Question Paper 8

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 8

Time Allowed : 54 minutes

Score : / 45

Percentage : /100

Grade Boundaries:

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

- 1 (a) The rate of photosynthesis at different wavelengths of light can be measured and plotted as a graph. This is called an action spectrum and is shown on Fig. 8.1.

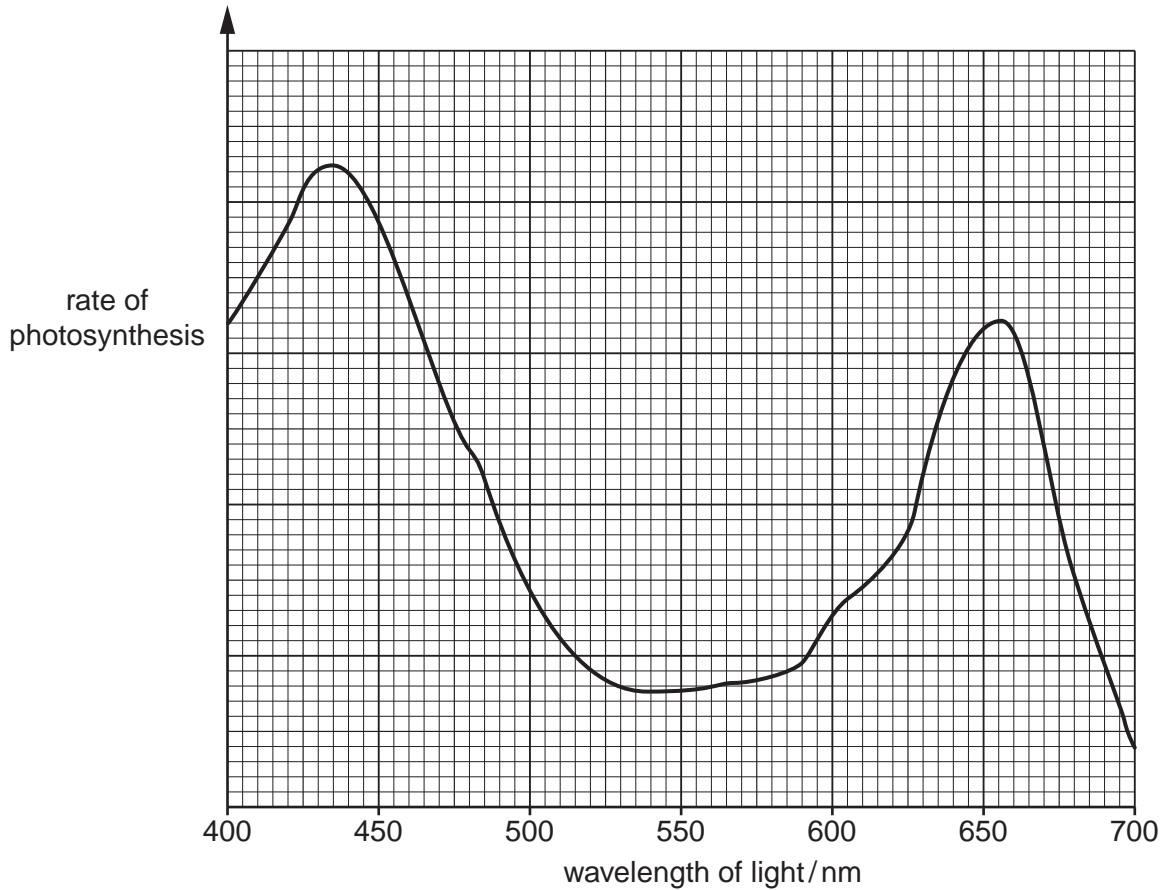


Fig. 8.1

Describe and explain the effects of different wavelengths of light on the rate of photosynthesis.

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(b) (i) Name two products of the light-dependent stage of photosynthesis that are used in the light-independent stage.

1.

2. [2]

(ii) Describe how these two products are used in the light-independent stage of photosynthesis.

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..... [3]

(c) The rate of photosynthesis is affected by factors other than the wavelength of light. These factors may act as limiting factors.

Explain what is meant by the term *limiting factor*.

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(d) Carbon dioxide concentration in the atmosphere may be a limiting factor in photosynthesis.

Describe how carbon dioxide reaches the photosynthetic cells in a leaf.

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- 2 (a) In Queensland, Australia, the effect of the water-holding capacity of soil on the yield of sorghum and wheat was investigated.
- Four test plots were prepared, two with high water-holding capacity (HWC) soil and two with low water-holding capacity (LWC) soil.
 - Sorghum seeds were sown on one plot with HWC soil and one plot with LWC soil.
 - Wheat seeds were sown on the second plot with HWC soil and the second plot with LWC soil.
 - The plots were regularly watered or irrigated throughout the growing season.
 - The yield of sorghum and wheat from all four plots was measured at the end of the growing season.

