

Photosynthesis

Question Paper

Level	Pre U
Subject	Biology
Exam Board	Cambridge International Examinations
Topic	The Life of Plants
Sub Topic	Photosynthesis
Booklet	Question Paper

Time Allowed: 89 minutes

Score: /74

Percentage: /100

Part - A

1 Fig. 24.1 summarises the reactions which occur in the Calvin cycle.

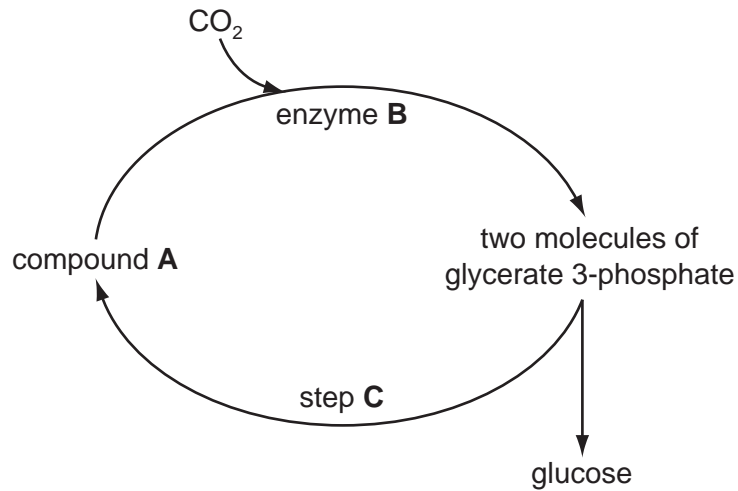


Fig. 24.1

(a) Where, precisely, in a plant cell do the reactions shown in Fig. 24.1 take place?

..... [1]

(b) Name

(i) compound A

..... [1]

(ii) enzyme B

..... [1]

(c) Calculate the proportion of carbon atoms from glycerate 3-phosphate molecules which are incorporated into glucose. Show your working.

..... [2]

(d) Some biologists describe enzyme B as ‘the most important enzyme in our biosphere’. Explain why they might hold this opinion.

..... [2]

- 2 In the 1950s, chemists thought that the Earth's atmosphere, before the existence of life, was highly reducing. In 1953, Stanley Miller, working under the supervision of Harold Urey at the University of Chicago, published the results of an experiment that showed that organic molecules could have formed in such an atmosphere.

A diagram of Miller's apparatus is shown in Fig. 1.1.

