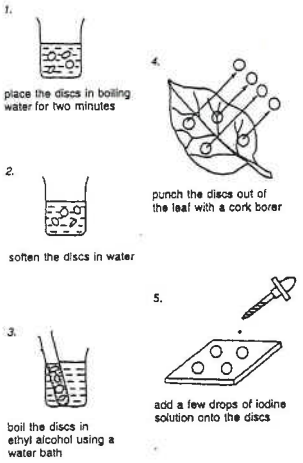
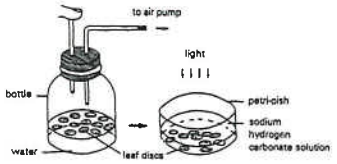
Past HKCEE Questions
Photosynthesis
Paper I

1. The following series of diagrams show the steps involved in testing for starch in green leaves.



(i) Using the numbers on the diagrams, indicate the correct sequence for such a test.
(ii) What are the reasons for carrying out the steps shown in diagrams 1 and 3?
(iii) If starch is present in the leaf discs, what would be the observable result of the above test?
(iv) What inference is usually made if starch is detected in the leaf discs using the above test?
(v) If the discs were taken from the non-pigmented part of the leaf, what result would you expect to get from the above test? Explain your answer. (10 marks)
(HKCEE 1979)

2.

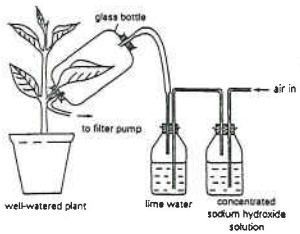


The diagram above shows the apparatus used in an experiment on photosynthesis. The leaf discs were punched from the same dicotyledonous leaf and were put in a bottle. Air trapped in the discs was removed by means of an air pump until all the discs sank to the bottom.
Equal numbers of leaf discs were then transferred to separate dishes containing sodium hydrogen carbonate solutions of different concentrations.
All dishes were exposed to light of the same intensity. The time required for all discs in each petri-dish to rise to the surface was measured for calculating the rate of photosynthesis as shown in the table below:

Concentration of sodium hydrogen carbonate solution (%)	Time (T) for the leaf discs to rise to the surface (seconds)	Rate of photosynthesis in terms of 1/T (second^{-1})
0	∞	0
0.10	135	7.4×10^{-3}
0.20	105	9.5×10^{-3}
0.30	90	11.1×10^{-3}
0.40	83	12.0×10^{-3}
0.50	83	12.0×10^{-3}

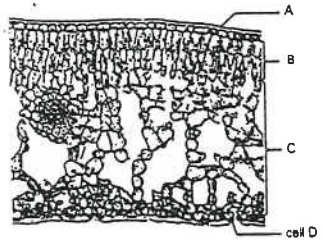
(i) Using graph paper, draw a curve to show the relationship between the rate of photosynthesis and the concentration of sodium hydrogen carbonate solution.
(ii) Describe the relationship shown by the curve drawn in (i).
(iii) Before transferring the leaf discs to the sodium hydrogen carbonate solution, why was it necessary to remove the air so that they all sank?
(iv) Explain why the leaf discs
(1) failed to rise in 0% sodium hydrogen carbonate solution.
(2) rose in the solutions of other concentrations.
(v) Why would the results be less accurate if the discs were punched from the mid-rib region of the leaf?
(vi) If the experiment were to be repeated with the same number of leaf discs, suggest one way to shorten the time to obtain the results.
(HKCEE 1985)

3. The following apparatus is put under sunlight to show that a certain condition is necessary for photosynthesis:



(i) What is the condition being studied? (1 mark)
(ii) In this experiment, what is the purpose of using
(1) the concentrated sodium hydroxide solution?
(2) the lime water? (2 marks)
(iii) Explain what should be done to the plant before the experiment starts. (2 marks)
(iv) After two hours, the leaf in the glass bottle is detached and tested to see whether photosynthesis has taken place. Describe how the test should be carried out. (4 marks)
(v) Suggest a control for this experiment. (2 marks)
(HKCEE 1989)

4. The following photomicrograph shows the transverse section of part of a leaf:



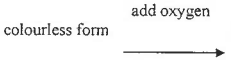
(i) Name C and D. (2 marks)
(ii) Structure B is the major site of photosynthesis. Describe TWO structural features which enable it to carry out photosynthesis efficiently. (2 marks)
(iii) What is the significance of the large intercellular spaces in C with respect to photosynthesis? (1 mark)
(iv) A leaf of the same kind as that shown in the photomicrograph was placed in hot water. Bubbles were found to evolve from one surface only.
(1) Explain why bubbling occurred.
(2) Explain why bubbling occurred only on one surface. (3 marks)
(v) Which TWO labelled structures may be absent in the leaves of certain aquatic plants? Explain your choice (4 marks)

