13.2 Investigation of Limiting Factors

Question Paper

Course	CIE A Level Biology
Section	13. Photosynthesis
Topic	13.2 Investigation of Limiting Factors
Difficulty	Medium

Time allowed: 60

Score: /45

Percentage: /100

Question 1a

A student wanted to investigate the effect of changing light intensity on the rate of photosynthesis in an aquatic plant. They set up their investigation as shown in Fig. 1.

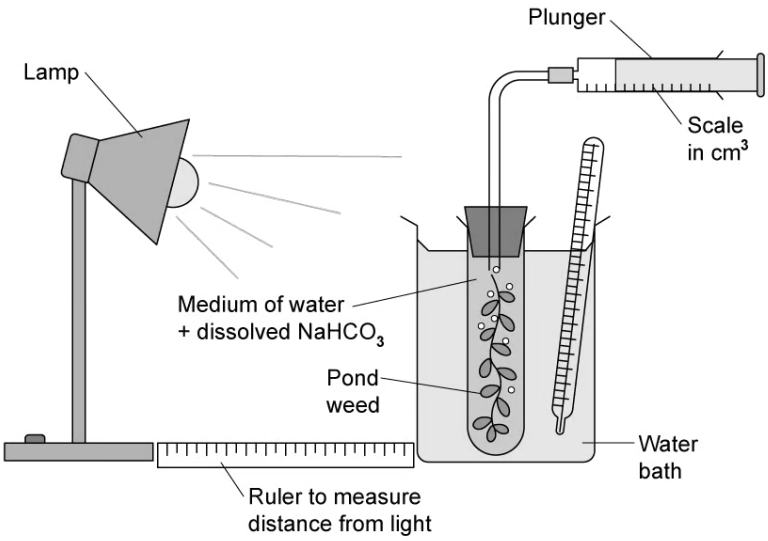

Fig. 1

The student assessed the rate of photosynthesis by measuring the volume of oxygen collected in the measuring syringe.

(i)
Explain why collecting oxygen is a measure of the rate of photosynthesis.

[1]

(ii)
State precisely where in the plant the oxygen is produced.

[1]

[2 marks]

Question 1b

Give **three** variables that the student should control in the experiment shown in Fig. 1

[3 marks]

Question 1c

Fig. 2 shows the results collected by the student during the experiment described in part a).

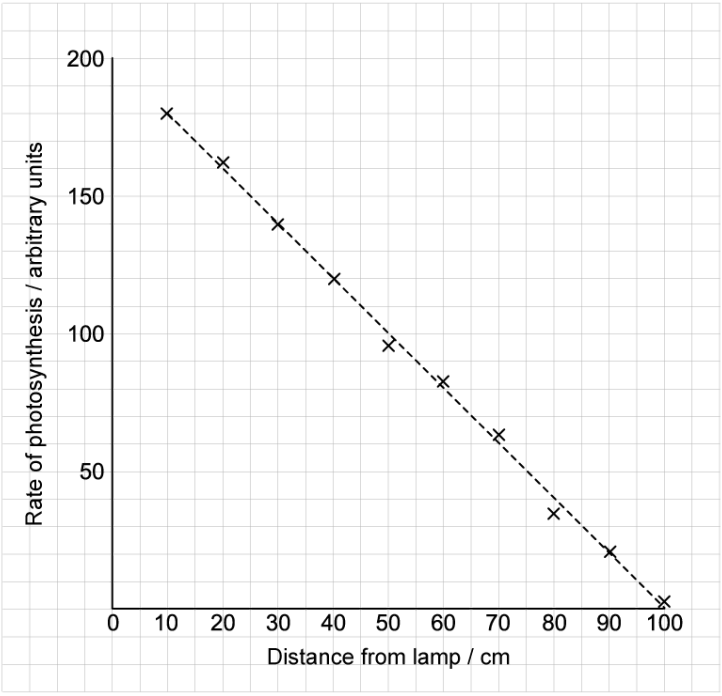

Fig. 2

Calculate the percentage decrease in the rate of photosynthesis that takes place in Fig. 2 when the distance from the lamp is 10 cm compared to when it is 90 cm.

[2 marks]

Question 1d

Explain why lower light intensity leads to a reduced rate of photosynthesis, as shown in Fig. 2.

[3 marks]

Question 2a

A student investigated the effect of changing light wavelength on the rate of photosynthesis. They set up four beakers of sodium hydrogen carbonate solution, each containing 20 spinach leaf discs, and each under a lamp with a different coloured bulb. They measured the time taken for 50 % of the leaf discs to rise to the surface of the beaker; this time is notated as ET_{50}. The student's results are shown in table 1 below.

