CHAPTER – 6 PHOTOSYNTHESIS

Progress Check 1

Question 1

Answer the following in "Yes" or "No"

(i) All parts of a green plant carry out photosynthesis.

(ii) All green parts of a plant carry out photosynthesis.

(iii) Photosynthesis is the only biological process that releases oxygen into the air.

(iv) Out of nine types of chlorophylls, chlorophyll a and b are the most abundant.

(v) Too much light destroys chlorophyll.

(vi) No transpiration occurs during photosynthesis.

(vii) During sunlight, the guard cells turn flaccid to open the stomata.

Answer

(i) No
Corrected Statement — A few parts of a green plant like roots and flowers does not carry out photosynthesis as they lack chloroplasts and chlorophyll.

(ii) Yes

(iii) Yes

(iv) Yes

(v) Yes

(vi) No
Corrected Statement — Photosynthesis and transpiration go on side by side.

(vii) No
Corrected Statement — During sunlight, the guard cells turn turgid to open the stomata.

Progress Check 2

Question 1

Write the overall summary of the chemical equation of photosynthesis.

Answer

$$6CO_2 + 12H_2O \xrightarrow[\text{chlorophyll}]{\text{light energy}} C_6H_{12}O_6 + 6H_2O + 6O_2 \uparrow$$

Question 2

Which single substance in the above equation is repeated in raw material as well as reproduced as an end product?

Answer

Water

Question 3

What is the source of oxygen released in photosynthesis — CO_2 or H_2O ?

Answer

H_2O

Question 4

What happens in photolysis?

Answer

The energy of Sun absorbed is used in splitting the water molecule into its two components (Hydrogen and Oxygen) and releasing electrons. This process is termed as photolysis.

Question 5

Dark reaction involves utilisation of CO_2 in producing $C_6H_{12}O_6$ (glucose). Why is this phase called dark reaction ?

Answer

The given reaction does not require light. It can occur during day as well as night. Therefore, it is known as Dark reaction.

Question 6

Glucose produced during photosynthesis is soon polymerised into starch. What does polymerisation mean?

Answer

The process of conversion of many simpler molecules into a complex, bigger molecule is termed as polymerisation. Several molecules of glucose join together to form a starch molecule.

Question 7

Why is it better to call the dark phase of photosynthesis as "light-independent phase"?

Answer

The old term 'dark-phase' did not mean that it occurs when it is dark i.e. night. It only means that the reactions are not dependent on light. That is why, it is now better called as "light-independent phase".

Progress Check 3

Question 1

How do the following favour increased photosynthesis?

(i) Large surface area of the leaf.

(ii) Thinness of the leaf.

(iii) More numerous stomata.

Answer

(i) **Large surface area** of the leaf enables maximum light absorption by plant. Increased absorption of solar energy increases the Photosynthesis.

(ii) **Thinness of the leaf** reduces the distance between cells facilitating rapid transport of raw materials and translocation of food.

(iii) **More numerous stomata** allow rapid gaseous exchange and speed up the process of photosynthesis.

Question 2

Name the three end-products of photosynthesis and mention the fate of each of them in the plant.

Answer

The three end products of photosynthesis are:

1. **Glucose ($C_6H_{12}O_6$)** — It is used in following four ways:
    i. immediately consumed by the plant cells
    ii. stored in the form of insoluble starch
    iii. converted into sucrose
    iv. used in synthesizing fats, proteins,etc.
2. Water — can be reutilized in continuance of photosynthesis.
3. Oxygen — It is used in respiration in the leaf cells. Extra oxygen is released and diffused out in atmosphere.

Question 3

If we keep on increasing CO_2 concentration in the air, will the rate of photosynthesis also keep on increasing in direct proportion? Yes/No. Explain.

Answer

Increasing carbon dioxide concentration increases rate of photosynthesis but it is stabilised at a particular point (upto 0.02% of CO_2) if there is no change in light intensity. If the light intensity is increased then increase in carbon dioxide concentration further increases the rate of photosynthesis and is again stabilised at 0.05% of CO_2.

