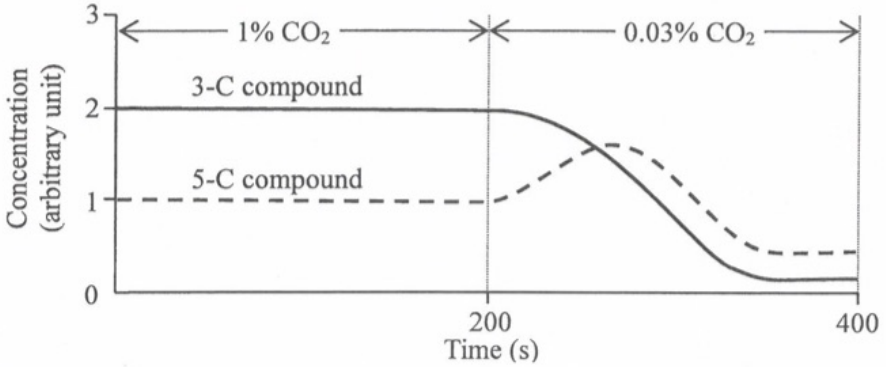
Directions: Questions 26 and 27 refer to an experiment in which a green algal culture was supplied with 1% carbon dioxide for 200 s and then followed by 0.03% carbon dioxide for another 200 s. The changes in the relative concentrations of a 3-C compound and a 5-C compound in the Calvin cycle of the green algae are shown below:



26. When the carbon dioxide concentration switched from 1% to 0.03%, which of the following combinations correctly shows the initial change of the concentration of the compound and its explanation?

	Initial change in concentration	***Explanation***
A.	3-C compound decreases	reduction of 3-C compound has increased
B.	3-C compound decreases	ATP from photochemical reactions has decreased
C.	5-C compound increases	carbon fixation has decreased
D.	5-C compound increases	regeneration of carbon dioxide acceptor has increased

27. Which of the following factors should be kept constant throughout the experiment?

(1) pH
(2) temperature
(3) light intensity

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

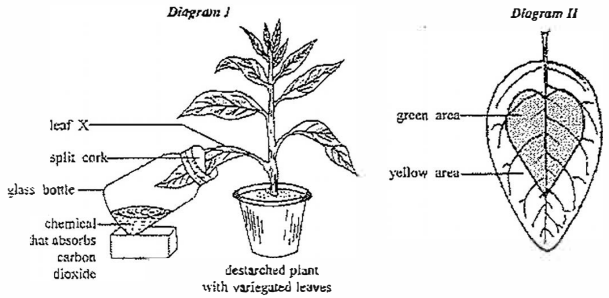
DSE M.C. Questions - Photosynthesis

(sort by difficulty)

Challenging

2019 Q.7 (31%)

Direction : Questions 6 and 7 refer to Diagram I and Diagram II below. Diagram I shows a set-up prepared by a student to study the conditions for photosynthesis. Diagram II shows the leaf surface of a variegated leaf X before the experiment.



How many independent variables were being studied in the experiment?

A. 1 B. 2 C. 3 D. 4

Average

2012 Q.23 (68%)

Which of the following descriptions about the role of light in photosynthesis are correct?

(1) Activation of chlorophyll provides high energy electrons.
(2) Photolysis of water releases oxygen for use in carbon fixation.
(3) Photolysis of water releases hydrogen for the formation of NADPH.

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

2013 Q.8 (42%)

Which of the following processes in photosynthesis require energy input from ATP?

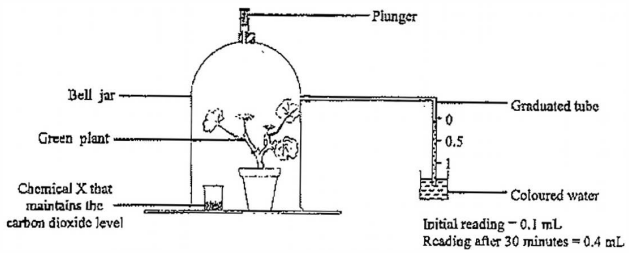
(1) fixation of carbon dioxide and the formation of 3-C compound
(2) reduction of 3-C compound leading to the formation of glucose
(3) regeneration of carbon dioxide acceptor

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

Average

Directions:

Questions 6 to 8 refer to the diagram below, which shows a set-up used to determine the rate of photosynthesis of a green plant. During the study, the position of the plunger remained unchanged.



2014 Q.6 (70%)

Based on the results, what was the rate of photosynthesis of this plant?

A. 0.6 mL oxygen released per hour
B. 0.3 mL oxygen released per hour
C. 0.6 mL carbon dioxide absorbed per hour
D. 0.3 mL carbon dioxide absorbed per hour

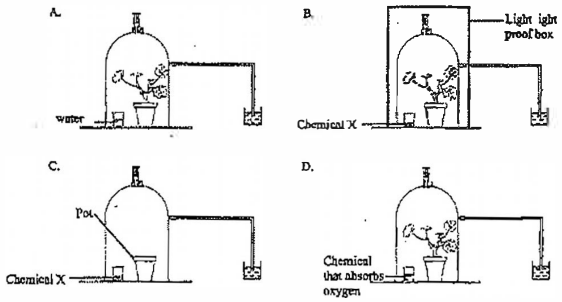
2014 Q.7 (74%)

The rate obtained was lower than the actual rate of photosynthesis of the plant. Which of the following is the most probable reason for this?

