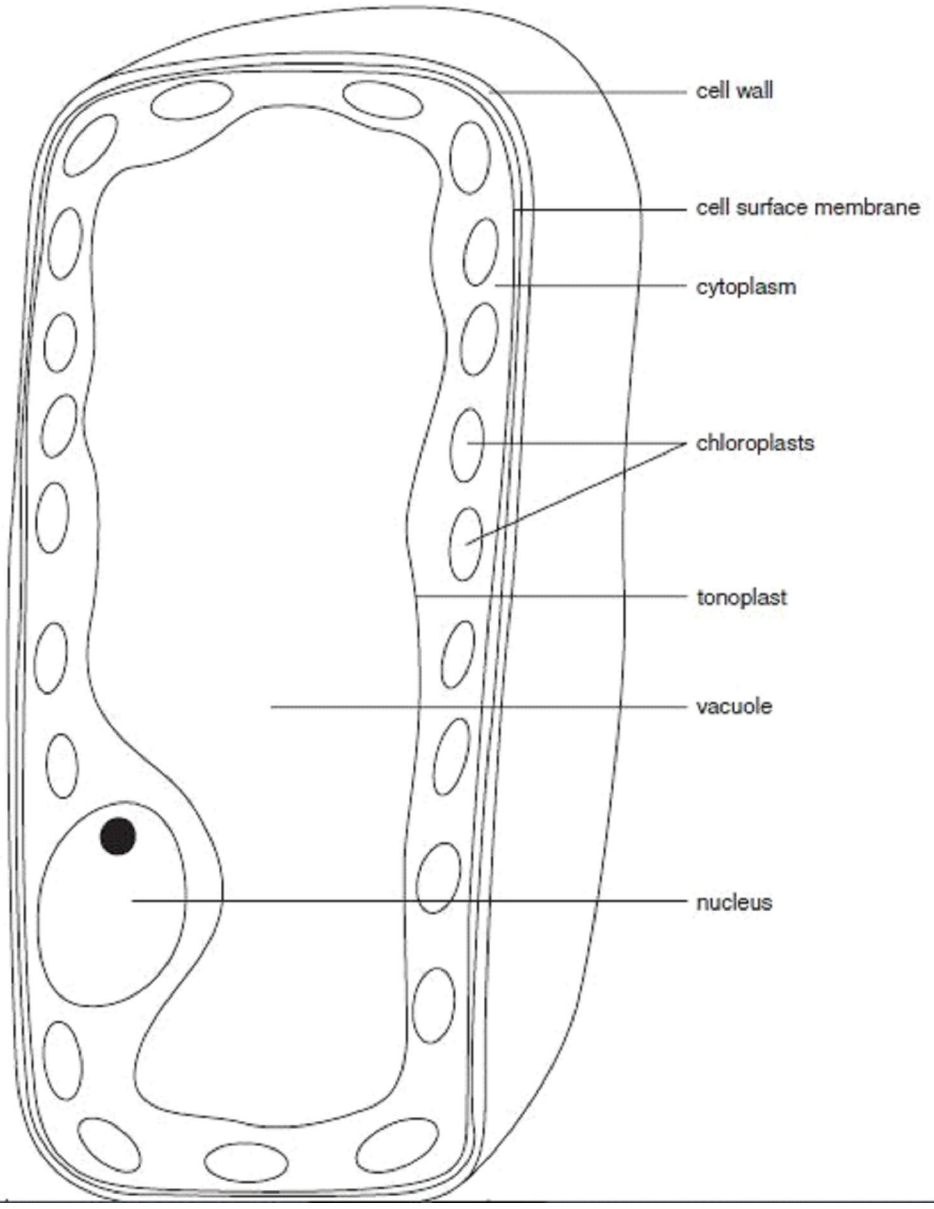
Q1.

1 Fig. 1.1 is a diagram of a palisade cell from a dicotyledonous leaf.



(a) Describe how these cells are arranged in the leaf.

.....

.....

.....[2]

(b) With reference to Fig. 1.1, explain how the structure of this cell is related to its function in photosynthesis.

.....

.....

.....

.....[3]

Fig. 1.2 is a diagram of an electron micrograph of part of a chloroplast showing thylakoid membranes.

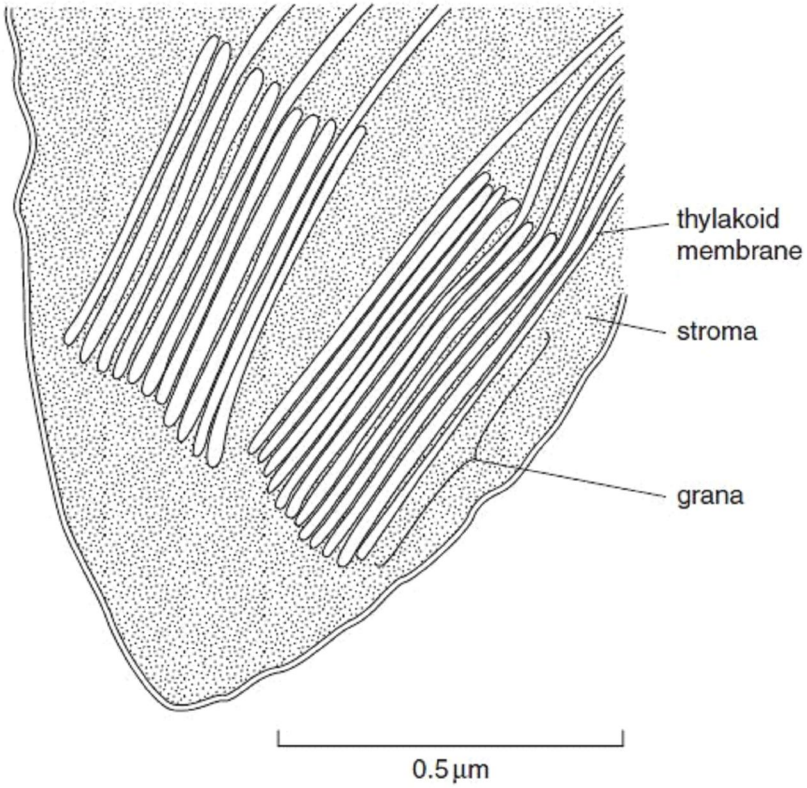


Fig. 1.2

(c) Describe the role of the thylakoid membrane in photosynthesis.

.....

.....

.....

.....

.....[4]

(d) Describe how carbon dioxide is fixed in the stroma.

.....

.....

.....[2]

[Total : 11]

Q2.

4 Fig. 4.1 is a diagram of a section through the undersurface of a dicotyledonous. leaf.

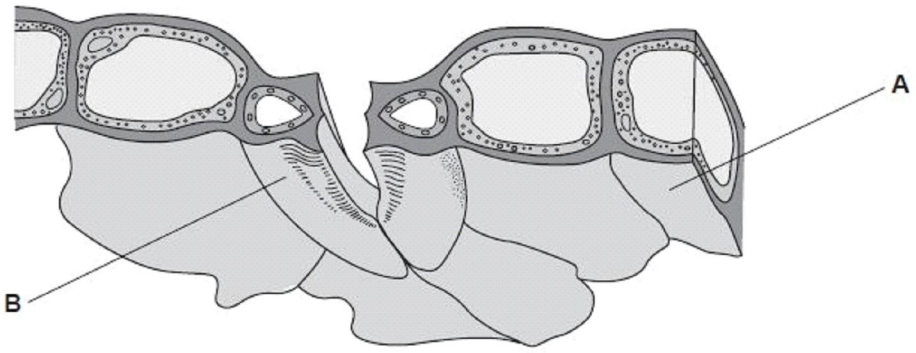


Fig. 4.1

(a) Name the cells **A** and **B**.

A .....

B .....[2]

(b) Explain the role of the pore shown, in relation to photosynthesis in the leaf.

.....

.....

.....

.....

.....

.....[4]

(c) With reference to Fig. 4.1, list two visible features of the cell **B** that allows the pore to open and close.

feature 1 .....

.....

feature 2 .....

.....[2]

[Total: 8]

Q3.

5 Fig. 5.1 shows the main stages of the Calvin cycle.

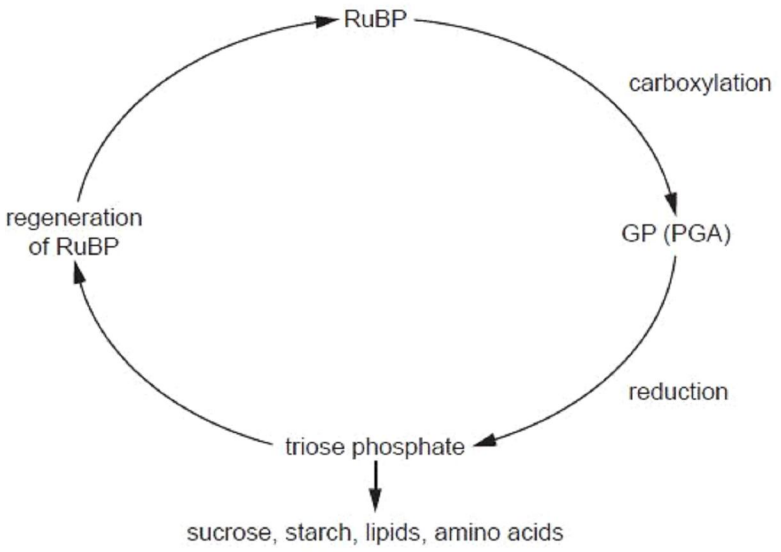


Fig. 5.1

(a) State precisely where the Calvin cycle occurs in plant cells.