Progress Check 4

Question 1

Why is it necessary to destarch the leaves of a plant before performing an experiment on photosynthesis?

Answer

In any experiment on photosynthesis, the presence of starch shows that the process of photosynthesis occurred. Therefore it is necessary to remove any pre-existing starch from the leaves. For destarching, the plant is kept for 24-48 hours in dark. It stops the synthesis of starch and the pre-existing starch, by then, is removed from leaves and is stored in storage organs.

Question 2

Why do we perform the iodine test ?

Answer

We perform the iodine test to test the presence of starch.

Question 3

What chemical do you use to remove CO_2 from inside a flask in certain experiments on photosynthesis ?

Answer

Potassium hydroxide

Question 4

All food chains start with a plant. Why is this so?

Answer

The plants are called producers. They are the only organism with ability to convert the solar energy into chemical energy of the food. Therefore, all food chains start with a plant.

Question 5

The honey bee produces honey. In terms of the food chain, is the honey bee a producer or a consumer?

Answer

In terms of food chain, the honey bee is a consumer as it consumes plant nectar and derive its energy from nectar to carry out all the physiological processes. Honey produced by it is derived indirectly from plants. Therefore, Honey bee cannot be called as a producer.

Multiple Choice Type

Question 1

Chlorophyll is located in :

1. Stroma
2. Thylakoid
3. Stoma
4. Fret

Answer

Thylakoid

Reason — Chlorophyll is located in the walls of thylakoid.

Question 2

Which of the following is not applicable to the process of photosynthesis ?

1. Oxygen is evolved
2. Carbon dioxide is absorbed
3. Carbon dioxide is evolved
4. Water is utilized

Answer

Carbon dioxide is evolved

Reason — In the process of photosynthesis, carbon dioxide is absorbed and oxygen is evolved as a by-product.

Question 3

The colour of VIBGYOR spectrum which is reflected by chlorophyll is:

1. Blue
2. Green
3. Red
4. Yellow

Answer

Green

Reason — The colour of any object is the light that is reflected by it. The chlorophyll reflects green colour and therefore it is green to our eyes.

Question 4

The basic functional unit of solar energy which is absorbed by the pigment chlorophyll is:

1. Proton
2. Phytochrome
3. Phyton
4. Photon

Answer

Photon

Reason — The basic functional unit of solar energy is photon that is absorbed by the chlorophyll molecules and this leads to start of chain of reactions of photosynthesis.

Question 5

The molecules of water split during:

1. Photorespiration
2. Phosphorylation
3. Photolysis
4. Photophosphorylation

Answer

Photolysis

Reason — The chlorophyll molecule absorbs solar energy and this energy is used to split the water molecule. This process ia called photolysis. (photo means light, lysis means disintegration)

Question 6

The granum is a pile of many :

1. Frets
2. Stoma
3. Stroma
4. Thylakoids

Answer

Thylakoids

Reason — Stacked thylakoids are known as granum.

Question 7

Which of the following is used to remove chlorophyll from the leaves:

1. Iodine solution
2. Methylated spirit
3. Potassium hydroxide
4. Soda lime

Answer

Methylated spirit

Reason — The leaf is boiled in Methylated spirit to remove chlorophyll.

Question 8

The raw material which is reduced during photosynthesis is :

1. Carbon dioxide
2. Glucose
3. Water
4. Oxygen

Answer

Carbon dioxide

Reason — Carbon dioxide loses its oxygen or is reduced to form glucose. (loss of oxygen is reduction)

Question 9

The optimum temperature for the process of photosynthesis is :

1. 53°C
2. 45°C
3. 25°C
4. 35°C

Answer

35°C

Reason — The rate of photosynthesis is maximum at 35°C and falls beyond it.

Question 10

Conversion of several glucose molecules into starch is termed as :

1. Photolysis
2. Phosphorylation
3. Polymerisation
4. Photorespiration

Answer

Polymerisation

Reason — Polymerisation is the process by which simple monomers (glucose) join to form complex polymers (starch).