A. The plant also carried out respiration during the study.
B. The plant also carried out transpiration during the study.
C. The air temperature might have increased during the study.
D. The atmospheric pressure might have decreased during the study.

2014 Q.8 (47%)

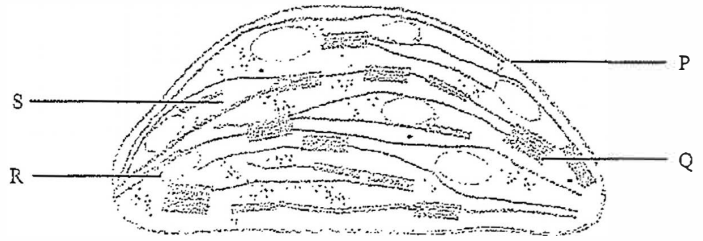
Which of the following set-ups can be used as a control for the above study to find out the actual rate of photosynthesis?



Average

2015 Q.4 (57%)

Directions: Questions 4 and 5 refer to the schematic diagram below, which shows the structures of a chloroplast:



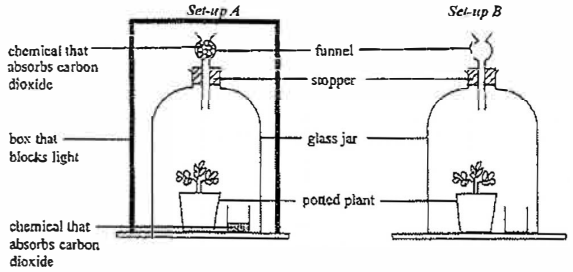
Regeneration of the carbon dioxide acceptor takes place at

A. P. B. Q. C. R. D. S.

2015 Q.12 (60%)

Directions:

Questions 11 and 12 refer to the following experiment. A student put two similar plants in darkness for 24 hours and then placed them in the following set-ups to conduct an investigation on photosynthesis:



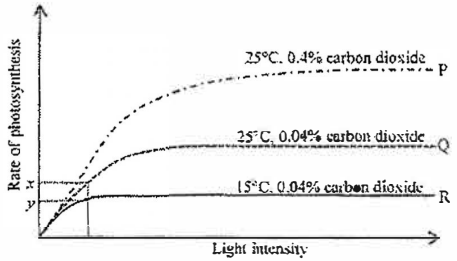
After the iodine test, the leaf taken from the set-up A was brown while the leaf taken from set-up B was blue-black. Which of the following conclusions can be drawn from the results?

A. Light is necessary for photosynthesis.
B. Carbon dioxide is necessary for photosynthesis.
C. Both light and carbon dioxide are necessary for photosynthesis.
D. Photosynthesis occurs in the plant in set-up B but not in set-up A.

Average

2016 Q.10 (67%)

Directions: Questions 9 and 10 refer to the diagram below, which shows the rate of photosynthesis of a plant under different conditions:



Which of the following descriptions best accounts for the higher rate of photosynthesis of P as compared to Q?

A. All conditions are optimum in P.
B. There is a faster diffusion of carbon dioxide into the leaves.
C. More carbon dioxide can be used as raw material for photosynthesis.
D. Carbon dioxide concentration in P is much higher than that in the atmosphere.

2017 Q.6 (73%)

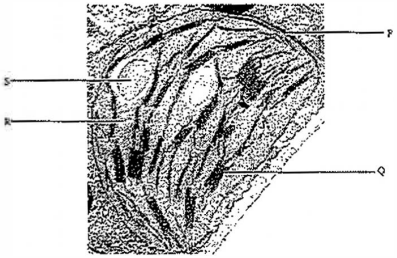
Which of the following reactions in photosynthesis takes place on the thylakoid membrane?

A. regeneration of carbon dioxide acceptor
B. reduction of 3-C compound
C. photolysis of water
D. carbon dioxide fixation

Average

2019 Q.2 (44%)

Directions: Questions 1 and 2 refer to the electron micrograph below, which shows a chloroplast of a plant cell:

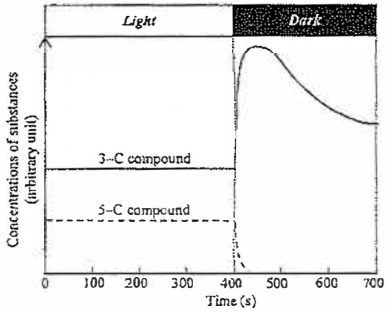


Carbon dioxide with radioactively labelled oxygen was provided to the plant cell for photosynthesis. Radioactivity can be detected in

A. Oxygen produced at Q.
B. Oxygen produced at R.
C. Glucose produced at Q.
D. Glucose produced at R.

2019 Q.4 (49%)

The graph below shows the changes in the relative concentrations of a 3-C compound and a 5-C compound (carbon dioxide acceptor) in the Calvin cycle in green plant cells which have been kept in bright light and then in darkness.



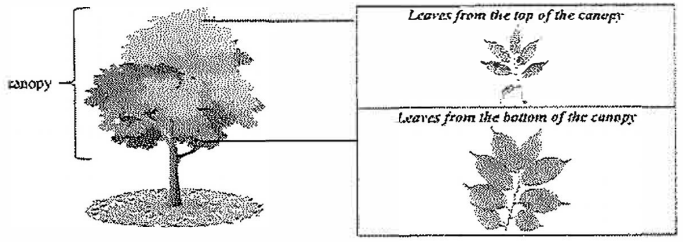
Which of the following is ***not*** a reason why the concentration of the 5-C compound decreased in the dark?