.....[1]

(b) Describe how carbon dioxide is fixed in the Calvin cycle.

.....

.....

.....[2]

(c) Explain how the products of photophosphorylation are used in the Calvin cycle.

.....

.....

.....

.....[3]

(d) Explain what initially happens to the concentration of RuBP and GP if the supply of carbon dioxide is reduced.

RuBP .....

.....

GP .....

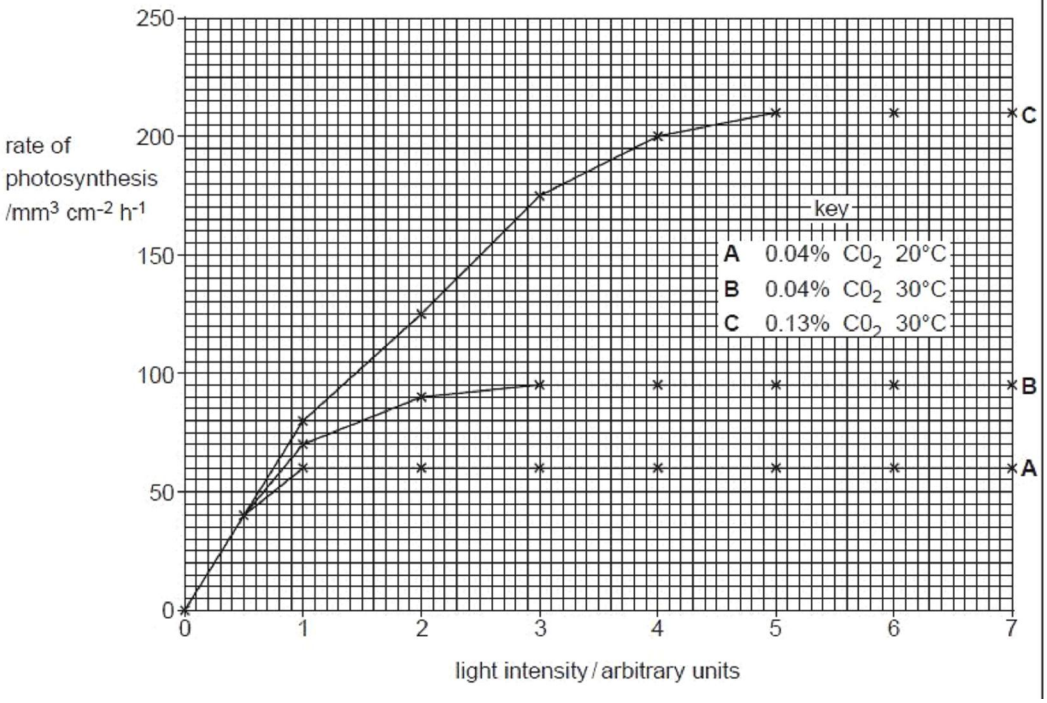
.....[3]

[Total: 9]

Q4.

Use

2 Fig. 2.1 shows the results of experiments investigating the effect of different light intensities on the rate of photosynthesis of cucumber plants measured as mm^3 CO_2 uptake per cm^2 leaf area per hour. The experiments were carried out at two different temperatures and two different carbon dioxide concentrations.



(a) With reference to Fig. 2.1,

(i) describe the shape of curve **A**,

.....

.....

.....

.....

.....

.....[3]

(ii) explain the reasons for the difference between curves **B** and **C**.

.....

.....

.....

.....

.....

.....

.....[4]

(b) Suggest **two** ways in which a commercial grower of cucumbers may increase the yield of the growing crop.

1 .....

.....

2 .....

.....[2]

[Total: 9]

Q5.

7 **(a)** An **absorption** spectrum is a graph of the absorption of different wavelengths of light by a photosynthetic pigment.

An **action** spectrum is a graph of the rate of photosynthesis at different wavelengths of light.

Fig. 7.1 shows the absorption spectra of chlorophyll a and chlorophyll b as well as an action spectrum.

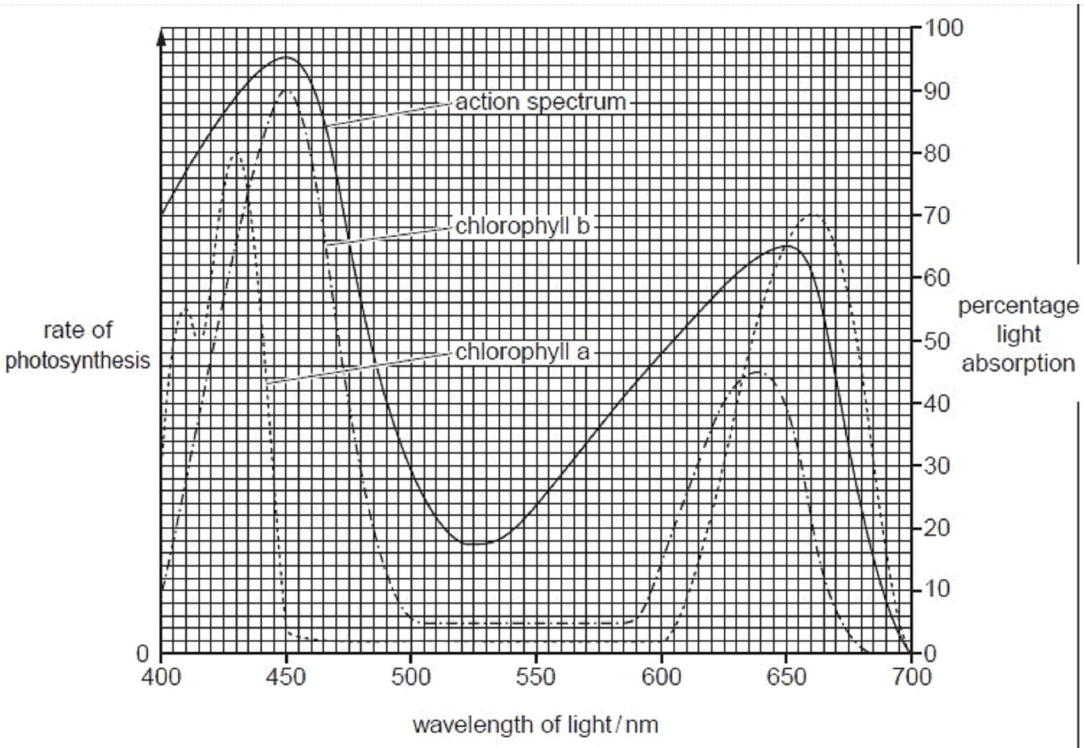


Fig. 7.1

With reference to Fig. 7.1,

(i) compare the **absorption** spectra of chlorophyll a and chlorophyll b,

.....

.....

.....

.....

.....

.....

..... [3]

(ii) explain the shape of the **action** spectrum,

.....

.....

.....

.....

.....[3]

(iii) explain why plants appear green .

.....

.....

.....

.....[2]

(b) Fig. 7.2 is an electron micrograph showing a section through part of a chloroplast.

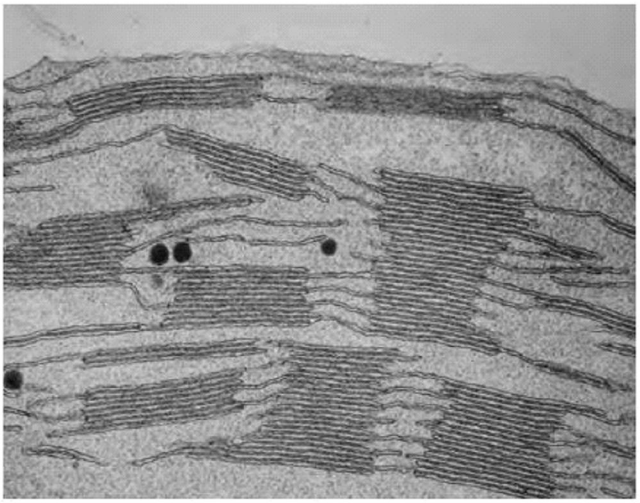


Fig. 7.2

On Fig. 7.2, draw label lines and use the letters **W** and **Y** to identify the following structures:

- **W** where the light-independent reactions occur
- **Y** where chlorophyll is found [2]

(c) Explain why increasing the concentration of carbon dioxide may increase the rate of production of carbohydrates at high light intensities.

Exa

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[5]

[Total: 15]

Q6.

8 (a) Fig. 8.1 shows a scanning electron micrograph of a section through a leaf of the Christmas rose, *Helleborus niger*.

For Examiner Use

Fig. 8.1

Name **M** and **N**.

M .....

N ..... [2]

(b) Gases leave and enter the leaf through pores called stomata.

Describe **and** explain how a stoma is opened.

.....

.....

.....

.....

.....

.....

.....

.....

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.....

.....

..... [6]

(c) Fig. 8.2 outlines the main reactions in the light-dependent stage of photosynthesis.