Assertion Reason type

Question 11

Assertion. Photosynthesis occurs in all parts of a green plant.

Reason. Chlorophyll is the green pigment which traps solar energy during daytime.

1. Both A and R are True.
2. Both A and R are False.
3. A is True and R is False.
4. A is False and R is True.

Answer

A is False and R is True.

Explanation
Photosynthesis only occurs in green parts of the plant. For example, roots and non-green tissues do not perform photosynthesis.
Chlorophyll is the pigment responsible for absorbing light energy from the sun, which is then used to drive the process of photosynthesis.

Question 12

Assertion. Guard cells regulate the opening and closing of the stomatal aperture.

Reason. Guard cells contain chloroplasts and are mostly located on the lower surface of the leaves. Other cells of the lower epidermis do not contain chloroplasts.

1. Both A and R are True.
2. Both A and R are False.
3. A is True and R is False.
4. A is False and R is True.

Answer

Both A and R are True.

Explanation
Guard cells are found in the lower portion of leaf and their function is to close and open the stomata as per need. They contain chloroplasts and carry out photosynthesis.

Question 13

Assertion. Palisade cells of mesophyll are loosely arranged towards the lower epidermis of a dorsiventral leaf.

Reason. Palisade cells contain the maximum amount of chlorophyll, trap solar energy and help in the process of photosynthesis.

1. Both A and R are True.
2. Both A and R are False.
3. A is True and R is False.
4. A is False and R is True.

Answer

A is False and R is True.

Explanation
Palisade cells of mesophyll are loosely arranged towards the upper epidermis of a dorsiventral leaf. They along with spongy tissues are engaged in photosynthesis.

Question 14

Assertion. Phosphorylation occurs in all organisms only during the process of respiration.

Reason. Photophosphorylation is the process during which ADP combines with inorganic phosphate (iP) and produces ATP.

1. Both A and R are True.
2. Both A and R are False.
3. A is True and R is False.
4. A is False and R is True.

Answer

A is False and R is True.

Explanation
Phosphorylation, the process of adding a phosphate group to a molecule (like ADP to form ATP), occurs during both respiration and photosynthesis. In respiration, this process is called oxidative phosphorylation, while in photosynthesis, it is called photophosphorylation.

Very Short Answer Type

Question 1

Name the following:

(a) The category of organisms that prepare their own food from basic raw materials.

(b) The kind of plastids found in the mesophyll cells of the leaf.

(c) The compound which stores energy in the cells.

(d) The first form of food substance produced during photosynthesis.

(e) The source of CO_2 for aquatic plants.

(f) The part of chloroplast where the dark reaction of photosynthesis takes place.

Answer

(a) Autotrophs.

(b) Chloroplasts.

(c) ATP (Adenosine triphosphate).

(d) Glucose.

(e) The carbon dioxide dissolved in water.

(f) Stroma.

Question 2

Given below are groups of terms. In each group, the first pair indicates the relationship between the two terms. Complete the second pair accordingly.

(a) Chlorophyll : Magnesium :: Haemoglobin : ..... .

(b) Light reaction : Granum :: Dark reaction : ..... .

(c) Producers : Autotrophs :: Consumers : ..... .

(d) Respiration : Carbon dioxide :: Photosynthesis : ..... .

(e) Water and minerals : Xylem :: Prepared food : ..... .

Answer

(a) Chlorophyll : Magnesium :: Haemoglobin : ***Iron***

(b) Light reaction : Granum :: Dark reaction : ***Stroma***

(c) Producers : Autotrophs :: Consumers : ***Heterotrophs***

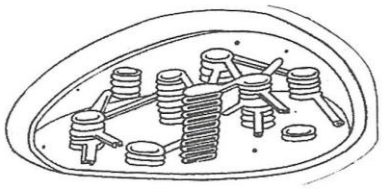
(d) Respiration : Carbon dioxide :: Photosynthesis : ***Oxygen***

(e) Water and minerals : Xylem :: Prepared food : ***Phloem***

Question 3

Given below is the internal structure of chloroplast. Read the information given ahead and fill in the blanks:

The chloroplast is an important cellular structure located in the green parts of the plant. It is covered by a double layered membrane. The main function of chloroplast is to prepare food material for all the parts of plant during daytime.