Table 1

Colour of bulb	ET_{50} (s)	Rate of photosynthesis ($1 / ET_{50}$)
White	6	
Red	12	
Blue	55	
Green	92	0.01

Calculate the rate of photosynthesis for leaf discs under white, red, and blue bulbs.

[1 mark]

Question 2b

Explain why sodium hydrogen carbonate ($NaHCO_3$) solution was used in the experiment described in part a).

[2 marks]

Question 2c

Explain the results shown in Table 1.

[5 marks]

Question 2d

The student suggested that the relatively low rate of photosynthesis could be due to light being primarily absorbed by pigments such as chlorophyll b and carotene, known as accessory pigments.

Describe the role of accessory pigments in the light dependent reactions.

[2 marks]

Question 3a

A group of scientists carried out a study into the effects of temperature and light intensity on photosynthesis. The results of the study are shown in Fig. 1

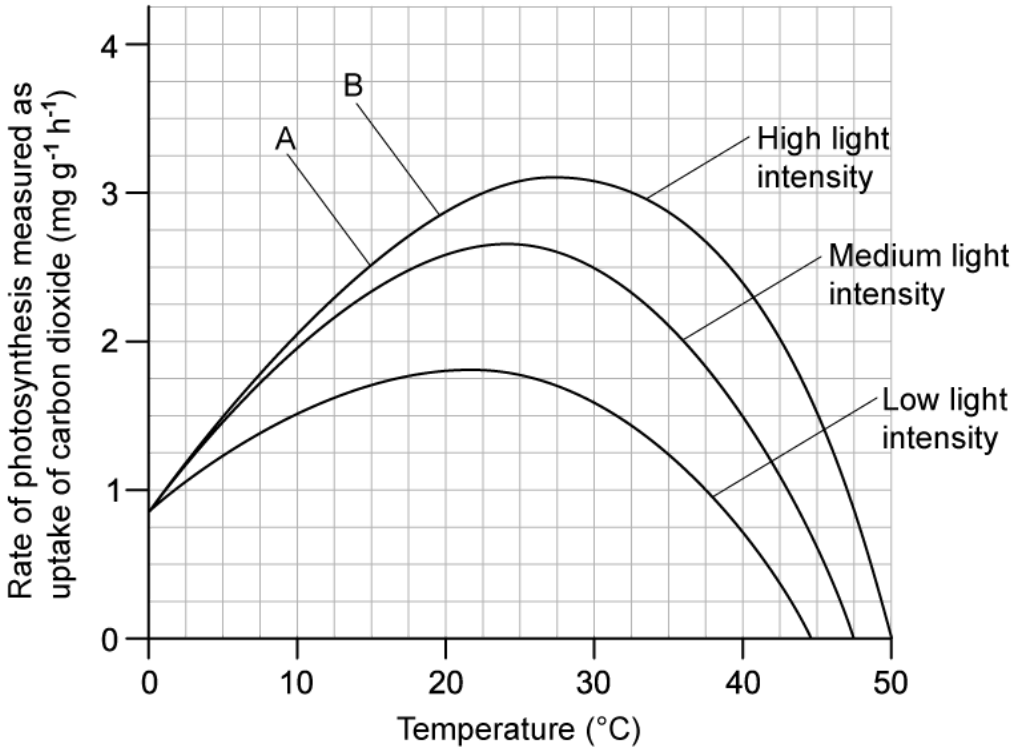

Fig. 1

(i)
State the limiting factor between the points marked **A** and **B** in Fig.1.

[1]

(ii)
Explain your answer to part i).

[1]

[2 marks]

Question 3b

Describe the effect of increasing light intensity on the rate of photosynthesis in Fig. 1

[3 marks]

Question 3c

Explain the effect of increasing temperature above 30 °C on the rate of photosynthesis in Fig.1

[3 marks]

Question 3d

The study shown in Fig.1 uses carbon dioxide uptake as a measure of the rate of photosynthesis.

Explain why carbon dioxide uptake does not give a true measure for the rate of photosynthesis.

[2 marks]

Question 4

Explain what is meant by the term limiting factor **and** explain how knowledge of limiting factors is used to increase crop yields in glasshouses.

[7 marks]

Question 5

Describe how you would carry out an investigation into the effect of wavelength of light on the rate of photosynthesis of a plant, using a redox indicator such as DCPIP.

[8 marks]