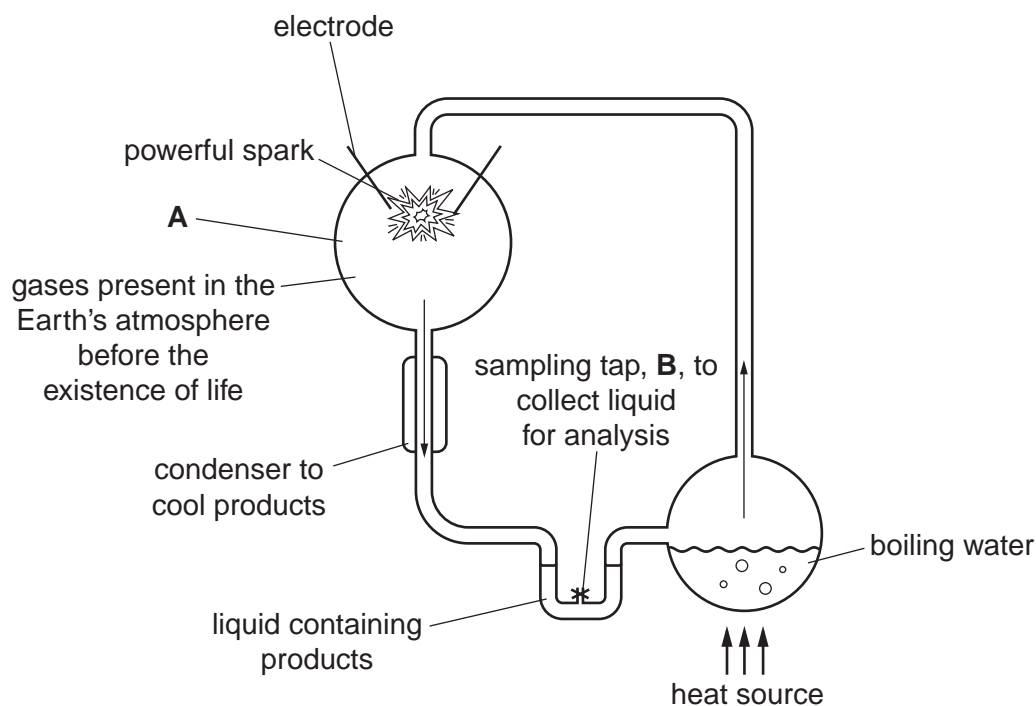


Fig. 1.1

- (a) (i) Name three gases, apart from water vapour, that were present in this early atmosphere and that Miller put into chamber A.

1.

2.

3. [3]

(ii) Name two different types of organic molecule that Miller collected at **B**.

1.

2. [2]

(iii) State the role of the powerful spark in Miller's apparatus.

.....

..... [1]

(iv) Explain why liquid water had to be present for life to originate on Earth.

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..... [3]

Fig. 1.2 shows a time line for the early history of the Earth.