5. The net carbon dioxide uptake and release from the stem and a single leaf of a herbaceous plant were measured at different light intensities. The results are shown below:

Light intensity (arbitrary units)	Net uptake (+)/net release (–) of carbon dioxide (mg cm^{-2}h^{-1})	
	stem	leaf
0	–1.0	–1.0
2	+0.6	+5.6
4	+2.2	+9.2
6	+3.4	+11.0
8	+4.4	+12.0
10	+5.0	+12.6

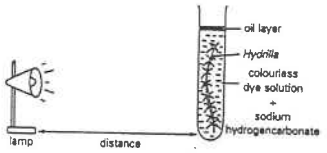
(i) Plot the above data on the same graph. (4 marks)
(ii) Considering a leaf of 10 cm2 at a light intensity of 5 units,
(1) state the net carbon dioxide uptake by the leaf in one hour. (1 mark)
(2) calculate the actual amount of carbon dioxide used by this leaf in photosynthesis in the same period. (2 marks)
(iii)
(1) With reference to the graph you have drawn, state which organ, the stem or the leaf, is more efficient in carrying out photosynthesis. Explain how you arrive at your answer. (2 marks)
(2) Suggest TWO structural features which enable this organ to carry out photosynthesis more efficiently. (2 marks)
(HKCEE 1990)

6. A water soluble dye has a colourless form which changes to blue if oxygen is provided:

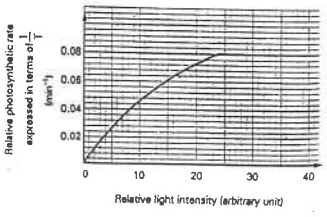


(i) The diagram below shows an experimental setup to study the effect of light intensity on the rate of photosynthesis of *Hydrilla*.. The time taken (T) for the colourless dye solution to change to blue is a measure of the relative rate of photosynthesis.

Provided by dse.life



Using the results of the experiment, a graph is plotted as shown below:



(1) What is the purpose of adding a layer of oil on top of the solution? (1 mark)

(2) Why is sodium hydrogencarbonate added? (1 mark)

(3) What is the relationship between the distance of the lamp away from the boiling tube and the relative light intensity? (1 mark)

(4) How long did it take for the solution to change to blue when the relative light intensity was at 10 arbitrary units? Show all your calculations. (2 marks)

(5) What conclusion can you draw from the results of this experiment? (2 marks)

(ii) A student found that gently blowing air into a solution of the colourless form of this dye could change it into the blue form. He doubted that this colour change was due to carbon dioxide rather than oxygen in his breath. Draw and label a simple experimental set-up to show that this colour change is NOT caused by carbon dioxide. (4 marks)

(HKCEE 1991)

7.

(i) Most leaves have the following features in common

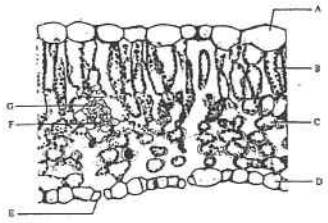
(1) they are thin, and

(2) they are green in colour.

Explain the importance of each of these features in relation to the photosynthetic function of leaves. (5 marks)

(HKCEE 1994)

8. The photomicrograph below shows the transverse section of a leaf:



(i) Using Tellers in the photomicrograph, state the cell types which

(1) contains chlorophyll.

(2) regulates water loss. (2 marks)

(ii) Describe how cell type B obtains

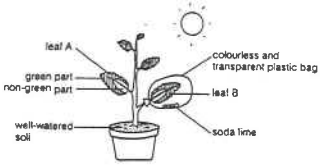
(1) water from cell type G. (2 marks)

(2) carbon dioxide from the atmosphere. (3 marks)

(iii) Describe what happens to water and carbon dioxide in cell type B during photosynthesis. (3 marks)

(HKCEE 1996)

9. To study the conditions required for photosynthesis, a destarched plant with variegated leaves was put under sunlight for 4 hours as shown in the diagram below:



(i) Explain why the plant can be destarched by keeping it in darkness for 48 hours. (1 marks)

(ii) What is the use of soda lime in the set-up? (1 mark)

(iii) After 4 hours, both leaf A and leaf B were detached and tested to see whether photosynthesis had taken place. Describe how the test should be carried rut. (4 marks)

(iv) After the test in (iii), what is the observed result of

(1) leaf A,

(2) leaf B? (2 marks)

(v) What conclusion, if any, can be drawn by comparing the results of

(1) the green part and the non-green part of leaf A only,

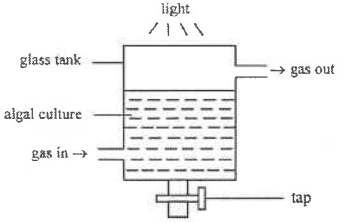
(2) the green part of leaf A and the green part of leaf B only,

(3) the green part of leaf A and the non-green part of leaf B only?