A. The 5-C compound was converted to the 3-C compound.
B. The 5-C compound combined with carbon dioxide to form glucose directly.
C. Regeneration of 5-C compound stopped because there was no ATP from photochemical reactions.
D. Regeneration of 5-C compound stopped because there was no NADPH from photochemical reactions.

Average

2019 Q.5 (45%)

The photographs on the right below show leaves taken from different parts of the canopy
of the same tree. (Note : The photographs are of the same magnification .)



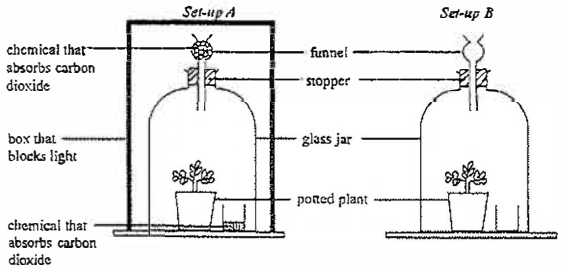
Which of the following is the most likely explanation for the differences between the leaves taken from the two parts of the canopy?

A. The leaves from the top of the canopy are smaller because they do not receive sufficient water for growth.
B. The leaves from the top of the canopy are smaller because they can reduce water loss due to transpiration.
C. The leaves from the bottom of the canopy are larger because they can store more food from photosynthesis.
D. The leaves from the bottom of the canopy are larger because they can collect light escaped through the top of the canopy .

Easy

2015 Q.11 (96%)

Directions:
Questions 11 and 12 refer to the following experiment. A student put two similar plants in darkness for 24 hours and then placed them in the following set-ups to conduct an investigation on photosynthesis:



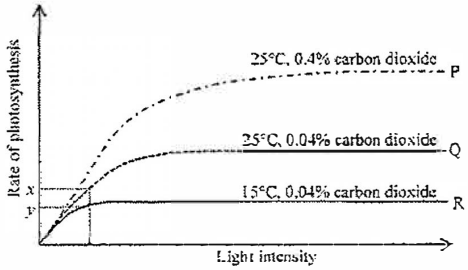
At the end of the experiment, leaves were taken from the plants in set-ups A and B for the iodine test. Arrange the following steps in the correct order:

(1) Put the leaf in boiling water for 5 minutes.
(2) Add iodine solution to the leaf.
(3) Put the leaf in hot alcohol solution for 5 minutes.
(4) Put the leaf in water at room temperature for a few seconds.

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

2016 Q.9 (79%)

Directions: Questions 9 and 10 refer to the diagram below, which shows the rate of photosynthesis of a plant under different conditions:



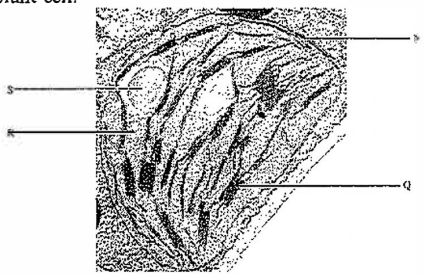
The factor(s) that determine(s) the difference in the values of x and y in the diagram is/are

A. temperature.
B. light intensity.
C. carbon dioxide concentration.
D. light intensity and temperature.

Easy

2019 Q.1 (83%)

Directions: Questions 1 and 2 refer to the electron micrograph below, which shows a chloroplast of a plant cell:

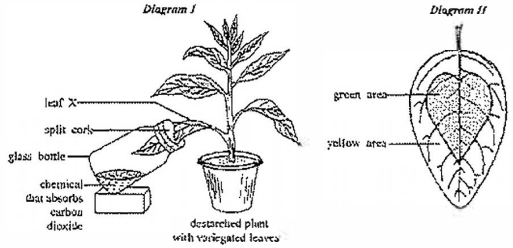


During photosynthesis, light is captured at

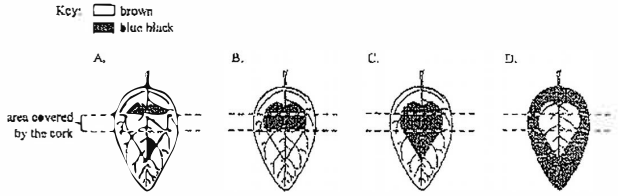
A.P. B.Q. C.R. D.S.

2019 Q.6 (77%)

Direction : Questions 6 and 7 refer to Diagram I and Diagram II below. Diagram I shows a set-up prepared by a student to study the conditions for photosynthesis. Diagram II shows the leaf surface of a variegated leaf X before the experiment.



After leaving the set-up under sunlight for several hours, iodine test was carried out on leaf X. Which of the following diagrams correctly shows the results?