Fig. 4.1 shows the results of this investigation.

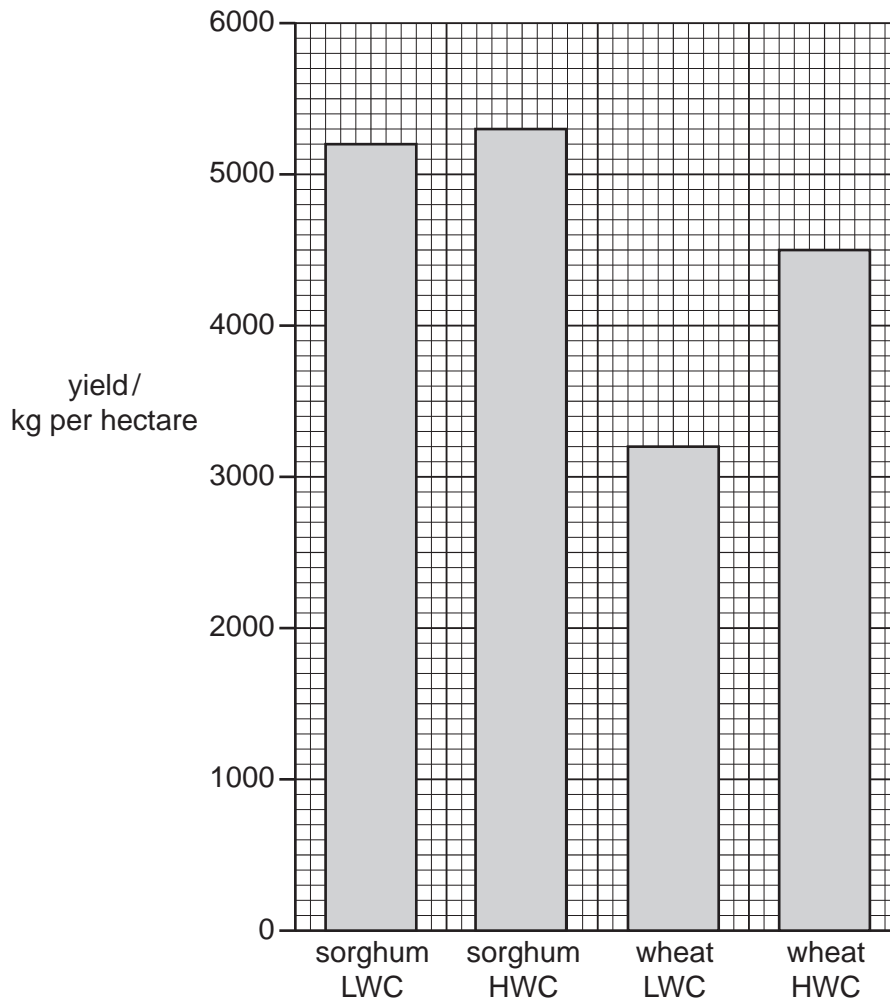


Fig. 4.1

(i) Describe **and** explain the results shown in Fig. 4.1.

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(ii) State two factors, other than water, light and temperature that would have to be controlled during this investigation to ensure that the results were valid.

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2 [2]

(b) Sorghum is able to carry out photosynthesis at high temperatures by preventing photorespiration.

Explain how sorghum is able to prevent photorespiration.

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[Total: 10]

3 (a) In the majority of plants the leaf is the main photosynthetic organ.

List four ways in which the structure of a dicotyledonous leaf is adapted for gas exchange.

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In an experiment to investigate the effect of light intensity on the rate of photosynthesis, the following procedure was carried out.

- Discs were cut, using a cork borer, from the photosynthetic tissue of the brown alga, *Fucus serratus*, a common seaweed of rocky shores.
- Ten discs were placed in each of four beakers containing 50 cm³ of sea water. The discs are denser than sea water and therefore initially sink to the bottom of the beaker.
- Each beaker was illuminated with a bench lamp placed at different distances, *d*, from the beaker.
- With time the discs began to rise to the surface of the water.
- The time, *t*, in minutes, at which the fifth disc from each batch reached the surface was recorded.
- The rate of photosynthesis was determined by calculating 1000 / *t*.

A student's set of results is shown in Table 8.1.

Table 8.1

distance of beaker from lamp, <i>d</i> / cm	light intensity $1/d^2$	time for fifth disc to reach the surface <i>t</i> / min	rate of photosynthesis 1000 / <i>t</i>
5	0.04	23	43.5
10	0.01	36	27.8
15	0.004	52	19.2
20	88	11.4

- (b) Calculate the value for light intensity when the distance between beaker and lamp was 20 cm.