Give an explanation if no conclusion can be drawn. (4 marks)

(HKCEE 1997)

10. Exhaust gas from power stations is rich in carbon dioxide. Some scientists attempted to make use of the exhaust gas for growing microscopic green algae. The diagram below shows a set-up used to compare the effect of air and exhaust gas on the growth of algae:



In the first treatment, air was passed into the glass tank. Two samples of the algal culture, each of 1 litre, were withdrawn at an interval of 24 hours. The dry mass of the algae in each sample was determined. In the second treatment, the same procedure was repeated but exhaust gas was used instead of air. The results are shown in the table below:

Treatment	Gas used	Dry mass of algae (g)	
		at hour 0	at hour 24
I	Air	3.60	3.64
II	Exhaust gas	3.70	3.68

(i) What is meant by the dry mass of the algae? (1 mark)

(ii) Explain the difference in dry mass of the two algal samples in treatment I. (4 marks)

(iii)

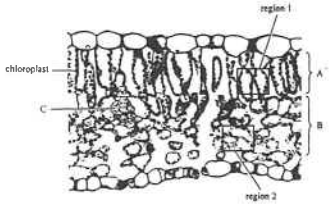
(1) Based on the results of treatments I and II, what is the effect of aerating the algal culture with the exhaust gas? (1 mark)

(2) Suggest a reason to explain why there is such an effect. (2 marks)

(iv) Explain how the global air temperature may be affected if the practice of using exhaust gas from power stations to culture algae is adopted all over the world. (3 marks)

(HKCEE 1999)

11. The diagram below shows part of a section of a leaf:



(i) Name tissues A and B. (2 marks)

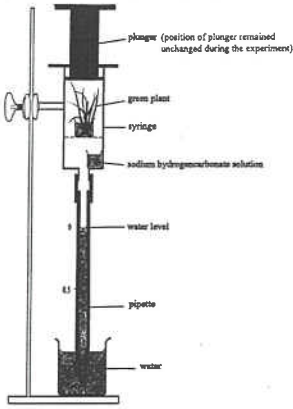
(ii) Regions 1 and 2 have the same area. Work out the ratio of the density of chloroplasts in region 1 to that in region 2. (2 marks)

(iii) With reference to your answer to (ii), what would be the significance of this pattern of chloroplast distribution in the leaf? Explain your answer. (4 marks)

(iv) It is suggested that cell type C is responsible for the transport of water from the stem to the leaf. Design an investigation to test this idea using a leafy shoot. (4 marks)

(HKCEE 2000)

12. The set-up below is used to measure the rate of photosynthesis of a green plant. The sodium hydrogencarbonate solution helps to maintain a constant level of carbon dioxide inside the syringe during the experiment.

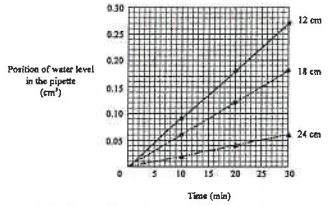


(i) Explain why the water level in the pipette will drop when the set-up is put under bright light condition. (4 marks)

(ii) A fluorescent lamp was placed 12 cm away from the set-up. The position of the water level was recorded at 10-minute intervals

Provided by dse.life

for 30 minutes. The same procedure was repeated with the lamp placed 18 cm and 24 cm away. The results of the experiment are shown in the graph below:



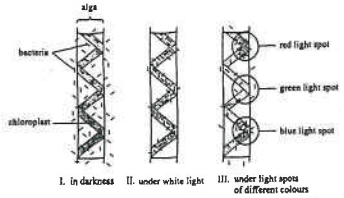
(1) Given that the rate of respiration of the plant is 0.002 cm^3 0_2 min^{-1}, calculate the rate of photosynthesis of the plant when the lamp was 12 cm away from the set-up. (2 marks)

(2) What was the effect on the rate of photosynthesis of the plant when the distance between the lamp and the plant increased? How would you explain this? (2 marks)

(iii) The set-up can be modified to measure the rate of respiration of the plant. State three necessary modifications. (3 marks)

(HKCEE 2001)

13. In 1883, a German scientist, Engelmann, used a green alga to study the effect of light on photosynthesis. This alga has long ribbon-like chloroplasts. He placed the alga on a slide with a suspension of bacteria which would migrate to regions with high oxygen concentration. He observed the distribution of the bacteria under different light conditions. The results are shown in the diagram below:



(i) Describe the distribution of bacteria in I and II. (2 marks)

(ii) How would you account for the bacteria distribution in II? (2 marks)

(iii) What did Engelmann wish to find out by setting up the experiment in III? (1 mark)

(iv) What conclusions can you draw from the results in III? (2 marks)

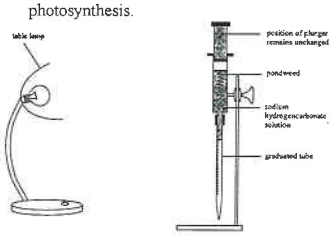
(v)

(1) Draw a labelled diagram to show an experimental set-up used to test whether the conclusions in (iv) are correct or not. You are provided with a waterweed, a table lamp, colour filters and materials that you can get in the laboratory. (3 marks)

(2) What data would you collect with this set-up? (1 mark)

(HKCEE 2004)

14. The diagram below shows a set-up used to measure the rate of photosynthesis of a pondweed. A lamp was placed at different distances from the pondweed. At each distance, the volume of gas collected per minute was taken as the rate of photosynthesis.



The results of the experiment are shown in the table below:

Light intensity (arbitrary unit)	Rate of photosynthesis (mm^3 min^{-1})
0.4	0.0
0.6	0.8
1.6	2.0
2.5	2.7
5.0	3.5
10.0	3.5

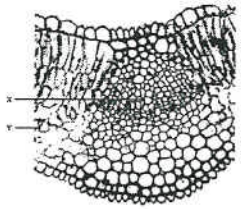
(i) How would you measure the volume of gas collected per minute using this set-up? (1 mark)

(ii) Present the results of the experiment in the form of a graph. (4 marks)

(iii) Describe and explain the change in the rate of photosynthesis with light intensity. (4 marks)

(iv) Explain why the rate of photosynthesis becomes 0 even there is 0.4 arbitrary unit of light. (2 marks)

14. The photomicrograph below shows a cross section of a dicotyledonous leaf:



(a) With reference to the photomicrograph, give two structural differences between cell types X and Y. (2 marks)

(b) (i) In the presence of light, carbohydrates are formed and then stored in cell type Y.

(1) State the carbohydrate stored. (1 mark)

(2) If you have prepared a thin section of a leaf, how would you show the presence of the stored carbohydrate in it? (3 marks)

(ii) Explain why the stored carbohydrate in cell type Y disappears when the plant is kept in darkness. (3 marks)

(c) During transpiration, water evaporates from the surface of cell type Y. How does this help cell type Y to obtain minerals? (3 marks)

(HKCEE 2007)

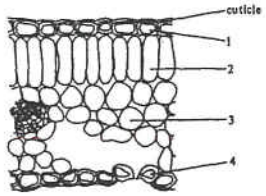
Provided by dse.life

15.

Past HKCEE Questions
Photosynthesis
Paper II

91-6
Which of the following cells possess chloroplasts?
(1) a guard cell
(2) a leaf mesophyll cell
(3) an onion epidermal cell
A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

92.
Directions: Questions 1 and 2 refer to the diagram below which shows a transverse section of a leaf:

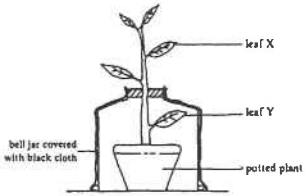


92-1
Which of the cells are green?
A. (1) and (4) only
B. (2) and (3) only
C. (1), (2) and (3) only
D. (2), (3) and (4) only

92-2
The cuticle covering the upper and lower surfaces is for
(1) supporting the leaf.
(2) preventing the invasion by germs.
(3) reducing water evaporation from the surfaces.
A. (1) and (2) only
R. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

92-5
The oxygen released during photosynthesis of green leaves comes from
A. air.
B. water.
C. chlorophyll.
D. carbon dioxide.

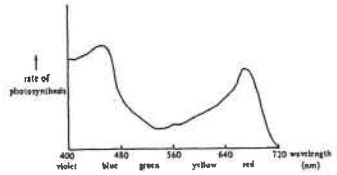
92-8
The experimental set-up shown below was kept in the dark for 48 hours before exposing it to sunlight for another 3 hours. Leaf X and Y were then tested for starch. Which of the following would be the probable results?



	Leaf X	Leaf Y
A.	starch present	starch present
B.	Starch present	starch absent
C.	starch absent	starch present
D.	starch absent	search absent

92-9
When testing a leaf for starch, the leaf is boiled with alcohol in a water bath to
A. kill the cells.
B. make it soft.
C. dissolve the starch.
D. extract the chlorophyll.