For Examiner Use

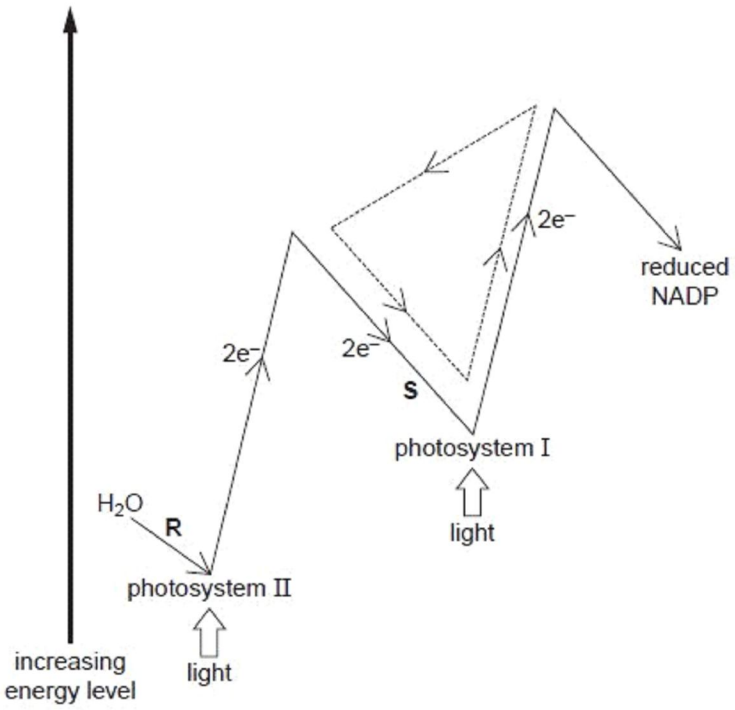


Fig. 8.2

(i) Name the process shown by the dotted arrows (⇢).

..... [1]

(ii) Describe what happens to water at **R**.

.....

.....

.....

..... [2]

(iii) State the product formed as electrons flow along **S**.

..... [1]

(iv) Explain briefly the role of reduced NADP in the **light-independent stage**.

.....

.....

.....

..... [2]

[Total: 14]

Q7.

4 Fig. 4.1 is a photomicrograph of a transverse section through the leaf of a C4 plant.

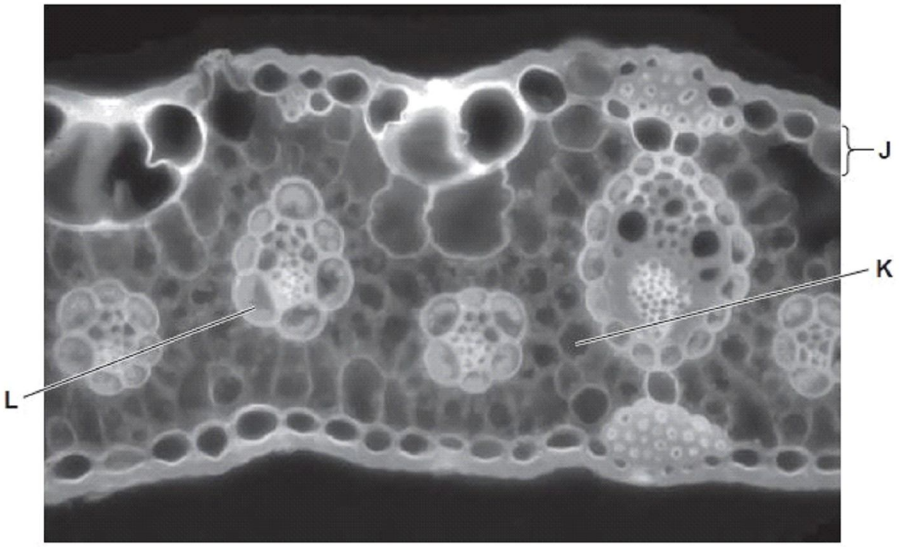


Fig. 4.1

(a) (i) Identify structures **J** to **L**.

J .....

K .....

L ..... [3]

(ii) Outline how this leaf anatomy adapts the plant for high rates of carbon fixation at high temperatures.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) Sorghum is a C4 plant and *Sorghum bicolor* is a major food crop in dry tropical regions. The leaves of *S. bicolor* are covered with a layer of wax made up of a mixture of esters and free fatty acids, with a melting point of 77–85 °C. Waxes from the leaves of non-tropical plants tend to have melting points lower than this. For example, wax from the bayberry, *Myrica* sp., has a melting point of 45 °C. E

Suggest how the wax on sorghum leaves helps the plant to survive in dry, tropical regions.

.....

.....

.....

..... [2]

(c) An investigation was carried out into the response of sorghum to being kept at a low temperature for a short period of time. Soybean plants, which are better adapted than sorghum for growth in subtropical and temperate climates, were used for comparison.

Plants of sorghum and soybean were kept at 25 °C for several weeks and then at 10 °C for three days. The temperature was then increased to 25 °C again for seven days. Day length, light intensity and carbon dioxide concentration were kept constant throughout.

The uptake of carbon dioxide, as mg CO_2 absorbed per gram of leaf dry mass, was measured

- at 25 °C before cooling
- on each of the three days at 10 °C
- for seven days at 25 °C.

The results are shown in Table 4.1.

Table 4.1

plant	carbon dioxide uptake / mg CO_2 g^{-1}				
	at 25 °C, before cooling	at 10 °C			at 25 °C (mean over days 4 to 10)
		day 1	day 2	day 3	
sorghum	48.2	5.5	2.9	1.2	1.5
soybean	23.2	5.2	3.1	1.6	6.4

(i) Compare the **changes** in carbon dioxide uptake in sorghum and soybean during the three days at 10 °C.

For Examin Use

.....

.....

.....

..... [2]

(ii) During the cooling period, the ultrastructure of the sorghum chloroplasts changed. The membranes of the thylakoids moved closer together, eliminating the spaces between them. The size and number of grana became reduced.

Explain how these changes could be responsible for the low rate of carbon dioxide uptake by sorghum even when returned to a temperature of 25 °C.

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 15]

Q8.

8 **(a)** Fig. 8.1 shows the effect of temperature on the rate of photosynthesis of a plant at a constant light intensity and a carbon dioxide concentration of 0.03%.

For Examiner's Use

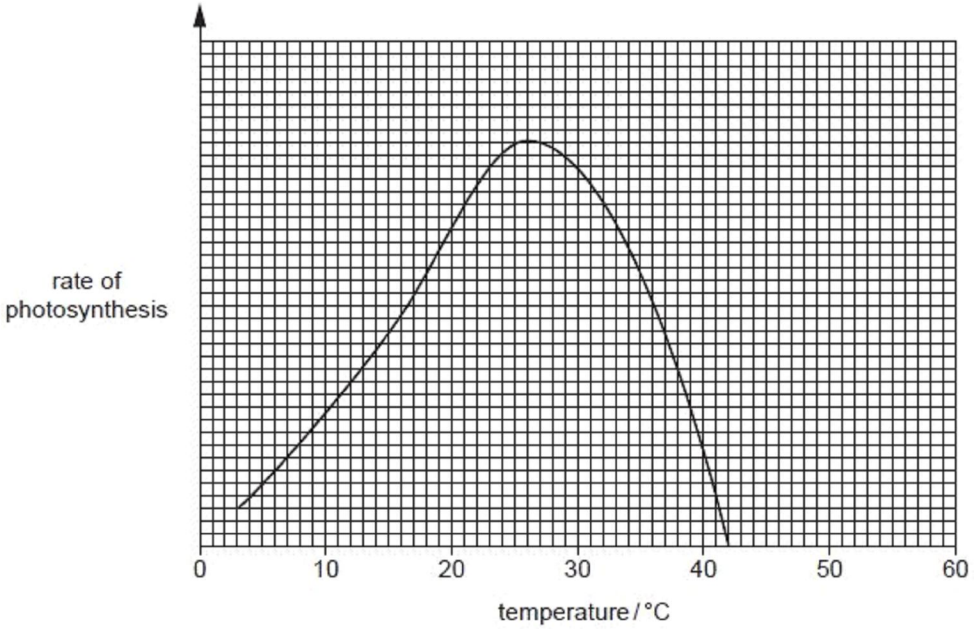


Fig. 8.1

(i) Suggest and explain why the rate of photosynthesis of the plant decreases to zero just above 40 °C.

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

(ii) Draw, **on Fig. 8.1**, the likely curve if the same experiment were carried out on a C4 plant, such as sorghum.

Give reasons to explain your curve.

.....

.....

.....

.....

.....

.....[3]

(b) Experiments were carried out to determine the effect of light intensity on the rate of photosynthesis of a species of the unicellular protoctist, *Chlorella*. A cell suspension of *Chlorella* was used.

- The suspension of *Chlorella* was illuminated at a light intensity of 5 lux for 20 seconds.
- The carbon dioxide uptake by *Chlorella* was measured at the end of the 20 second period of illumination.
- The experiment was repeated at 10, 13 and 15 lux.
- The suspension was maintained at a temperature of 20 °C.

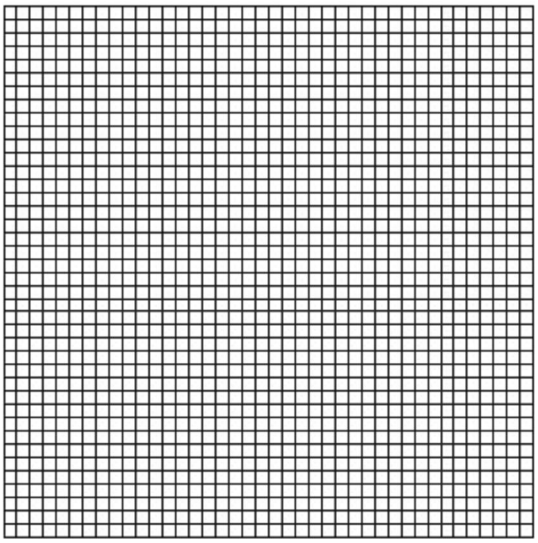
Table 8.1 shows the results of the experiments.

Table 8.1

light intensity / lux	total CO_2 uptake after 20 seconds / µmol	rate of photosynthesis / µmol s^{-1}
5	36	1.8
10	84	
13	104	
15	120	

(i) Complete Table 8.1. [1]

(ii) Use the data in the table to plot a graph on the grid below to show the effect of light intensity on the rate of photosynthesis.