Answers

Challenging

2019

7 [C]

Average

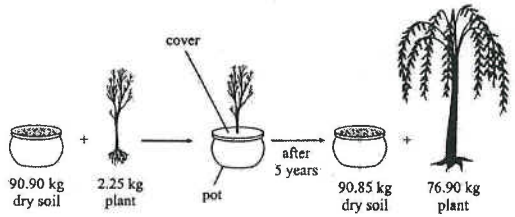
2012	2013	2014	2015	2016	2017	2019
23 [B]	8 [C]	6 [A]	4 [D]	10 [C]	6 [C]	2 [D]
		7 [A]	12 [D]			4 [B]
		8 [B]				5 [D]

Easy

2015	2016	2019
11 [B]	9 [A]	1 [B]
		6 [A]

CE - 2003

4. (a) In the 17th century, a Dutch scientist, van Helmont, wanted to test the following hypothesis: the soil is the main source of food for plant growth. He grew a young willow plant in a known mass of soil for five years. In this period, he only supplied the plant with water. His investigation is summarized in the diagram below:



(i) Calculate the change in mass of the dry soil and that of the plant in these five years. (1)

(ii) Based on the results obtained in (i), what conclusion can you draw with reference to the above hypothesis? Explain your answer. (3)

(iii) Explain why it is important to put a cover on the pot in this investigation. (2)

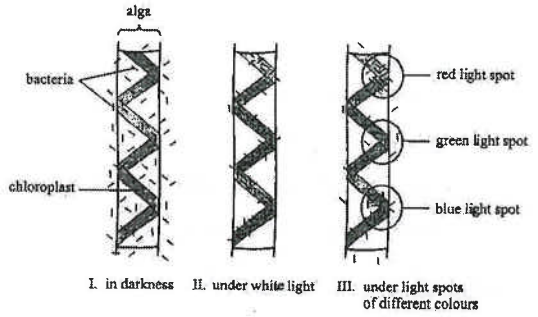
(iv) At van Helmont's time, people did not know that carbon dioxide in the air is also needed by plants for making food.

(1) You are provided with a destarched potted plant. Draw a labeled diagram of an experimental set-up which can be used to show that carbon dioxide is necessary for the plant to make food. (3)

(2) What is the purpose of destarching the plant before the experiment? State how you would destarch the plant. (2)

CE - 2004

2. (b) 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)

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

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

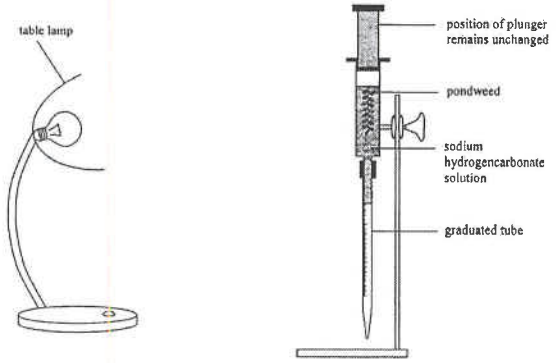
(iv) What conclusions can you draw from the results in III? (2)

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

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

CE - 2006

8. (a) 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)

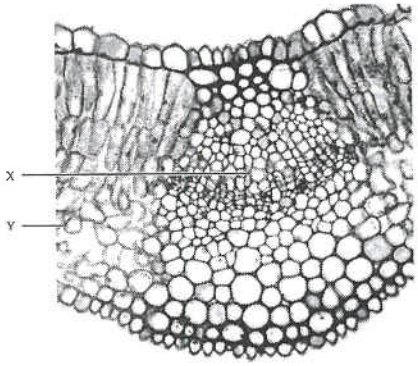
(ii) Present the results of the experiment in the form of a graph. (4)

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

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

CE - 2007

3. 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 marks)

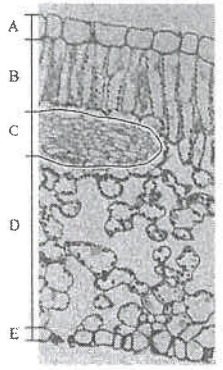
(2) If you have prepared a thin section of a leaf, how would you show the presence of the stored carbohydrate in it? (3 marks)

(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)

CE - 2009

5. (a) The photomicrograph below show the cross-section of a leaf of a dicotyledonous plant. A to E show the different parts of the leaf.



(i) Using the letters in the photomicrograph, list the parts in descending order of their photosynthetic rates. (1 mark)

(ii) State two features of the part with highest photosynthetic rate shown in the photomicrograph and explain how these features contribute to its high photosynthetic rate. (3 marks)

(iii) Explain how the arrangement of the cells in part D facilitates photosynthesis. (2 marks)

(b) The arrangement of the leaves of an African violet is shown in the photograph below.

How does the arrangement of the leaves of this plant help photosynthesis? (1 mark)

CE - 2010

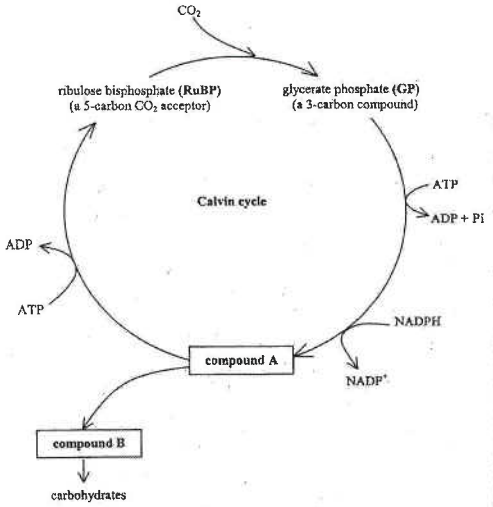
6. The following table shows the comparison of two vital processes -- photosynthesis and aerobic respiration. Complete the table with suitable words.