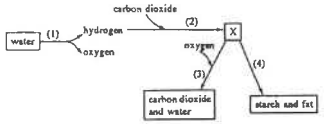
93.
Directions: Questions 16 and 17 refer to tire graph below. The graph shows the rate of photosynthesis of a green plant when it is placed under lights of different colours:



93-16
Which coloured lights are moat effective for photosynthesis?
A. yellow and green
B. yellow and blue
C. red and green
D. red and blue

93-17
Which of the following would occur if only green light reached the earth?
A. The total number of animals on earth would decrease.
B. The amount of food produced by green plants would increase.
C. The amount of oxygen in the atmosphere would increase.
D. The amount of carbon dioxide in the atmosphere would decrease.

94.
Directions: Questions 7 and 8 refer to the diagram below which shows certain metabolic pathways that take place in a mesophyll cell:



94-7
Which of the following processes requires light energy?
A. (1)
B. (2)
C. (3)
D. (4)

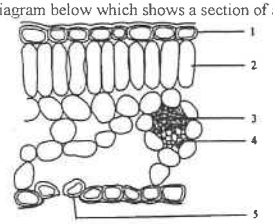
94-8
What is substance X?
A. amino acid
B. cellulose
C. chlorophyll
D. simple sugar

95-10
The diagram below shows a plant viewed from the top

The leaves of the plant are so arranged in order to allow the leaves to
A. have more space to grow.
B. absorb the maximum amount of light.
C. spread out for the landing of insects.
D. absorb the maximum amount of rain water.

96-10
Which of the following elements in plants are obtained from the air through the leaves?
A. carbon and oxygen
B. carbon and nitrogen
C. nitrogen and oxygen
D. carbon, nitrogen and oxygen

97.
Directions: Questions 17 and 18 refer to the diagram below which shows a section of a leaf:

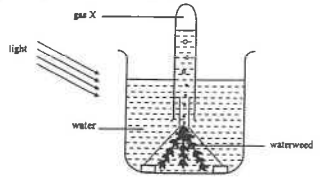


97-17
Which cell types are green?
A. 1 and 4 only
B. 2 and 5 only
C. 1, 2 and 4 only
D. 1, 2 and 5 only

97-18
Respiration occurs in all cell types except
A. 2.
B. 3.
C. 1 and 2.
D. 3 and 4.

01-13
The oxygen produced during photosynthesis comes from
A. water.
B. glucose.
C. chlorophyll.
D. carbon dioxide.

02.
Directions: Questions 5 and 6 refer to the set-up below, which is used to investigate the photosynthesis of a waterweed



02-5
The waterweed produces gas X and starch from

	Gas X	Starch
A.	water	carbon dioxide
B.	water	carbon dioxide and water
C.	carbon dioxide	Glucose
D.	carbon dioxide	carbon dioxide and water

Provided by dse.life

02-6
Arrange in the correct order the following steps for testing the presence of starch in the green leaves of the waterweed

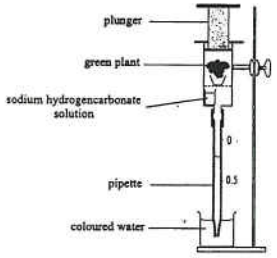
(1) Add iodine solution.
(2) Soak the leaves in warm water.
(3) Boil the leaves in water for two minutes.
(4) Immerse the leaves in alcohol heated in a hot water bath.

A. (1), (2), (3), (4)
B. (2), (4), (3), (1)
C. (3), (4), (2), (1)
D. (4), (1), (3), (2)

03-3
Which of the following correctly compares an epidermal cell and a mesophyll cell of a leaf?

	Epidermal cell	*Mesophyll cell*
A.	without nucleus	with nucleus
B.	without cell wall	with cell wall
C.	without chloroplasts	with chloroplasts
D.	without large vacuole	with large vacuole

03.
Directions: Questions 7 and 8 refer to the diagram below, which shows a set-up used to find the rate of photosynthesis of a green plant. The sodium hydrogencarbonate solution helps to maintain a constant level of carbon dioxide inside the syringe. During the study, the position of. the plunger remained unchanged.