[3]

(iii) With reference to photosynthesis, state what is meant by a limiting factor.

.....

.....

.....

.....

.....[2]

(iv) State the limiting factor in these four experiments.

.....[1]

[Total: 15]

Q9.

8 Fig. 8.1 shows a diagram of a stoma, its guard cells and adjacent epidermal cells.

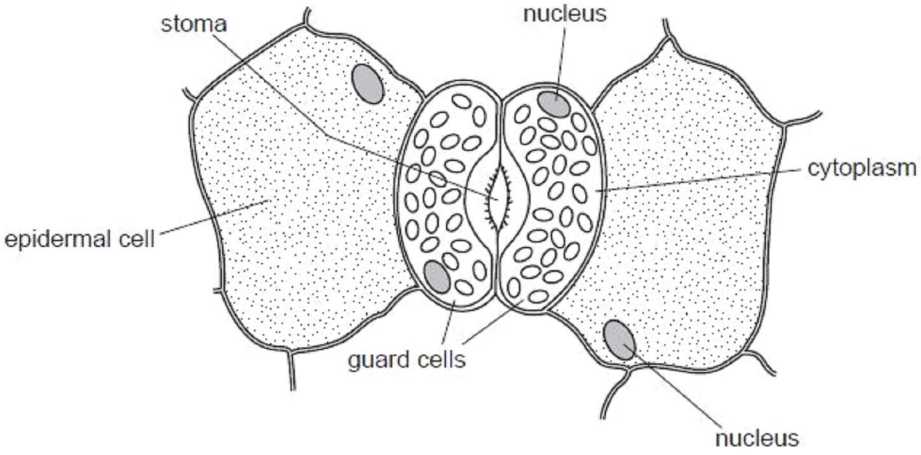


Fig. 8.1

(a) Guard cells have chloroplasts while epidermal cells do not have chloroplasts.

State **one other** difference, visible in Fig. 8.1, between guard cells and epidermal cells.

.....

.....[1]

(b) During stomatal closure:

(i) state precisely where abscisic acid (ABA) binds

.....[1]

(ii) identify the ion that diffuses from the guard cells to epidermal cells

.....[1]

(iii) compare the relative water potential of the guard cells with that of epidermal cells

.....[1]

(iv) describe the change in volume of the guard cells.

.....[1]

(c) The following experiment was carried out to investigate the effect of light intensity on the rate of photosynthesis of a water plant, *Elodea*.

- *Elodea* was cut into three pieces, each 10 cm long.
- Each piece of *Elodea* was placed in a glass tube, containing 0.5% sodium hydrogencarbonate solution, which was then sealed with a bung.
- Tube **A** was placed 10 cm away from a lamp.
- Tube **B** was placed 5 cm away from a lamp.
- Tube **C** was placed in a dark room.
- An oxygen sensor was used to measure the percentage of oxygen in the solutions at the start of the experiment and again at 5, 10 and 20 minutes.

The results are shown in Fig. 8.2.

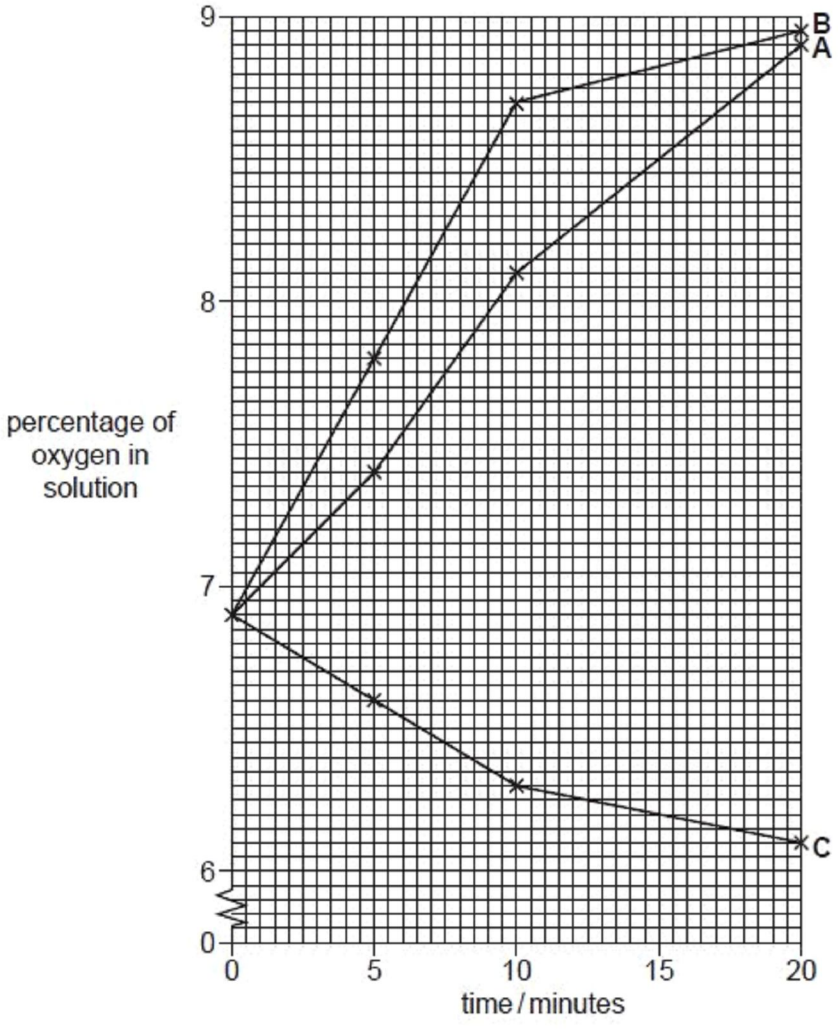


Fig. 8.2

(i) State why sodium hydrogencarbonate solution was used.

.....

.....[1]

(ii) Calculate the mean rate of oxygen production for tube **A** for the 20 minutes of the experiment.

Show your working.

answer .....[2]

(iii) Compare the results for tubes **A** and **B**.

.....

.....

.....

.....[2]

(iv) Explain the results for tube **C**.

.....

.....

.....

.....[2]

(v) Suggest what factor, which may have an effect on the rate of photosynthesis, was **not** taken into account in this experiment.

.....[1]

(d) Fig. 8.3 shows the relationship between the light-dependent and light-independent reactions in a chloroplast.

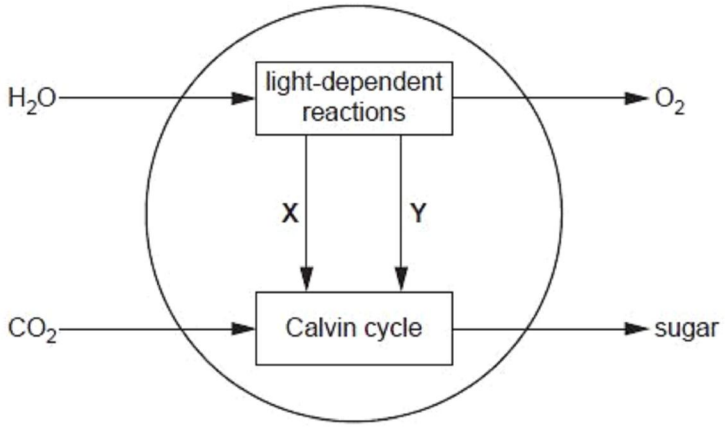


Fig. 8.3

Name the substances **X** and **Y** in Fig. 8.3.

X .....

Y .....[2]

[Total: 15]

Q10.

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

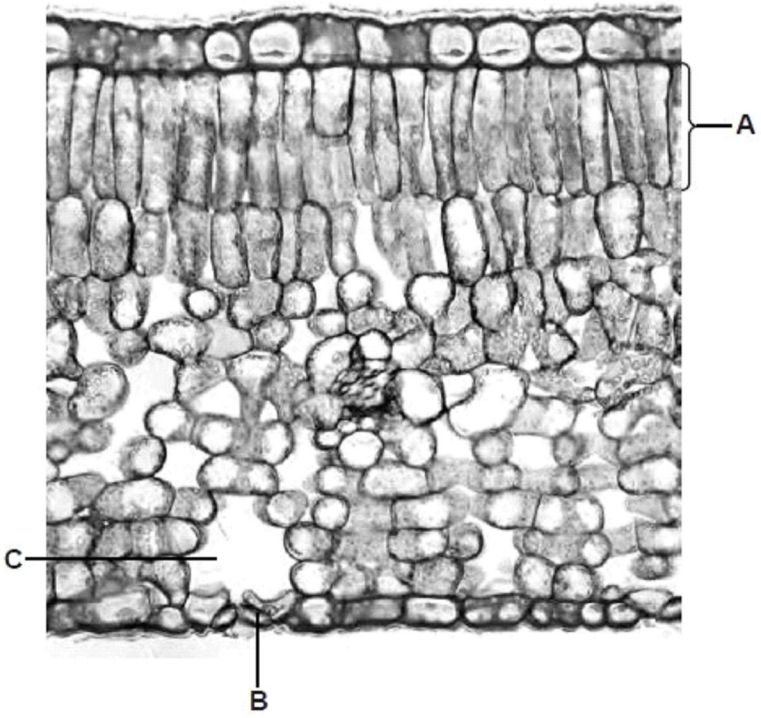


Fig. 1.1

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.

.....

.....

.....

..... [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.

.....

.....

.....

..... [2]

[Total: 8]

Q11.