The chloroplast is a kind of (a) ..... suspended in the cytoplasm of the plant cells. It contains a vital pigment (b) ..... which traps solar energy for the process of (c) ..... . The photochemical phase of photosynthesis occurs in (d) ..... of granum and the biosynthetic phase occurs in the (e) ..... of chloroplast.

Answer

(a) Plastid

(b) Chlorophyll

(c) Photosynthesis

(d) Thylakoids

(d) Stroma

<u>Short Answer Type</u>

Question 1

Identify the false statements and rewrite them correctly by changing the first or last word only.

(a) Dark reaction of photosynthesis occurs during night time.

(b) Photosynthesis requires enzymes.

(c) Green plants are consumers.

(d) Photosynthesis results in loss of dry weight of the plants.

(e) Photosynthesis stops at a temperature of about 35°C.

(f) Photosynthesis occurs only in cells containing chloroplasts.

(g) Green plants perform photosynthesis.

(h) Algae are autotrophs.

Answer

(a) False
Corrected statement — Dark reaction of photosynthesis occurs simultaneously with light reaction.

(b) True

(c) False
Corrected statement — Green plants are producers.

(d) False
Corrected statement — Respiration results in loss of dry weight of the plants.

(e) False
Corrected statement — Photosynthesis stops at a temperature of about **40°C.**

(f) True

(g) True

(h) True

Question 2

Fill in the blanks with the appropriate answer from the choices given in the brackets.

(a) The site of light reaction in the cells of a leaf is ..... (cytoplasm, stroma, grana).

(b) The chemical substance used to test the presence of starch in the cell of a leaf is .....

($CaCl_2$, iodine solution, Benedict solution).

(c) Stroma is the ground substance in ..... (cytoplasm, chloroplast, ribosomes).

(d) The dark reaction of photosynthesis is known as ..... (Hill reaction, cyclic phosphorylation, Calvin cycle).

(e) In the flowering plants, food is transported in the form of ..... (sucrose, glucose, starch).

Answer

(a) The site of light reaction in the cells of a leaf is ***grana***.

(b) The chemical substance used to test the presence of starch in the cell of a leaf is ***iodine solution***.

(c) Stroma is the ground substance in ***chloroplast***.

(d) The dark reaction of photosynthesis is known as ***Calvin cycle***.

(e) In the flowering plants, food is transported in the form of ***Sucrose***.

Question 3

Are the following statements **true** or **false**? Give reason in support of your answer.

(a) The rate of photosynthesis continues to rise as long as the intensity of light rises.

(b) The outside atmospheric temperature has no effect on the rate of photosynthesis.

(c) If you immerse a leaf intact on the plant in ice cold water, it will continue to photosynthesise in bright sunshine.

(d) Destarching of the leaves of a potted plant can occur only at night.

(e) If a plant is kept in bright light all the 24 hours for a few days, the dark reaction (biosynthetic phase) will fail to occur.

(f) Photosynthesis is considered as a process supporting all life on earth.

Answer

(a) False
Corrected statement — Photosynthesis increases with the light intensity up to a certain limit only, and then it gets stabilised at the point S'(0.02% CO_2).

(b) False
Corrected statement — The atmospheric temperature is an important external factor affecting photosynthesis. With the rise in temperature, the rate of photosynthesis rises. This rise occurs up to the optimum temperature of 35°C (maximum suitable temperature when the photosynthesis occurs best) after which the rate falls and stops above 40°C.

(c) False
Corrected statement — Ice cold water will hamper the process of photosynthesis in the immersed leaf, even if there is sufficient sunshine because the temperature is an important factor for the rate of photosynthesis.

(d) False
Corrected statement — For destarching, the potted plant can be kept in a dark room for 24-48 hours. During this period, all the starch will be removed from the leaves and stored in the storage organs.