The results of the study are:
Initial pipette reading = 0.20 mL
Pipette reading after 30 minutes = 0.45 mL

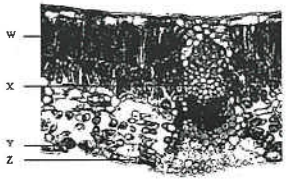
03-7
Based on the results, what is the rate of photosynthesis of this plant?
A. 0.25 mL CO_2 absorbed per hour
B. 0.50 mL CO_2 absorbed per hour
C. 0.25 mL O_2 produced per hour
D. 0.50 mL O_2 produced per hour

03-8
The rate obtained in this study is lower than the actual rate of photosynthesis of the plant. This is because
A. the plant carried out respiration at the same time.
B. the plant carried out transpiration at the same time.
C. there might be a rise in the air temperature during the study.
D. there might be a change in the relative humidity in air during the study.

05-10
Water is a raw material for photosynthesis. In which of the following substances will the hydrogen and oxygen from water be found at the end of photosynthesis?

	Hydrogen	*Oxygen*
A.	carbohydrate	oxygen gas
B.	carbohydrate	carbohydrate
C.	hydrogen gas	oxygen gas
D.	hydrogen gas	carbohydrate

06.
Directions: Questions 26 and 27 refer to the photomicrograph below, which shows the cross section of a leaf:



Source: Department of Biology, 5500 University of Parkway, *Biology Images*. URL: http://biology.com/tutorial/cross_section.htm

06-26
Which of the following correctly lists the functions of cell types W, X and Z?

	W	*X*	*Z*
A.	support	transport	protection
B.	photosynthesis	transport	storage
C.	storage	support	photosynthesis
D.	photosynthesis	support	protection

06-27
Which of the following comparisons of the different cell types are correct?

(1) Cell type W contains more mitochondria than cell type Z.
(2) Cell type W contains more chloroplasts than cell type Y.
(3) Cell type X contains a larger vacuole than cell type Z.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

07-03
Which of the following correctly describe photosynthesis'?

(1) It is a catabolic process.
(2) It is an energy conversion process.
(3) It is a process by which producers make food.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

Provided by dse.life

Past HKCEE Questions
Photosynthesis
Suggested Answers

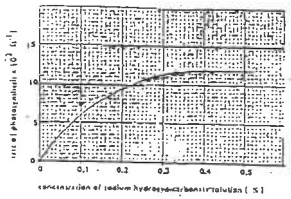
Paper I

1. (i) 4, 1, 3, 2, 5 — 2
   (ii) diagram 1:
   - to kill the leaf cells
   - to stop any chemical changes
   - for easier extraction of chlorophyll

   diagram 3:
   - to extract chlorophyll / to decolourize leaf

   (any 2) — 2
   (iii) leaf discs change to dark blue
   (iv) photosynthesis has taken place in the leaf
   (v) no colour change / stained brown — 1
   no starch is formed — 1
   because chlorophyll is absent — 1

2. (i) Graph:
   axes - correct with labels — 1
   points - at least 5 correctly plotted — 1
   curve - joining up the points plotted — 1



   (ii) no photosynthesis at 0% — 1
   rate of photosynthesis increases rapidly from 0 - 0.2%
   AND/OR increasing steadily from 0.2 - 0.4% — 1
   becoming constant beyond 0.4% — 1
   (iii) to prepare the discs in such a position so that they may be buoyed up by the gas evolved from photosynthesis — 1
   (iv)

	CO_2 supply	Rate of photosynthesis	Surplus O_2 accumulated / density lowered	
(1)	lacking	zero / equal or slower than respiration rate	no	1 + 1 + 1
(2)	increasing	faster than respiration rate	yes	1 + 1 + 1

   (v) mid-rib region contains mainly vascular tissues (main vein) with less photosynthetic cells — 1
   (vi) increase the temperature / increasing the light intensity / increase the concentration of each $NaHCO_3$ solution used by say 0.1 % — 1

3. (i) carbon dioxide — 1
   (ii) (1) to absorb carbon dioxide from the incoming air — 1
   (2) to check that all carbon dioxide from the incoming air has been removed — 1
   (iii) (any 2) — 2
   - by putting the plant in darkness for a few days before setting up
   - destarch the leaves
   - to ensure that any starch detected was formed during the experiment

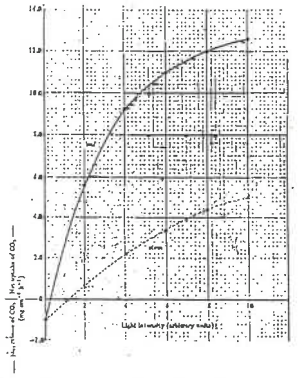
   (iv) put the leaf in boiling water for a few minutes — 1
   put the leaf in a tube of alcohol in a hot water bath — 1
   put the leaf in water — 1
   add iodine solution — 1
   (v) replace both sodium hydroxide solution and lime water by water / put the leaf outside the glass bottle — 1