1 **(a)** A student investigated the effects of temperature and light intensity on the rate of photosynthesis of an aquatic plant.

Fig. 1.1 shows the results of the investigation.

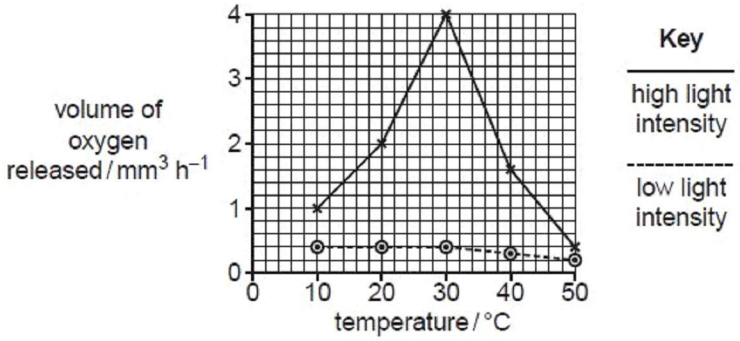


Fig. 1.1

With reference to Fig. 1.1:

(i) describe the results of the investigation

.....

.....

.....

.....

.....

.....

.....

..... [3]

(ii) suggest explanations for the results for high light intensity **above 30 °C**.

.....

.....

.....

.....

..... [2]

(b) (i) Name the process in the light-dependent stage of photosynthesis that produces oxygen.

..... [1]

(ii) Name the photosystem involved in the production of oxygen in the light-dependent stage.

..... [1]

(iii) Explain why the volume of oxygen released from the plant does not give a true rate of photosynthesis.

.....

.....

..... [1]

[Total: 8]

Q12.

1 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.

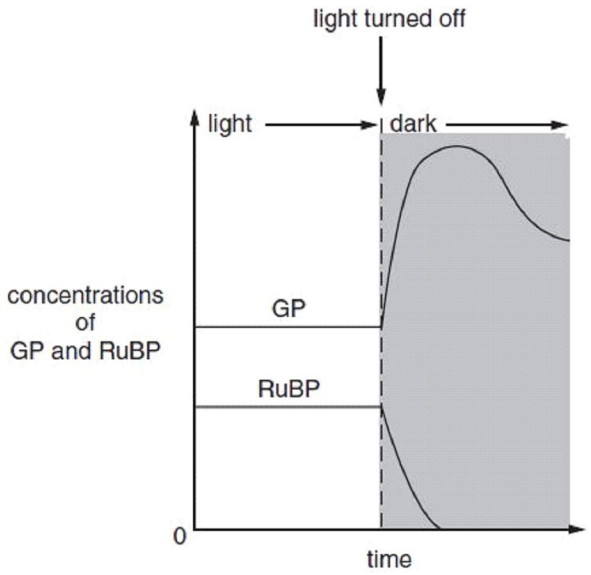


Fig. 1.1

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

(i) GP;

.....

.....

.....[2]

(ii) RuBP.

.....

.....[1]

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

(i) GP;

.....

.....

.....[2]

(ii) RuBP.

.....

.....

.....[2]

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

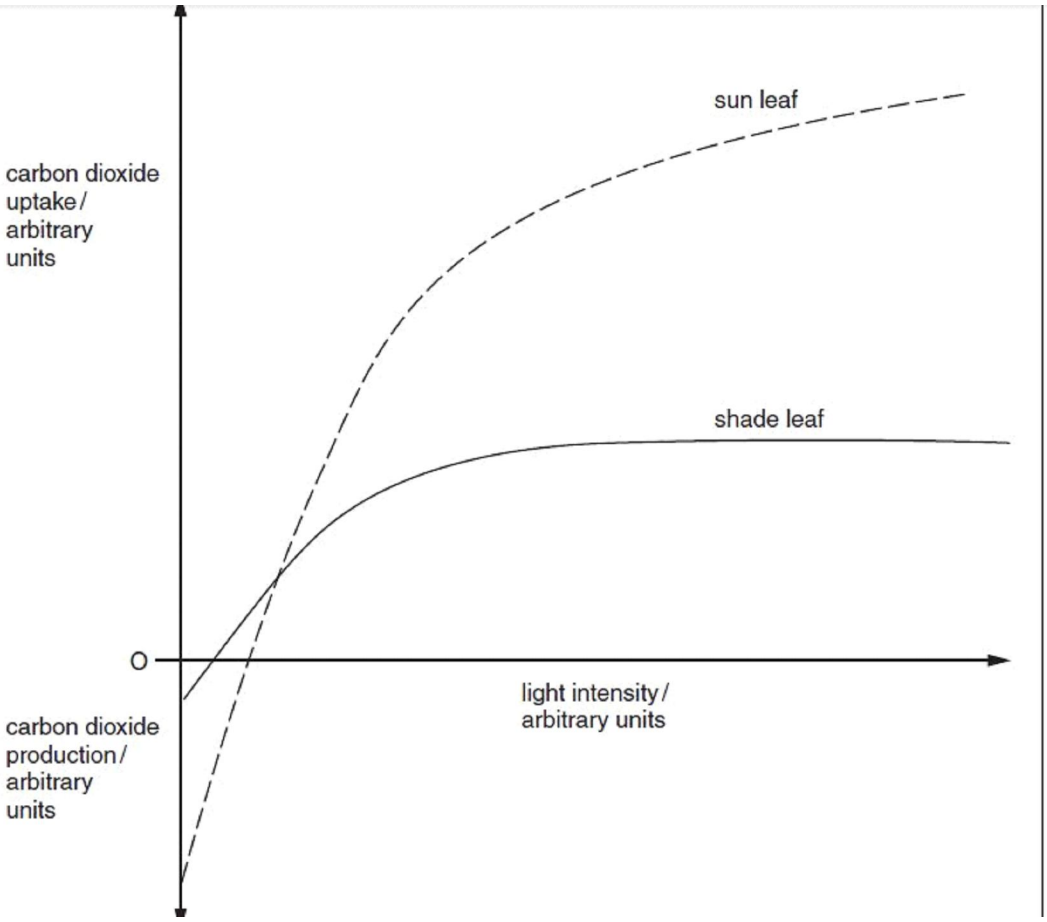
1. .....

2. .....[2]

[Total : 9]

Q13.

1 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.


sun leaf
carbon dioxide uptake / arbitrary units
shade leaf
O
light intensity / arbitrary units
carbon dioxide production / arbitrary units

(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.

1 .....

.....

2 .....

.....

3 .....

.....[3]

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

.....

.....

.....

.....[3]

(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.

.....

.....

.....

.....[3]

[Total : 9]

Q14.

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

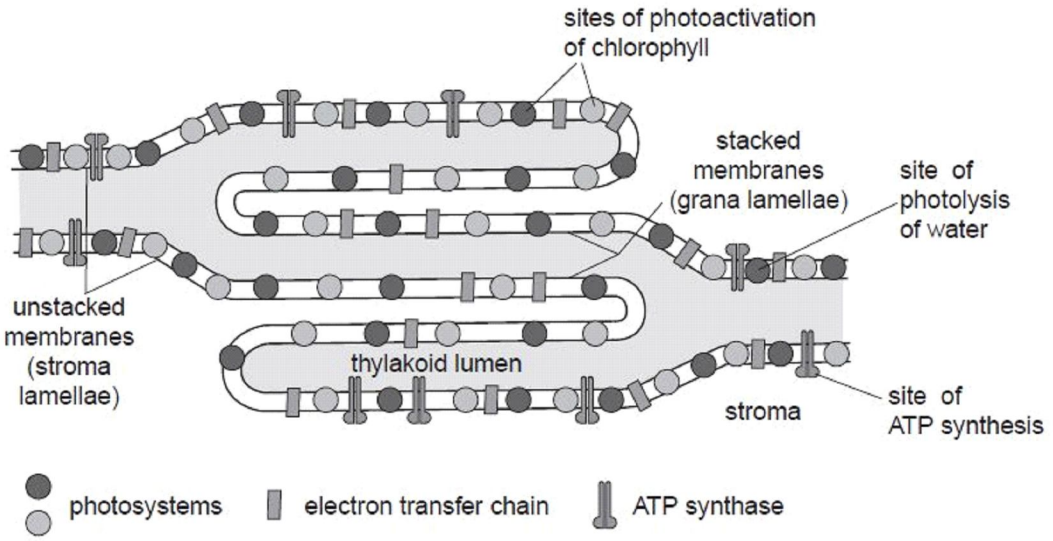


Fig. 1.1

(a) Describe the photoactivation of chlorophyll.

.....

.....

.....

.....

.....[3]

(b) Explain how the photolysis of water occurs.

.....

.....

.....

.....

.....[3]

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

.....

.....

.....

.....

.....[3]

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

.....[1]

[Total : 10]

Q15.

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

Fig. 9.1 is an outline of this cycle.

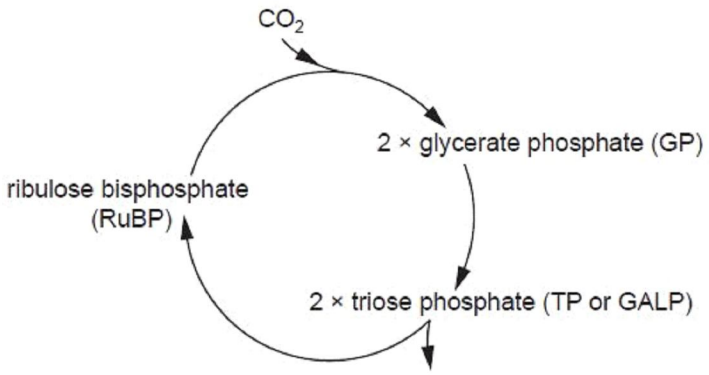


Fig. 9.1

(a) State,

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

.....[1]

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

.....[1]

(iii) where in the chloroplast the Calvin cycle occurs

.....[1]

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

.....[1]

(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.