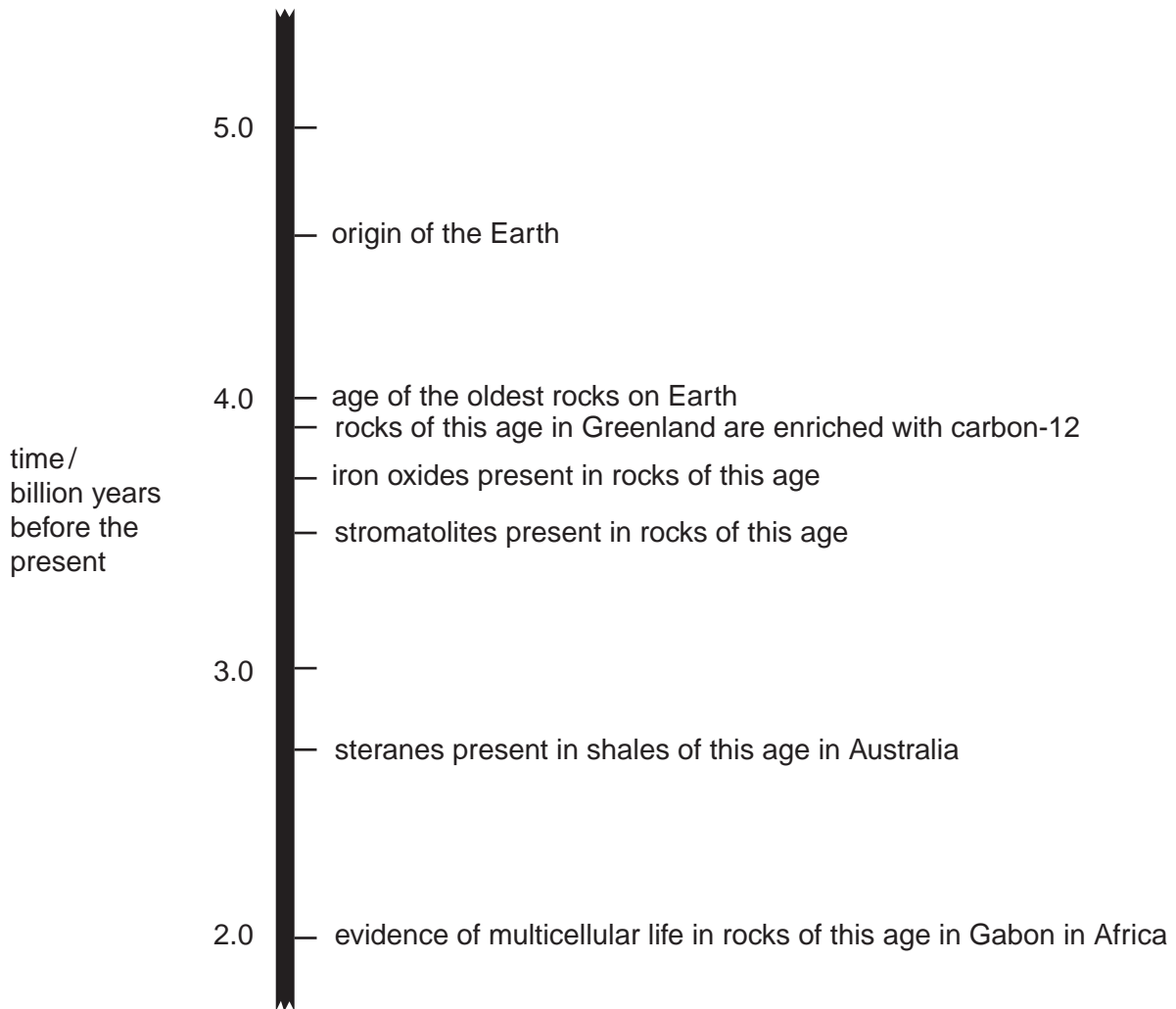


Fig. 1.2

(b) State the significance of,

(i) the enrichment with carbon-12 of rocks that are 3.9 billion years old

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..... [1]

(ii) the presence of stromatolites in rocks that are 3.5 billion years old

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..... [1]

(iii) presence of steranes in shales that are 2.7 billion years old.

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..... [2]

(c) Life may have originated around hydrothermal vents. Today, communities associated with these vents are rich in chemoautotrophic bacteria.

Describe briefly the nutrition of chemoautotrophic bacteria.

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..... [3]

[Total: 16]

Part - B

- 3 The rate of carbon dioxide uptake at a range of carbon dioxide concentrations by barley, a C3 plant, and sugar cane, a C4 plant, were compared at two temperatures using the apparatus shown in Fig. 3.1.

The results of the experiment are presented in Fig. 3.2.