	Photosynthesis	Aerobic respiration
Type of metabolic process	Anabolism	(a)
Organelle where the process occurs	Chloroplasts	(b)
Raw materials needed	(c)	Glucose and oxygen
Energy conversion	from (d) _____ energy to chemical energy in glucose	from chemical energy in glucose to chemical energy in ATP and (e)_____ energy

Total: 5 marks

AL - 2004 2A

2. The following flow chart shows the Calvin cycle:



(a) The rate of GP formation can be affected by a number of external factors. Explain why two of these external factors can have this effect. (2)

(b) Describe the roles of ATP and NADPH in the conversion of GP to compound A. (2)

(c) If all of compound A is channeled to form compound B, what will be the effect on the Calvin cycle? Why? (3)

(e) Other than carbohydrates, plants need to synthesize nutrients such as proteins.

(ii) Suggest two additional substances that have to be acquired from the environment to form proteins. (2)

(f) Oxygen is a by-product of photosynthesis. Suggest and outline a method that could be used to determine whether this oxygen comes from CO_2 or H_2O. (5)

AL - 2006 2B

5. (b) Explain how the structural features of the chloroplast are adapted to the photochemical reactions of photosynthesis. (5)

AL - 2008 1A

9. Select the appropriate substance listed in column 2 to match with the description given in column 1. Put the appropriate letter in the space provided. (3)

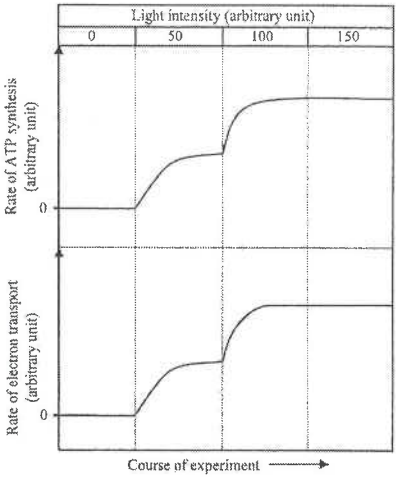
Column 1		Column 2
Substance that donates hydrogen to the Calvin cycle	(a)	A. NADH B. NADPH C. oxygen D. acetyl CoA E. carbon dioxide F. triose phosphate
Substance that is produced in the Calvin cycle and is used to form starch in the chloroplasts	(b)	
Substance that serves as the final electron acceptor in the electron transport chain in the mitochondria	(c)	

AL - 2008 2B

6. (c) Unlike animals, plants can make their own proteins from different inorganic substances. Briefly outline how these substances are assimilated to form proteins after their uptake into the mesophyll cells. (4)

AL - 2009 1B

9. The following figure shows the results of a study on the photochemical process of photosynthesis.
In this study, grana taken from chloroplasts were incubated with an adequate amount of ADP and inorganic phosphate (Pi) and treated with different light conditions during the course of the experiment,



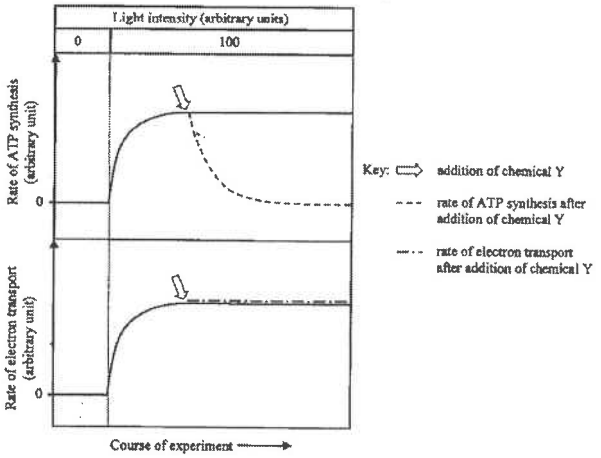
N.B. Incubated with an adequate supply of ADP and Pi

(a) Both ATP synthesis and electron transport are events of the photochemical process of photosynthesis. How do the results provide evidence that the photochemical process is light dependent? (3 marks)

(b) Explain why the rate of ATP synthesis and the rate of electron transport levelled off at 50 arbitrary units of light intensity. (2 marks)

(c) Give a reason why the rate of ATP synthesis and the rate if electron transport remained unchanged when light intensity increased from 100 to 150 arbitrary units. (1 mark)

(d) It is known that ATP synthesis and electron transport are linked to each other in the photochemical process. To study this relationship, chemical Y was added to the reaction mixture exposed to light intensity of 100 arbitrary units. Chemical Y served to break the linkage of the two events. The results of this study are shown below:



N.B. Incubated with an adequate supply of ADP and Pi

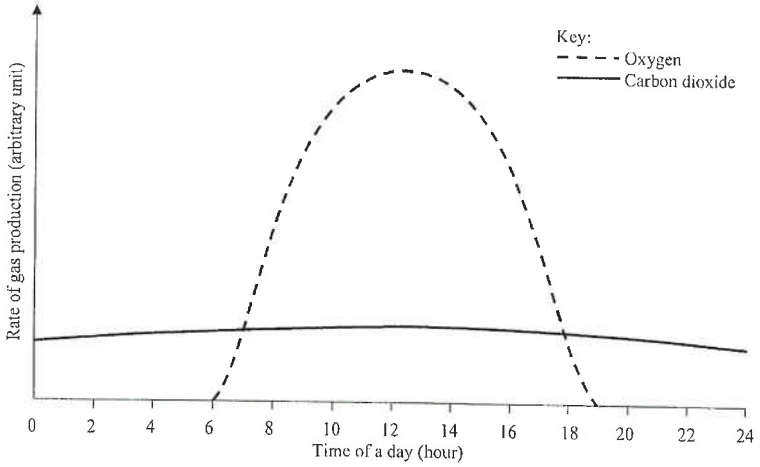
(i) Describe the results after the addition of chemical Y. (2 marks)