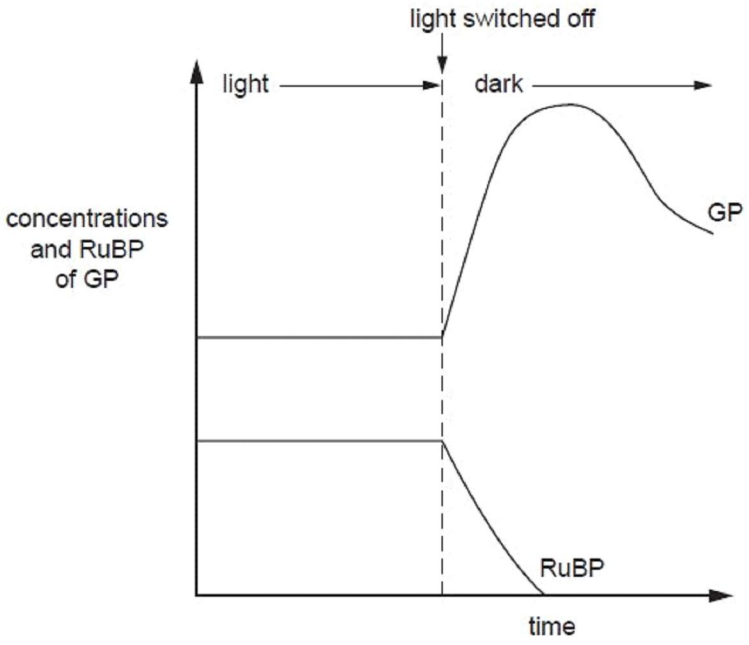


Fig. 9.2

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

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 8]

Q16.

8 **(a)** Fig. 8.1 shows the results from two experiments carried out to investigate the effect of light intensity and carbon dioxide concentration on the rate of photosynthesis.

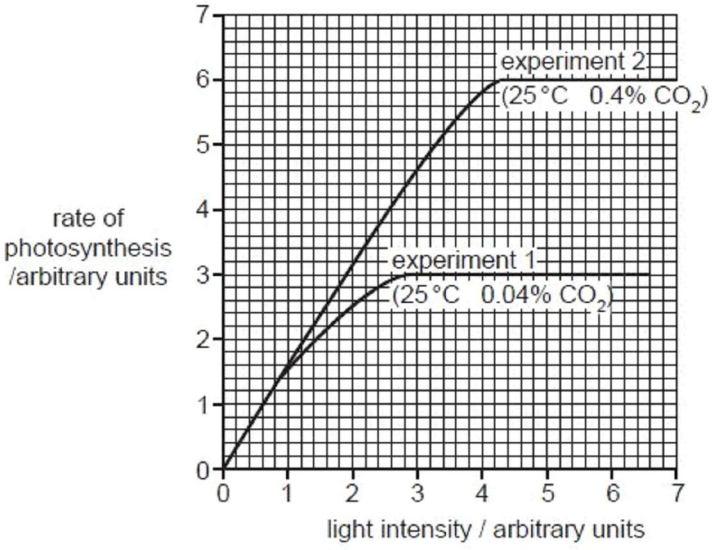


Fig. 8.1

(i) Describe **and** explain the results shown in Fig. 8.1 for **experiment 1**.

.....

.....

.....

.....

.....

.....[3]

(ii) Describe **and** explain the difference between the results for experiment 1 **and** experiment 2.

.....

.....

.....

.....

.....

.....[3]

(b) The optimum temperature for many plants living in temperate regions is approximately 25 °C.

Explain why the rate of photosynthesis in these plants decreases at temperatures above 25 °C.

.....

.....

.....

.....

.....

.....

.....

.....

.....[5]

[Total: 11]

Q17.

8 **(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.

1 .....

.....

2 .....

.....

3 .....

.....

4 .....

..... [4]

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 cm^3 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, *d* / cm	light intensity $1/d^2$	time for fifth disc to reach the surface *t* / min	rate of photosynthesis 1000 / *t*
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.

.....

.....

.....

.....

.....

.....[3]

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

.....

.....

.....

.....[2]

(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.

.....

.....

.....

.....[2]

[Total: 12]

Q18.

8 **(a)** In flowering plants, the light-dependent reactions are carried out by photosynthetic pigments which fall into two categories: primary pigments and accessory pigments.

Outline the role played by accessory pigments in the light-dependent reactions.

.....

.....

.....

..... [2]

(b) Photosynthetic pigments are arranged in photosystems. There are two photosystems, PSI and PSII. PSI takes part in cyclic photophosphorylation but PSII does not.

Outline the differences between cyclic and non-cyclic photophosphorylation.

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..... [4]

(c) The rate of photosynthesis is affected by several environmental factors. Fig. 8.1 shows the effect of temperature on the rate of photosynthesis.

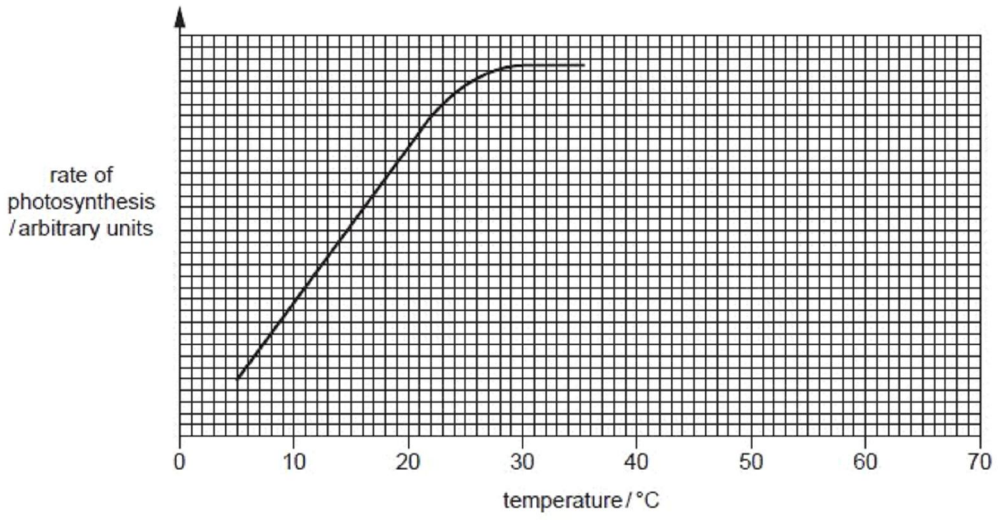

Fig. 8.1

(i) Explain why the rate of photosynthesis levels out at 30 °C.

.....

.....

.....

..... [2]

(ii) On Fig. 8.1 continue the curve to indicate what would happen to the rate of photosynthesis if the temperature was increased to 70 °C. [1]

(iii) Explain why you have continued the curve in this way.

.....

.....

.....

..... [2]

(d) A palisade mesophyll cell is adapted to carry out photosynthesis. The table below lists some of the adaptations of a palisade mesophyll cell.

Complete the table to show how these adaptations help the cell to carry out photosynthesis.

adaptation	how the adaptation helps photosynthesis
thin cell wall	....
cylindrical shape	....
large vacuole	....
chloroplasts can be moved within the cell	....

[4]

[Total: 15]

Q19.

8 **(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.

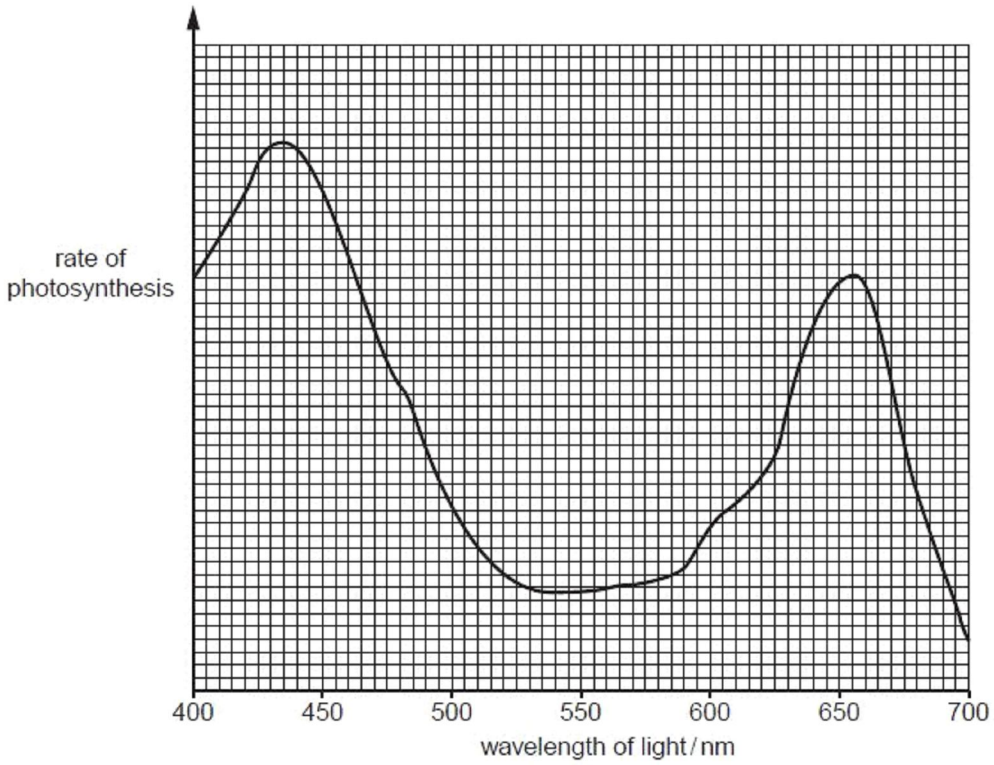

Fig. 8.1

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

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.....