(e) False
Corrected statement — If a plant is kept in bright light all the 24 hours for a few days, the dark reaction (biosynthetic phase) will continue to occur because the dark reaction is independent of light and it occurs simultaneously with the light dependent reaction.

(f) True

Question 4

Given below are five terms. Rewrite the terms in the correct order so as to be in logical sequence with regard to photosynthesis: (i) water molecules, (ii) oxygen, (iii) grana, (iv) hydrogen and hydroxyl ions, (v) photons.

Answer

Photons, grana, water molecules, hydrogen and hydroxyl ions, oxygen.

Question 5

State any four differences between photosynthesis and respiration.

Answer

Photosynthesis	**Respiration**
Photosynthesis utilizes carbon dioxide and water in the presence of light to produce glucose and oxygen.	Respiration uses oxygen and glucose to power the activities of the cell.
Photosynthesis results in gain of dry weight of the plants.	Respiration results in loss of dry weight of the plants.
The raw materials for the photosynthesis are water, carbon dioxide and sunlight.	The raw material for respiration is glucose.
Photosynthesis occurs in plants and some photosynthetic bacteria.	Respiration occurs in all living organisms.

Question 6

Complete the following food chains by writing the names of appropriate organisms in the blanks:

(i) Grass → ..... → Snake → .....

(ii) ..... → Mouse ..... → Peacock

Answer

(i) Grass → **Grasshopper** → Snake → **Hawk**

(ii) **Corn** → Mouse → **Snake** → Peacock

Question 7

Name these :

(a) Two aquatic plants which can be used for the experiment of photosynthesis.

(b) Two plants having variegated leaves.

(c) Two raw materials for photosynthesis.

(d) Four essentials for photosynthesis.

(e) Two main phases of photosynthesis.

Answer

(a) Hydrilla, Elodea

(b) Geranium, Croton

(c) Carbon dioxide, water

(d) Light, Chlorophyll, Carbon dioxide and water

(e) Photo-chemical phase, Biosynthetic phase

Question 8

Match the terms given in column A with column B:

Column A	**Column B**
Chlorophyll	Removes/absorbs CO_2
Methylated spirit	Tests presence of starch
Potassium hydroxide	Traps solar energy
Iodine solution	Produces oxygen
Water	Bleaches chlorophyll

Answer

Column A	**Column B**
Chlorophyll	Traps solar energy
Methylated spirit	Bleaches chlorophyll
Potassium hydroxide	Removes/absorbs CO_2
Iodine solution	Tests presence of starch

Column A	Column B
Water	Produces oxygen

Question 9

Complete the following by filling the blanks 1 to 5 with appropriate words/ terms/ phrases:

To test the leaf for starch, the leaf is boiled in water to (1) ..... . It is next boiled in methylated spirit to (2) ..... . The leaf is placed in warm water to soften it. It is then placed in a dish and (3) ..... solution is added. The region, which contains starch, turns (4) ..... and the region, which does not contain starch, turns (5) ..... .

Answer

To test the leaf for starch, the leaf is boiled in water to ***(1) kill the cells.*** It is next boiled in methylated spirit to ***(2) remove chlorophyll.*** The leaf is placed in warm water to soften it. It is then placed in a dish and ***(3) iodine*** solution is added. The region, which contains starch, turns ***(4) blue-black*** and the region, which does not contain starch, turns ***(5) brown.***.

Question 10

Write the exact location of each :

(a) Chlorophyll

(b) Chloroplast in the parts of a plant

(c) Stroma

(d) Guard cells

(e) Palisade cells

Answer

(a) Wall of thylakoid.

(b) Mesophyll cells of upper and lower epidermis of leaves.

(c) Chloroplast.

(d) Stomata.

(e) Beneath epidermis.

Descriptive Type

Question 1

Define the following terms:

(a) Photosynthesis

(b) Thylakoids

(c) Chloroplast

(d) Photolysis of water

(e) Polymerisation

Answer

(a) **Photosynthesis** — Photosynthesis is the process by which living plant cells, containing chlorophyll, produce food substances (glucose and starch), from carbon dioxide and water, by using light energy and release oxygen as a by-product.