(ii) Hence deduce how ATP synthesis and electron transport are linked to each other. (1 mark)

(e) Explain why intact chloroplasts should not be used in these studies. (2 marks)

DSE-2012 1B

5. The graph below shows the oxygen production rate and carbon dioxide production rate of a local plant on a summer day:



(a) State times at which there is no net exchange of gases into or out of the leaves. (1 mark)

(b) Sketch a line on the above graph to show the oxygen production rate of the plant on a winter day. (2 marks)

(c) The area below the line showing the oxygen production rate is usually greater than the area below the line showing the carbon dioxide production rate. Explain the importance of this observation. (4 marks)

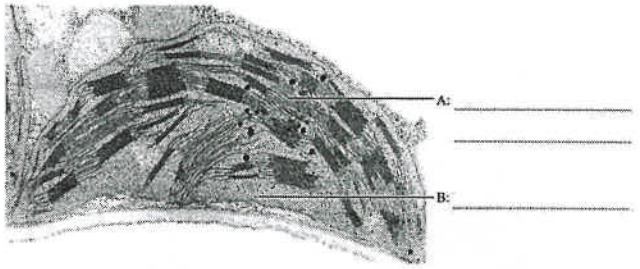
DSE-2014 1B

1. For each of the brain parts listed in column 1, select from column 2 one phrase that matches it. Put the appropriate letter in the space provided. (3 marks)

Column 1		Column 2
NADPH	____	A. a product of oxidative phosphorylation
pyruvate	____	B. a product of photochemical reactions
NAD	____	C. a product of carbon dioxide
		D. a product of glycolysis

DSE – 2016 1B

3. The diagram below shows the electron micrograph of an organelle:



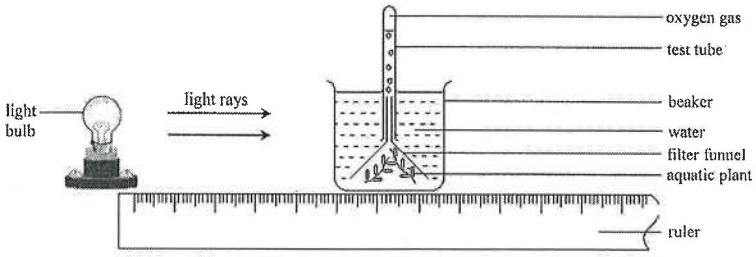
(a) Label A and B. (2 marks)

(b) State a type of plant cell that contains this organelle. (1 mark)

(c) What is the functional relationship between A and B? (3 marks)

HKDSE - 2017 1B

7. The diagram below shows an experiment set-up for investigating the effect of light intensity on the rate of photosynthesis:



a. What is the assumption behind using the volume of oxygen released per unit time to indicate the photosynthetic rate? Explain your answer. (2 marks)

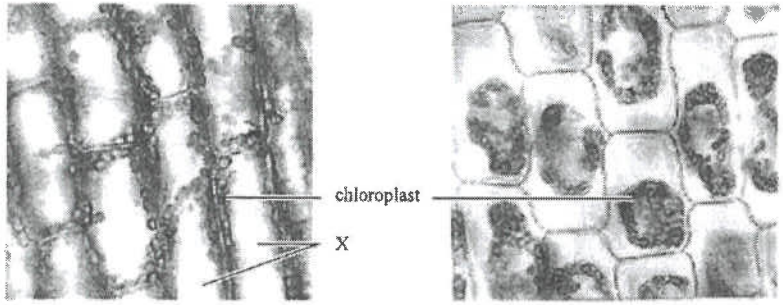
b. Suggest ***one*** modification to this experimental set-up to make sure that the result is due to the independent variable only. Explain your answer. (3 marks)

c. What is the significance of the ***two*** products of the photochemical reactions to the whole photosynthetic process? (4 marks)

HKDSE - 2018 1B

2. The leaf of an aquatic plant was placed in a concentrated sucrose solution and observed under a light microscope. Photomicrographs A and B show the appearance of the cells at the beginning of the experiment and after five minutes respectively:

Photomicrograph A – at the beginning ***Photomicrograph B – after five minutes***



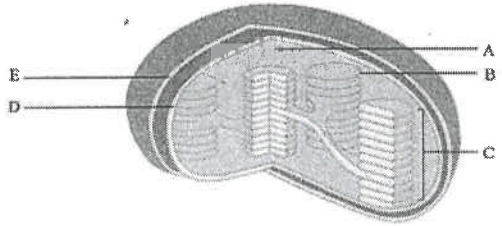
(a) X is an organelle which is invisible without staining. Name this organelle. (1 mark)

(b) Comparing the photomicrographs, state ***two*** observable changes in the appearance of the cells after five minutes. (2 marks)

(c) Explain how the observable changes stated in (b) are brought about. (2 marks)

HKDSE - 2020 1B

1. The diagram below shows the structures in a chloroplast:

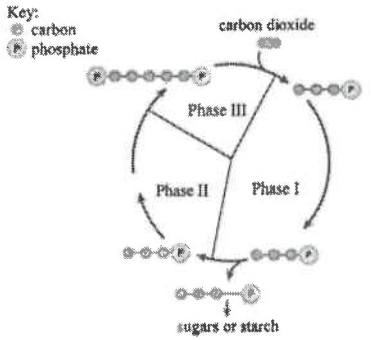


(a) Using the letters from the diagram, list ***all*** of the structures that contain photosynthetic pigments. (1 mark)

(b) Structure C produces intermediates that are used in the Calvin Cycle. State the intermediates. (1 mark)

HKDSE - 2020 1B

1.(c) The diagram below shows a simplified Calvin Cycle:



Match the three phases with the following reactions: (2 marks)

Reactions	***Phase***
Regeneration of carbon dioxide acceptor	.....
Reduction of 3C compound	.....
Carbon dioxide fixation	.....