.....

.....

.....

.....

.....

..... [4]

(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.

.....

.....

.....

.....

.....

..... [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*.

.....

.....

.....

..... [2]

(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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.....

.....

.....

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.....

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..... [4]

[Total: 15]

Q20.

7 **(a)** An experiment was carried out into the effect of light of different colours on photosynthesis.

- 15 leaf discs from the same plant were obtained.
- Five sealed test-tubes were set up, each containing three leaf discs in hydrogencarbonate indicator solution.
- Hydrogencarbonate indicator solution changes colour at different pH values.
- At the start of the experiment the indicator solution in all five test-tubes was orange-red.
- Four of the test-tubes were illuminated by light of a specific colour.
- The test-tubes were illuminated for the same length of time.
- The fifth test-tube was covered in black paper and was a control.

The results are recorded in Table 7.1.

Table 7.1

colour of light	final colour of hydrogencarbonate solution
white	purple
blue	purple
green	orange-yellow
red	purple
control – no light	yellow

When the pH increases, the indicator becomes purple and when the pH decreases, the indicator turns yellow.

(i) Explain the results for the leaf discs illuminated by blue light.

.....

.....

.....

.....[2]

(ii) Explain why the indicator in the control went yellow.

.....

.....

.....

.....[2]

(b) Cyclic and non-cyclic photophosphorylation take place in the light-dependent stage of photosynthesis.

(i) Describe the role of accessory pigments in photophosphorylation.

.....

.....

.....

.....[2]

(ii) Write a balanced equation that summarises photolysis.

.....[1]

(iii) State **precisely** the location of photosynthetic pigments within a chloroplast.

.....[1]

[Total: 8]

Q21.

7 The light-dependent stage of photosynthesis takes place on the thylakoids of the chloroplast.

Fig. 7.1 shows some of the components involved in the light-dependent stage.

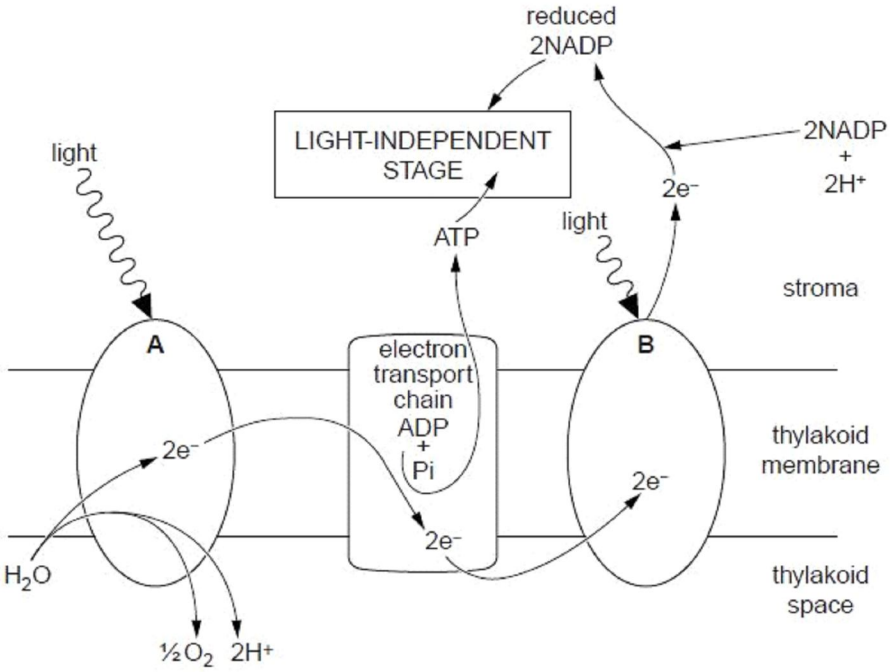

Fig. 7.1

(a) With reference to Fig. 7.1, identify structures **A** and **B**.

A .....

B .....[2]

(b) Describe the roles of the following substances in the light-independent stage of photosynthesis:

E

(i) RuBP

.....

.....

.....

.....[2]

(ii) reduced NADP

.....

.....

.....

.....[2]

(iii) ATP.

.....

.....

.....

.....[2]

[Total: 8]

Q22.

1 **(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*.

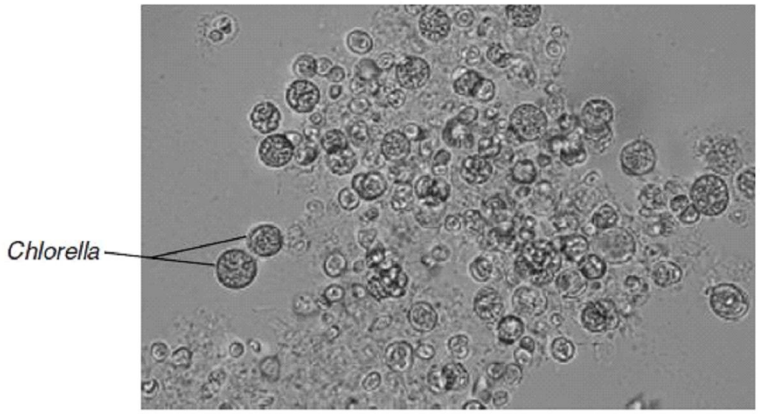

Fig. 1.1

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.

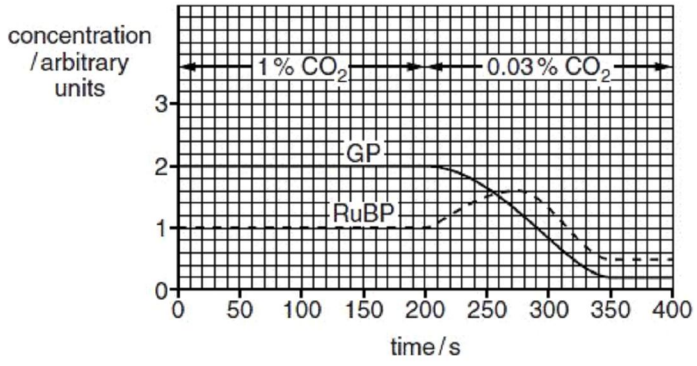

Fig. 1.2

(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.

.....

.....

.....

.....

.....

.....[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*.

.....

.....

.....

.....

.....

.....[2]

[Total: 7]

Q23.

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

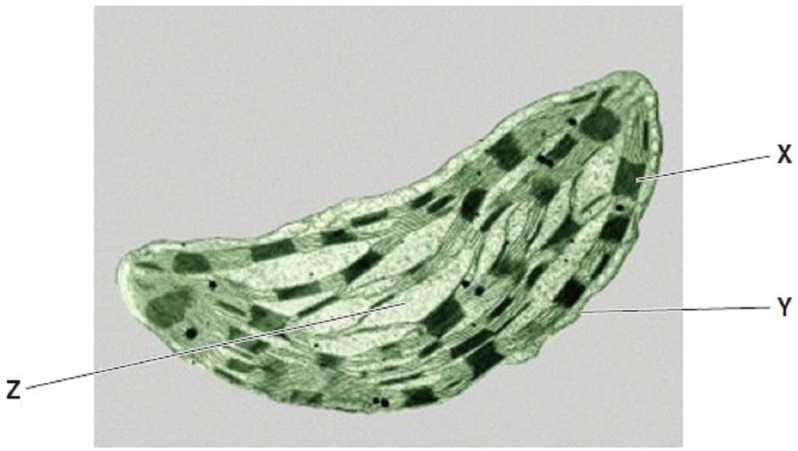

Fig. 1.1

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.

.....

.....

.....

.....

.....

.....[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]

Q24.

8 **(a)** Fig. 8.1 shows some of the reactions that take place inside a palisade mesophyll cell.

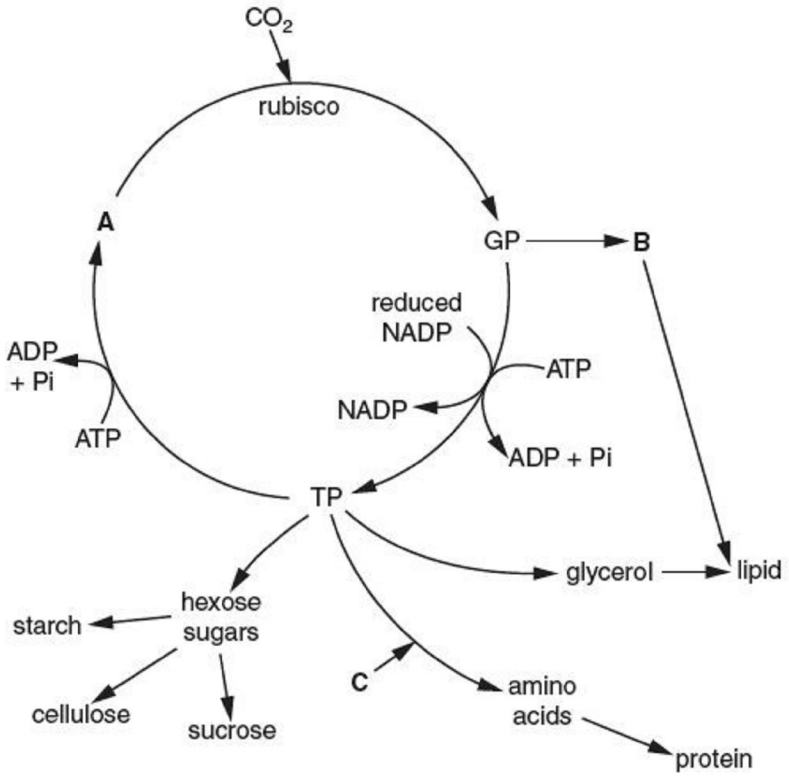

Fig. 8.1

(i) Identify substances **A**, **B** and **C**.