Record the value in the space in Table 8.1.

[1]

- (c) Explain why the discs rise to the surface after being illuminated for a length of time.

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- (d) Using the data in Table 8.1, describe the relationship between light intensity and the rate of photosynthesis.

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- (e) The student found that there was no increase in the rate of photosynthesis when two lamps were placed 5 cm from the beaker.

Suggest why there was no increase in the rate of photosynthesis.

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[Total: 12]

- 4 In the majority of photosynthetic organisms, fixation of carbon dioxide occurs in the Calvin cycle.

Fig. 9.1 is an outline of this cycle.

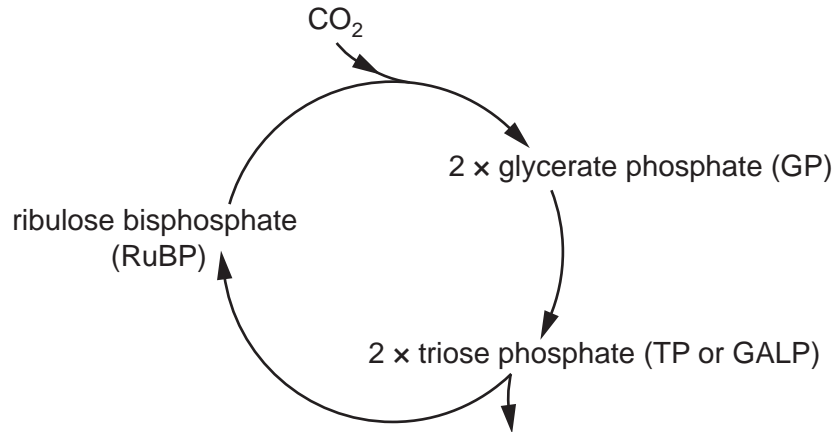


Fig. 9.1

(a) State,

- (i) the name of the five carbon sugar in the cycle

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- (ii) the name of the enzyme that fixes carbon dioxide

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- (iii) where in the chloroplast the Calvin cycle occurs

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- (iv) the name of another compound that is produced in the light-dependent stage of photosynthesis that is used in the Calvin cycle.

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- (b) Fig. 9.2 shows the changes in the relative concentrations of RuBP and GP produced in the Calvin cycle before and after a light source is switched off. All other conditions are constant.

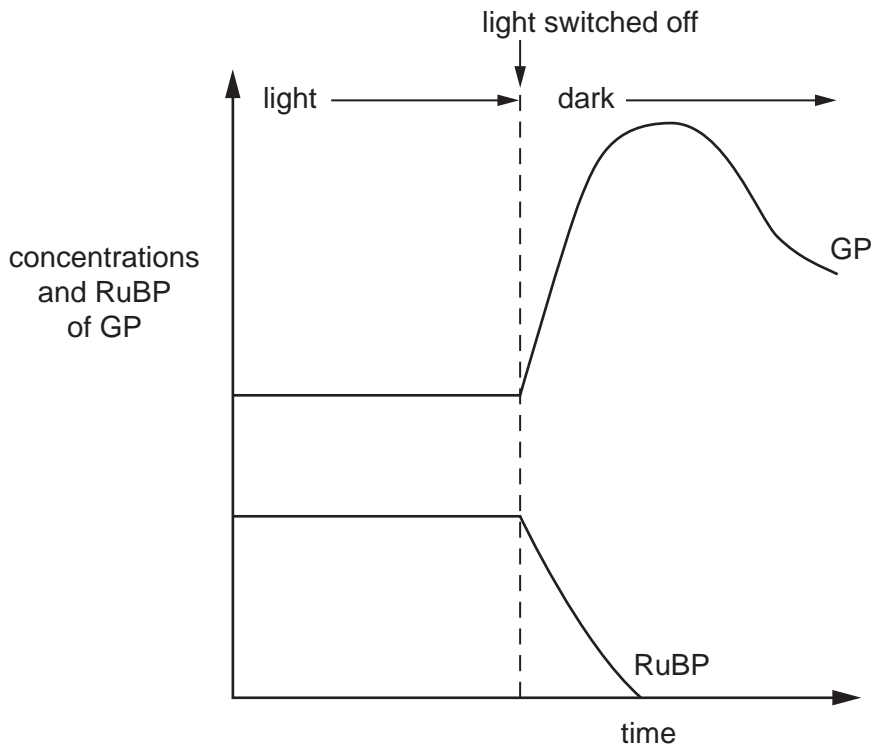


Fig. 9.2

Explain the changes in the relative concentrations of RuBP and GP **after** the light source is switched off.

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[Total: 8]