Past Papers Marking Scheme – Photosynthesis

CE - 2003 Q.4 (a)

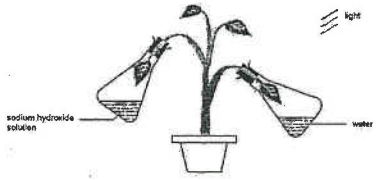
(i) dry soil : 50g / 0.05 kg plant : 74.65 kg ½,½
(no unit, no mark)

(ii) The soil is not the main source of food for plant growth 1
because the drop in mass of the dry soil is very small 1
in comparison with the gain in mass of the plant 1

(iii) To reduce the amount substance in air added to the soil / the amount of soil lost to the air 1
so that the loss in weight of the soil is mainly due to the plant 1

(iv)

(1) Title ½
Design of set-up :
leaf with CO_2 supply (1),
leaf in a container having sodium hydroxide solution (1)
light source (½)



Experimental set-up for showing that CO_2 is necessary for the plant to make food

(2) To make sure that the starch detected at the end of the experiment was made during the experiment 1
By keeping the plant in darkness for two days 1

CE - 2004 Q.2 (b)

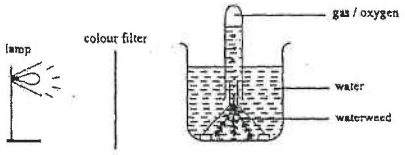
(i) The bacteria distributed evenly in I 1
but concentrated on the chloroplast in II 1

(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 1
which are higher than that in green light 1

(v) (1) Workable set-up (S): (must include light source, water, waterweed & colour filters) 1
Labels (L): colour filters, waterweed, water/ lamp / gas or oxygen 3 x½
Title(T) ½



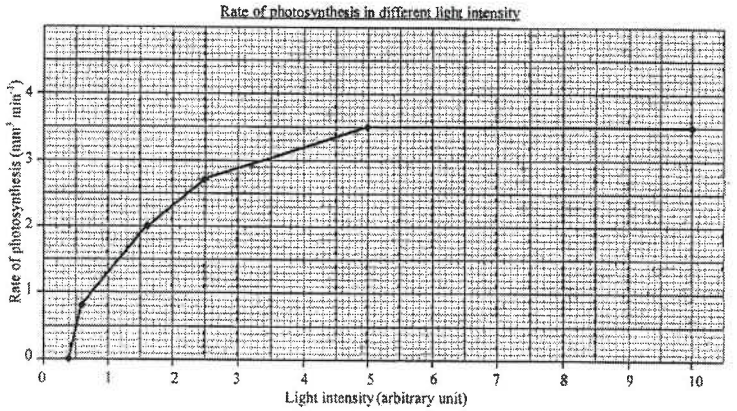
Set-up for studying the effect of light colours on photosynthesis

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

CE - 2006 Q.8 (a)

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

(ii) Title 1
Correct choice of axes ½
Correct labelling of axes together with units ½,½
Correct plotting and joining of points (deduct ½ for 1 mistake) 1½



(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 1
/ enzyme activity is not high enough at high light intensity 1

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

CE - 2007 Q.3

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

(b) (i) (1) Starch 1
(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

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

CE - 2009 Q.5

(a) (i) B, D, E, A & C 1

(ii) B is at the upper part of the leaf / close to upper surface exposing directly to sunlight 1
The chloroplast density is highest in B 1
These help to maximize the amount of light absorbed for photosynthesis 1

(iii) Cells in part D are loosely packed with a lot of air spaces between the cells 1
This is to allow carbon dioxide to move freely by diffusion to the mesophyll cells 1

(b) There is little overlapping among the leaves which enables leaf to receive maximum amount of light 1

CE - 2010 Q.6

(a) catabolism/ catabolic process/ breaking down process (1)
(b) mitochondria (1)
(c) carbon dioxide and water (1 or 0)
(d) light/ solar (1)
(e) heat (1)

AL - 2004 2A

2. (a)

Concept for mark award (Any two):
- why CO_2 concentration can affect the rate of GP formation (1) max. 2
- why temperature can affect the rate of GP formation (1)
- why light intensity can affect the rate of GP formation (1)
- why water in soil can affect the rate of GP formation (1)

e.g.
- CO_2 is raw material for GP (1)
- temperature will affect the kinetic energy of the reactants (1) max. 2

or
- temperature will affect the rate of enzyme catalysis (1)
- light for ATP synthesis which is necessary for the resynthesis of RuBP, which in turn forms GP (1) / light opens up stomata and increases CO_2 availability

(b)
- ATP provides the energy for the conversion of GP to TP (1) 2
- NADPH reduces GP to TP (1) / supply H

(c)
- Calvin cycle will stop (1) 3
- no regeneration of RuBP from TP / A (1)
- RuBP is necessary to fix CO_2 (1)