4. (i) C - spongy mesophyll / cells / layer — 1
   D - guard cell — 1
   (ii) cells are closely packed possessing a large number of chloroplasts — 1
   (iii) for rapid diffusion of gases to facilitate photosynthesis — 1
   (iv) (1) air in the intercellular spaces expands on heating — 1
   (2) and passes out through the stomata — 1
   (v)

A (cuticle)	there is no danger of desiccation	1 + 1
cell D (guard cell)	gaseous diffusion occurs all over the plant surfaces where there is no cuticle	1 + 1

(accept other suitable answers)

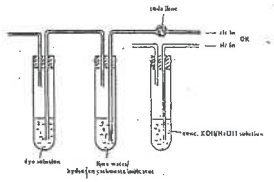
5. (i) correct choices of axes — 1
   correct labelling of axes and giving a key to each curve — 1
   correct plotting of 5 points for each curve (1+1) — 2



   (ii) (1) (10.2 +/- 0.2) x 10 mg = 102 +/- 2 mg — 1
   (N.B. No unit, no mark.)
   (2) [(10.2 +/- 0.2) + 1.0] x 10 mg — 1
   = 112 +/- 2 mg — 1
   (N.B. No unit, no mark.)
   (iii) (1) the leaf because the carbon dioxide uptake by the leaf is always higher than that by the atmosphere — 1
   (2) (Any 2) (1 x 2) — 2
   - more chloroplast (per unit area) / closely packed palisade cells
   - more stomata / numerous air spaces
   - thin / flat

6. (i) (1) to prevent oxygen in air dissolving into the solution — 1
   (2) to provide sufficient carbon dioxide in the tube — 1
   (3) the relative light intensity is inversely proportional to the (square of) distance of the lamp away from the test-tube — 1
   (4) $1/T = 0.05\ min^{-1}$ — 1
   $T = 20$ min (no unit, no mark) — 1
   (5) the rate of photosynthesis increases with increasing light intensity up to a certain point, — 1
   beyond which the rate levels off — 1

   (ii) Points to note for in the diagram:
   soda lime / conc. KOH / conc. NaOH solution in an enclosed container to absorb CO_2 — 1
   lime water / hydrogen carbonate indicator in an enclosed container to check the absence of CO_2 — 1
   correctly linked glass tubings and rubber tubings — 1
   dye solution in container with an air outlet — 1
   (N.B. No mark is to be awarded if the set-up is not workable.)



7. (i) (1) It allows the mesophyll cells (photosynthetic cells) — 1
   to have a rapid supply of gases, — 1
   and adequate supply of light — 1
   (2) Because mesophyll cells contain chloroplasts / chlorophyll — 1
   to absorb light — 1

8. (i) (1) B, C (E optional) — 1
   (2) E — 1
   (ii) (1) Water moves from cell to cell by osmosis — 1
   (2) Carbon dioxide in air diffuses through stomatal pores — 1
   into the air spaces to cell type B — 1
   (iii) Water is split into hydrogen and oxygen — 1
   Hydrogen combines with carbon dioxide — 1
   to form carbohydrate inside cell type B — 1

9. (i) In darkness, starch in the leaves is converted to sugars — 1
   which are transported away from the leaves / oxidized in respiration — 1
   (ii) To absorb carbon dioxide in the plastic bag — 1
   (iii) Put the leaf in boiling water — 1
   Immerse the leaf in hot alcohol — 1
   Immerse it in water — 1
   Add iodine solution onto the leaf — 1

Provided by dse.life

(iv) (1) In leaf A, the green part turned to dark blue and the non-green part became brown in colour after the iodine test 1

(2) In leaf B, both the green part and non-green part became brown after the iodine test 1

(v) (1) Chlorophyll is necessary for photosynthesis 1

(2) Carbon dioxide is necessary for photosynthesis 1

(3) No conclusion can be drawn because the non-green part of leaf B differs from the green part of leaf A by the absence of chlorophyll and carbon dioxide / by two variables 1

10. (i) Dry mass of the algae is the mass of the algae in which all the water has been removed 1

(ii) The dry mass of the algae at hour 24 was greater than that at hour 0 because the algae have carried out photosynthesis in the 24 hours to make carbohydrates / organic compounds 1
And the rate of photosynthesis is greater than the rate of respiration of the algae 1
Effective communication (C) 1

(iii) (1) The algae grow faster when they are supplied with exhaust gas 1

(2) The exhaust gas is rich in carbon dioxide so that the algae can carry out photosynthesis at a higher rate 1

(iv) The carbon dioxide output to air is reduced 1
leading to a decrease in the greenhouse effect which is caused by carbon dioxide 1
Thus it helps to slow down / prevent global warming 1