A .....

B .....

C ..... [3]

(ii) Name precisely the process that produces reduced NADP.

.....[1]

(iii) Name the type of reaction that takes place to produce starch from hexose sugars **and** name the type of bonds formed.

reaction .....

bond .....[2]

(iv) Describe how carbon dioxide reaches the inside of a palisade mesophyll cell from the external atmosphere.

.....

.....

.....

.....

.....

.....

.....[3]

(b) The optimum pH for the activity of rubisco is pH8.

Explain why the illumination of chloroplasts leads to optimum pH conditions for rubisco.

.....

.....

.....

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.....

.....

.....

.....

.....[3]

[Total: 12]

Q25.

8 **(a)** Fig. 8.1 is a diagram of a palisade cell from a leaf.

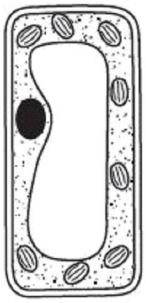


Fig. 8.1

Using label lines and the letters **X**, **Y** and **Z**, identify a structure in Fig. 8.1 that:

- contains RuBP – **X**
- is fully permeable – **Y**
- is made mainly of phospholipids – **Z** [3]

(b) An experiment was carried out to investigate the effect of light intensity on the rate of photosynthesis in an aquatic plant using the apparatus shown in Fig. 8.2.

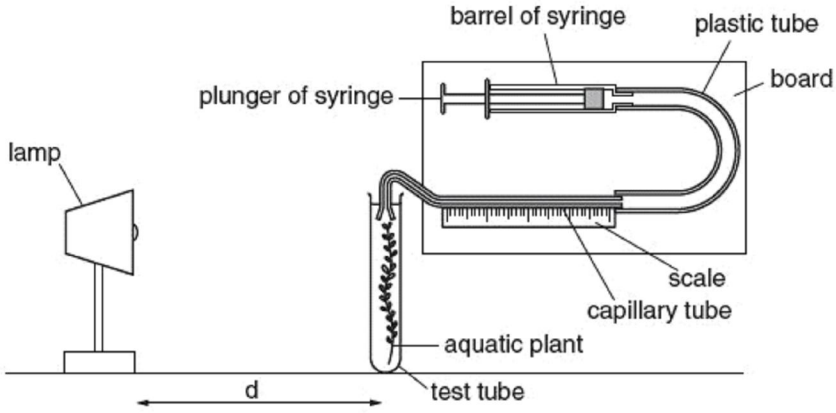


Fig. 8.2

As photosynthesis took place, the oxygen produced formed a bubble of gas which moved along the scale in the capillary tube. The distance moved by the bubble in a fixed period of time was used to calculate the rate of photosynthesis.

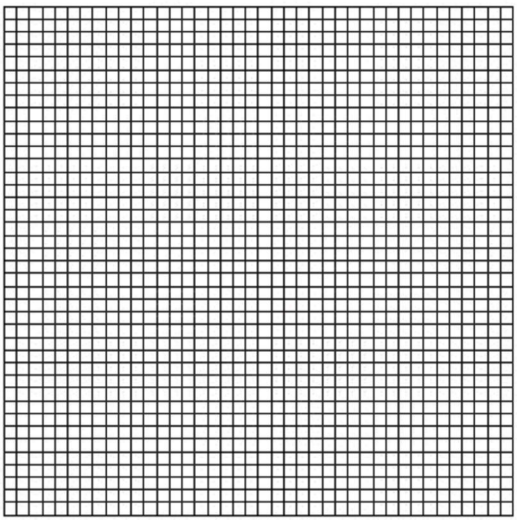
The light intensity was varied by altering the distance, d, between the lamp and the photosynthesising plant.

The results are shown in Table 8.1.

Table 8.1

light intensity / arbitrary units	rate of photosynthesis / arbitrary units
50	50
100	100
125	110
150	115
200	120
300	120

(i) Using the data in Table 8.1, draw a graph to show the relationship between light intensity and the rate of photosynthesis.



[3]

(ii) **Explain** the shape of the graph you have drawn, with reference to limiting factors.

.....

.....

.....

.....

.....

.....

.....

.....[3]

(c) Fig. 8.3 shows the absorption spectra of the photosynthetic pigments of a flowering plant.

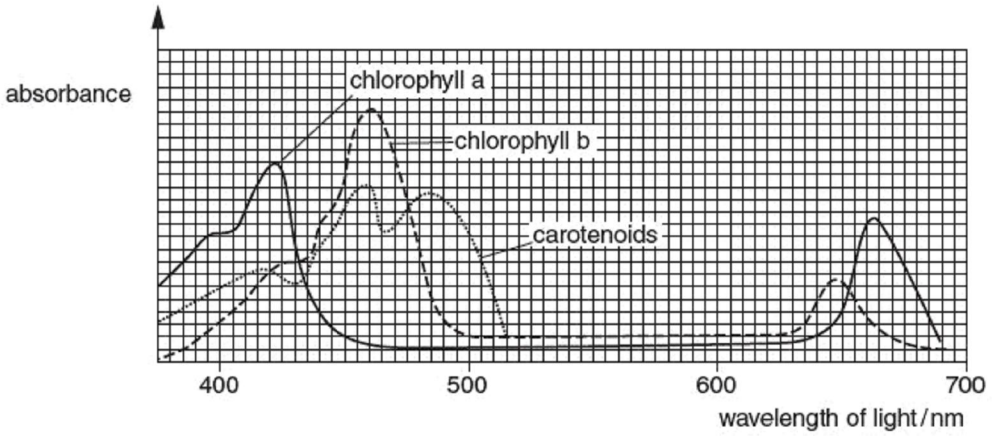


Fig. 8.3

(i) Name the accessory pigment(s) shown in Fig. 8.3.

.....

.....[1]

(ii) Outline the role of the accessory pigments in photosynthesis.

.....

.....

.....

.....

.....

.....

.....[3]

(iii) Very little light of wavelength 550 nm is absorbed by the photosynthetic pigments.

State what happens to most of this light.

.....

.....[1]

(iv) A graph can also be drawn to show the relationship between the wavelength of light and the rate of photosynthesis.

State the name of this type of graph.

.....[1]

[Total: 15]

Section B

1.

7 (a) Outline the main features of the Calvin Cycle. [9]

(b) Explain the role of NADP in photosynthesis. [6]

[Total: 15]

2.

10 (a) Describe the structure of a chloroplast. [9]

(b) Explain how the palisade mesophyll cells of a leaf are adapted for photosynthesis. [6]

[Total: 15]

3.

9 **(a)** Explain how the palisade mesophyll cells of a leaf are adapted for photosynthesis. [8]

(b) Outline the light-independent stage of photosynthesis. [7]

[Total: 15]

4.

9 **(a)** Describe the structure of photosystems and explain how a photosystem functions in cyclic photophosphorylation. [8]

(b) Explain briefly how reduced NADP is formed in the light-dependent stage and how it is used in the light-independent stage. [7]

[Total: 15]

5.

10 **(a)** Describe how non-cyclic photophosphorylation produces ATP and reduced NADP. [9]

(b) Outline the steps of the Calvin cycle. [6]

[Total: 15]

6.

10 **(a)** Describe the photoactivation of chlorophyll **and** its role in **cyclic** photophosphorylation. [8]

(b) Explain briefly how reduced NADP is formed in the light-dependent stage and how it is used in the light-independent stage. [7]

[Total: 15]

7.

10 **(a)** Explain how the physiology of the leaves of a C4 plant, such as maize, is adapted for efficient carbon fixation at high temperatures. [7]

(b) Describe how, in photosynthesis, light energy is converted into chemical energy, in the form of ATP. [8]

[Total: 15]

8.

6 **(a)** Describe how the structure of a dicotyledonous leaf is related to its functions in photosynthesis. [7]

(b) Discuss the effects that variations in carbon dioxide concentration and light intensity have on the rate of photosynthesis. [8]

9.

10 **(a)** Describe the structure of photosystems and explain how a photosystem functions in **cyclic** photophosphorylation. [9]

(b) Explain briefly how reduced NADP is formed in the light-dependent stage of photosynthesis and is used in the light-independent stage. [6]

[Total: 15]

10.

10 **(a)** Describe how the structure of a chloroplast is related to its functions. [9]

(b) Describe how you would separate chloroplast pigments using chromatography. [6]

[Total: 15]

11.

10 **(a)** Explain how the palisade mesophyll cells of a leaf are adapted for photosynthesis. [7]

(b) Describe the structure of photosystems **and** explain how a photosystem functions in ***cyclic*** photophosphorylation. [8]

[Total: 15]

12.

10 **(a)** Describe the arrangement and location of chloroplast pigments **and** discuss their effect on absorption spectra. [8]

(b) Describe the part played by auxins in apical dominance in a plant shoot. [7]

[Total: 15]

13.

10 **(a)** Outline the process of the photolysis of water **and** describe what happens to the products of photolysis. [10]

(b) Describe the roles of gibberellins in stem elongation. [5]

[Total: 15]