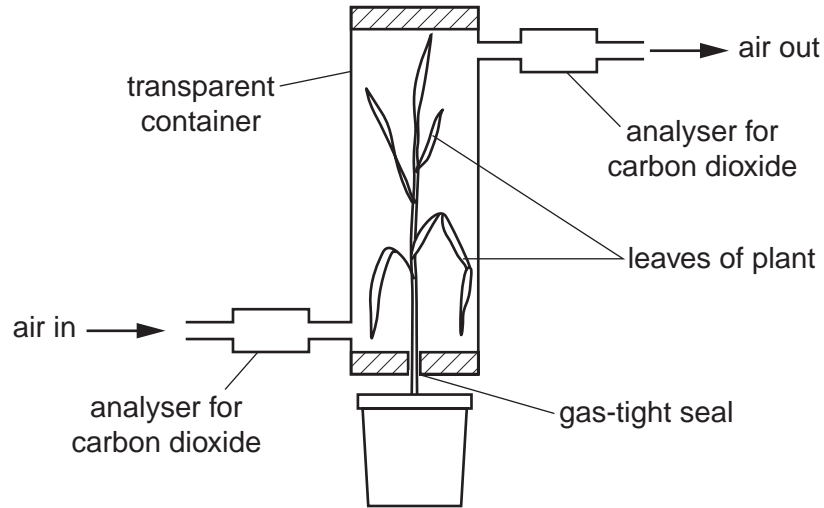


Fig. 3.1

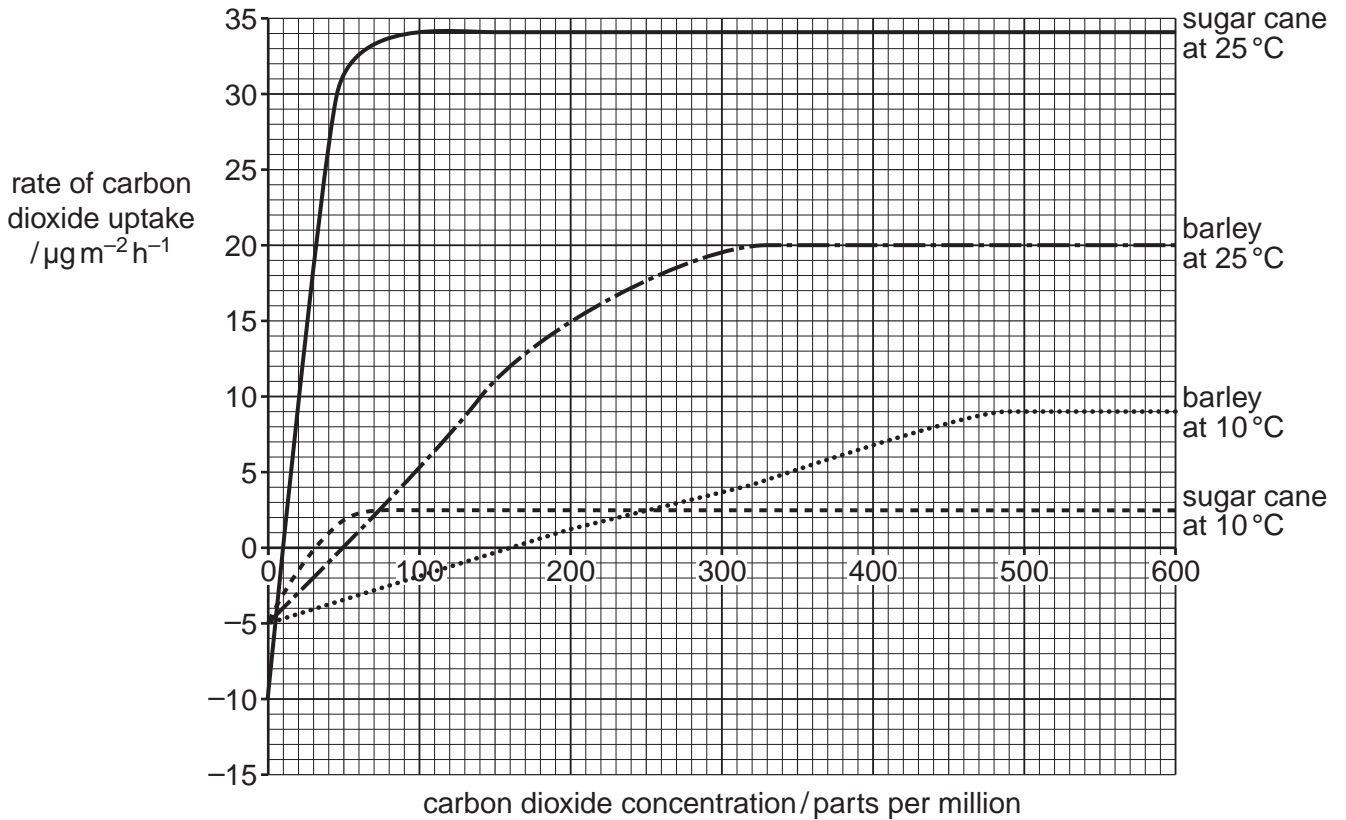


Fig. 3.2

Fig. 3.3 shows a key reaction in the light-independent stage of photosynthesis. One 5C molecule combines with one molecule of carbon dioxide to form two 3C molecules.

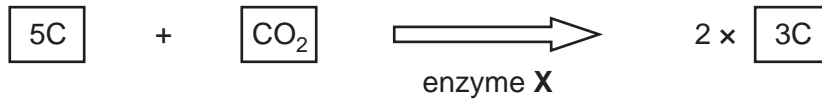


Fig. 3.3

(a) Name enzyme X and the 3C molecule.

enzyme X

3C molecule

[2]

(b) With reference to Fig. 3.2, describe the differences in rates of carbon dioxide uptake by barley and sugar cane in response to increasing carbon dioxide concentrations at both 10°C and 25°C.