11. (i) Tissue A is 'palisade mesophyll 1
Tissue B is 'spongy mesophyll 1

(ii) Number of chloroplasts in region 1 is 20; while that in region 2 is 12 1
Ratio of chloroplast density in region 1 to that in region 2 is 5:3 1

(iii) This allows the leaf to carry out photosynthesis at a higher rate 1
because tissue A has a higher density of chloroplasts 1
and it is located in the upper layer of the leaf 1

so its cells are under direct illumination / can receive more sunlight than the cells of tissue B . 1
Effective communication (C) 1

(iv) Put the stem of a leafy shoot in a dye solution for some time 1
Cut cross sections of the stem and the leaf 1
Examine the sections under the microscope 1
Cell type C would be stained by the dye 1

12. (i) Under bright light condition, the rate of photosynthesis of the plant becomes greater than the rate of respiration 1
Thus there is a net production of oxygen by the plant 1
Meanwhile, the carbon dioxide level inside the syringe remains constant 1
This results in an increase in air pressure inside the syringe 1
Effective communication (C) 1

(ii) (1) Net rate of oxygen produced by the plant = 0.009 cm^3 O_2 min^{-1} 1
Rate of photosynthesis of the plant when the lamp was 12 cm from it
= (0.009 + 0.002) cm^3 O_2 min^{-1}
= 0.011 cm^3 O_2 min^{-1} 1

(2) The rate of photosynthesis decreased 1
because the light intensity decreased as the distance between the plant and the lamp increased 1

(iii) Remove the sodium hydrogencarbonate solution 1
Put a vial of soda lime / sodium hydroxide solution into the syringe 1
Wrap the syringe with black paper / aluminium foil 1

13. (i) The bacteria distributed evenly in I, but concentrated on the chloroplast in II. 1

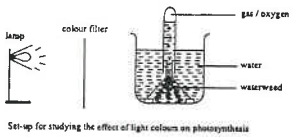
(ii) In the presence of light, the chloroplast produced oxygen during photosynthesis. 1
This led to the movement of bacteria toward the chloroplast. 1

(iii) To study the effect of light of different colours on (the rate of) photosynthesis. 1

(iv) Photosynthesis occurs at similar rates in red and blue lights which are higher than that in green light. 1

(v)

(1) Workable set-up : (must include light source, water, waterweed & colour filters) 1
Labels : ① colour filters, ② waterweed, ③ water / lamp / gas or oxygen
Title

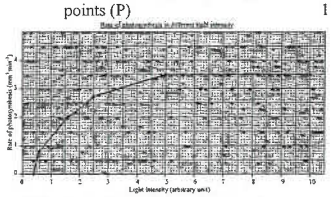


Set-up for studying the effect of light colours on photosynthesis

(2) Measure the volume of oxygen produced / number of oxygen bubbles released per unit time / over a period of time. 1

14. (i) Measure the displacement of the solution level in the graduated tube 1

(ii) Title (T) 1
Correct choice of axes (A) 0.5
Correct labelling of axes together with units (L) 1
Correct plotting and joining of points (P) 1.5



(iii) From 0.4 — 5.0 arbitrary units light intensity, the rate of photosynthesis increases with increasing light intensity 1
because there is more energy trapped for dark reaction 1
Above 5.0 arbitrary units light intensity, the rate of photosynthesis remains the same 1
because there is insufficient supply of carbon dioxide at high light intensity / enzyme activity is not high enough at high light intensity 1
Effective Communication (C) 1

(iv) Because at 0.4 arbitrary unit of light, the rate of respiration is equal to the actual rate of photosynthesis 1
so there is no net oxygen released 1

15. (a) Cell type X has no celilular content while cell type Y has 1
Cell type X has a thicker cell wall than cell type Y 1

(b) (i) (1) Starch
(2)
Add a drop of iodine solution to the leaf section 1
Observe the leaf section under the microscope 1
The section turns blue black 1

(ii) In darkness, photosynthesis stops 1
The stored carbohydrate is converted to sugars 1
which are transported away to other parts of the plant / are used in respiration 1
Effective Communication 1C

(c) When water evaporates from cell type Y, a transpiration pull is set tip 1
Water is drawn from xylem to cell type Y 1
together with dissolved minerals 1

Paper II

91-6	A	01-13	A
92-1	D	02-5	B
92-2	C	02-6	C
92-5	B	03-3	C
92-8	B	03-7	D
92-9	D	03-8	A
93-16	D	05-10	A
93-17	A	06-26	D
94-7	A	06-27	A
94-8	D	07-03	C
95-10	B		
96-10	A		
97-17	B		
97-18	B		

Provided by dse.life