(e) (ii) Any two (1 mark each):
- ammonium / nitrate
- sulphate 2
- phosphate

(f)
- use tracer technique (1) max. 5
- label the O of CO_2 with ^{18}O (1) / the isotope of O
- let photosynthesis take place (1) / expose the plant to light
- collect the gas (O_2) evolved (1)
- in a separate experiment, label the O of H_2O with ^{18}O (1) / the isotope of O
- interpretation of result: whichever experiment releases the labeled O_2 will determine the source (1)

AL - 2006 2B

5. (b)

Concept for mark award:
- structural feature: thylakoid stacking / grana (1) 1
- significance of stacking:
  - > increase surface area (1) for trapping light (2) and electron transport (2) } max. 4
  - > within a small space (1)

5

e.g.
- within the chloroplast are many stacks of thylakoids (1) / grana 1
- this provides a large surface area (1) for holding the chlorophyll molecules (1) for trapping light (1), and for holding carriers of electron transport (1) and enzyme for ATP synthesis (1) without taking up too much space (1) } max. 4

AL - 2008 1A

9. (a) B (1)
(b) F (1)
(c) C (1)

AL - 2008 2B

6. (c)
- in photosynthesis, carbon dioxide and water (1) is assimilated to form glucose (1) / sugars / triose phosphate
- nitrate (1) / ammonium ions and the carbon skeleton derived from glucose / sugars (1) are used for synthesizing amino acids(1) (max .4)
- amino acids are then condensed / polymerized to form proteins (1)

AL - 2009 1B

9. (a)
- in darkness, the rates of the two events are both 0 (1) (3)
- at 50 arbitrary units of light intensity, the rates increase (1)
- at 100 arbitrary units of light intensity, the rates increase further (1), and are nearly double that at 50 arbitrary units of light intensity (1 bm)

(b)
- because light is limiting at the given conditions (1) as further increase in light intensity increases the rate of ATP synthesis and rate of electron transport (1) (2)

(c)
- because factors other than light intensity and ADP + Pi supply (e.g. amount of chlorophyll / grana / NADP[marker's mtg.]) become limiting (1) (1)

(d) (i)
- in the presence of chemical Y, the rate of ATP synthesis decreased sharply (1) while the rate of electron transport remained the same (1) (2)

(ii)
- this indicates that ATP synthesis is dependent in the coupling to electron transport (1) / electron transport provides energy for ATP synthesis (1)

(e)
- intact chloroplasts contain stroma (1) where the Calvin cycle will consume the ATP formed in the photochemical process (1) (2)

DSE-2012 1B

5. (a)
- 7:00 and 18:00 (1) (1)

(b)
- shorter light period (1), overall rate lower (1) (1,1)

(c)
- the area below the line showing oxygen production rate represents the food production in 24 hrs (1) (1)
- whereas the area below the line showing carbon dioxide production rate represents the food consumption in 24 hrs (1) (1)
- it is therefore important for food production to be greater than food consumption such that there is a net amount of food produced (1) (1)
- as a result, this provide energy for the plant to survive, grow and produce fruits (1) (1)

7 marks

DSE-2014 1B

1. B (1)
D (1)
A (1)

3 marks

DSE – 2016 1B

3. (a) A: thylakoid membrane (1) / thylakoid
B: stroma (1) 2

(b) mesophyll cell / palisade mesophyll cell / spongy mesophyll cell / guard cell (photosynthetic cell not accepted) 1

(c) light-dependent reactions take place at A (1)
which supplies ATP and NADPH (1)
for light-independent reactions that take place at B (1)
Or
light-independent reactions take place at B (1)
which regenerate NADP (1)
for light-dependent reactions that take place at A (1) 3

HKDSE – 2017 1B

7. (a) • the rate of respiration remains constant throughout the experiment (1)
• so that any change in the net production of oxygen can be attributed to the change in the photosynthetic rate (1)

OR

The size of oxygen bubbles should be uniform (1)
thus the rate of release of bubbles **is directl**y proportional to the rate of photosynthesis (1) (2)

(b) • add a heat shield / water bath between the light bulb and the beaker/use a cold light source/use a bigger beaker containing more water instead to conduct this experiment (1)
• to avoid the heating up of water in the beaker (1)
• as temperature is also a factor that may affect the photosynthetic rate (1) (3)

OR

• place a thermometer in the beaker (1)
• to ensure the temperature is constant (1)
• as temperature is also a factor that may affect the photosynthetic rate (1)

(c) • Photochemical reactions produce ATP (1)
• Which provides energy to drive the light-independent reactions / regeneration of CO_2 acceptor (1)
• Photochemical reactions also produce NADPH (1)
• In photosynthesis, reducing power/H/H^+ is required for reduction of 3-C compound to form glucose (1) (4)

Instructions to markers: if candidates presented a wrong/irrelevant reaction to describe the significance of ATP or NADPH, no mark is awarded to the first and third points.

9 marks

HKDSE – 2018 1B

2. (a) • vacuole * (1) (1)

(b) Any *two* of the following:
• the cell membrane / cytoplasm of the leaf cells has detached from the cell wall / the leaf cell is plasmolysed (1)
• chloroplasts condense to the centre of the cell (1)
• the vacuole / X has shrunk (1) (2)

(c) • sucrose solution has a lower water potential than the cell content (1)
• there is a net movement of water from the cell content to the bathing solution by osmosis (1) (2)

5 marks