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..... [4]

(c) Explain why C3 plants and C4 plants respond differently to changes in carbon dioxide concentration.

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..... [4]

- (d) Table 3.1 shows some data about six crop plants, three of which are C3 and three of which are C4.

Table 3.1

crop	C3 or C4	mass of water absorbed per gram dry mass produced /g
rice	C3	682
potato	C3	575
wheat	C3	542
maize	C4	350
sorghum	C4	304
millet	C4	285

Comment on the data shown in Table 3.1.

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..... [4]

- (e) C4 plants constitute only 3% of flowering plant species yet they account for about 25% of global terrestrial primary productivity.

Fig. 3.4 shows the changes in atmospheric carbon dioxide concentration since 1959 measured at Mauna Loa Observatory in Hawaii. It is widely believed that the rising carbon dioxide concentration of the atmosphere is linked to increases in global mean surface temperature and that this, in turn, is resulting in climate change, such as changes in rainfall patterns.

- 4 Fig. 4.1 and Fig. 4.2 show the effects of leaf temperature and light intensity on the rate of photosynthesis in a leaf of the plant *Atriplex patula*. This plant grows in temperate regions.

All measurements were made at atmospheric carbon dioxide concentration and show results at two different concentrations of oxygen.

All measurements in Fig. 4.1 were taken at a light intensity of $300 \text{ J m}^{-2} \text{ s}^{-1}$. All measurements in Fig. 4.2 were taken at 27°C .

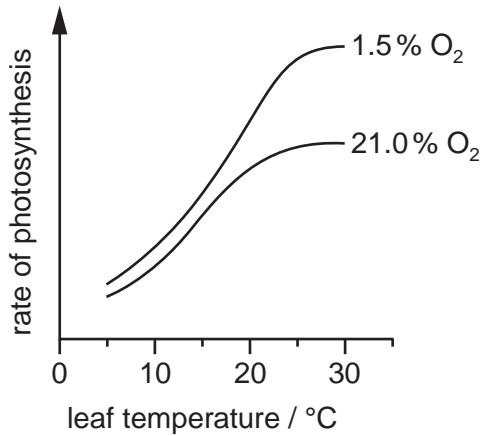


Fig. 4.1

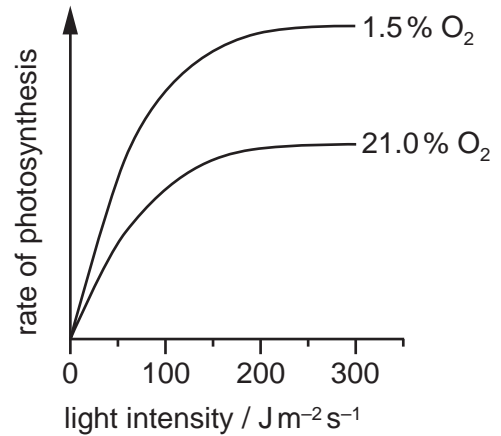


Fig. 4.2

- (a) In Fig. 4.2 the units used for light intensity are $\text{J m}^{-2} \text{ s}^{-1}$. State the meaning of these abbreviations in words.

..... [1]

- (b) With reference to Fig. 4.1, compare and contrast the effects of leaf temperature on the rate of photosynthesis at oxygen concentrations of 21.0% and 1.5%.

.....

 [3]

- (c) Why was the experiment on the effect of leaf temperature (Fig. 4.1) carried out in conditions of light saturation?

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..... [1]

- (d) In certain conditions, oxygen exerts a significant inhibitory effect on photosynthesis in *A. patula*.

With reference to Fig. 4.1 and Fig. 4.2, state what these conditions might be.

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..... [3]

- (e) Explain, with reference to reactions within the light-independent stage of photosynthesis and the data provided, how oxygen inhibits photosynthesis in *A. patula*.

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..... [5]

[Total: 13]

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