(b) **Thylakoids** — Closely packed flattened sacs arranged in piles in the interior of chloroplasts are called Thylakoids.

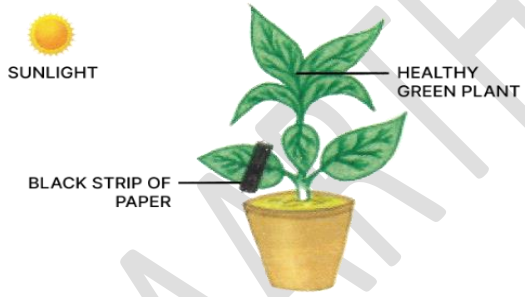
(c) **Chloroplast** — Chloroplasts are minute oval bodies bounded by a double membrane which contains Thylakoids arranged in piles called Grana lying in a colourless ground substance called Stroma.

(d) **Photolysis of water** — Photolysis of water is defined as the splitting of H_2O molecules into hydrogen ions and oxygen in the presence of light.

(e) **Polymerisation** — Polymerisation is the process in which several glucose molecules are transformed to produce one molecule of starch.

Question 2

Given below is the figure of an experimental set-up, showing a physiological act of the plants. Study and answer the following questions.



(a) What is the objective of this experiment ?

(b) Name and define the process shown here.

(c) Why do we destarch the leaves before performing the experiment ?

(d) How do we destarch the leaves ?

(e) What will be the observation when we pour iodine solution over the bleached experimental leaf.

(f) Write a well-balanced equation of the above process.

Answer

(a) The objective of given experiment is to show that sunlight is necessary for photosynthesis.

(b) The process shown here is photosynthesis.

Photosynthesis is the process by which living plant cells, containing chlorophyll, produce food substances (glucose and starch), from carbon dioxide and water, by using light energy and release oxygen as a by-product.

(c) We destarch the leaves before experiment in order to remove the starch from leaves so that occurence of photosynthesis can be detected.

(d) To destarch the leaves the plant is kept in dark for 24-48 hours. This stops photosynthesis in the plant. During this time the starch already present in the leaves is translocated to storage organ of the plant fom the leaves.

(e) When we pour iodine solution over the bleached experimental leaf the area where starch is present turns blue.

(f) The equation for photosynthesis is given below:

$$6CO_2 + 12H_2O \xrightarrow[\text{chlorophyll}]{\text{light energy}} C_6H_{12}O_6 + 6H_2O + 6O_2 \uparrow$$

Question 3

Give reasons/explain:

(a) It is necessary to place a plant in the dark before starting an experiment on photosynthesis.

(b) It is not possible to demonstrate respiration in a green plant kept in sunlight.

(c) Most leaves have the upper surface more green and shiny than the lower surface.

(d) During the starch test, the leaf is -

1. boiled in water.
2. boiled in methylated spirit.

Answer

(a) A plant used for experiments on photosynthesis should initially be placed in the dark for 24 to 48 hours to destarch the leaves. During this period, all the starch will be removed from the leaves and stored in the storage organs. The leaves will not show the presence of starch. So the various experiments on photosynthesis can be carried out effectively.

(b) If a green plant is kept in bright light, it tends to use up all the CO_2 produced during respiration, for photosynthesis. Thus, the release of CO_2 cannot be demonstrated. Hence, it is difficult to demonstrate respiration as these two processes occur simultaneously.

(c) Due to more amount of chlorophyll on the upper surface more light is trapped. The chloroplasts are concentrated in the upper layers of the leaf which helps cells to trap the sunlight quickly. The upper surface is more green and shiny because it has a waxy coating to prevent loss of water due to evaporation.

(d) During the starch test,

1. The leaf is boiled in water to kill the cells.
2. The leaf is boiled in methylated spirit till it becomes pale-white due to the removal of chlorophyll. The leaf now becomes hard and brittle.

Question 4

Distinguish between the following pairs on the basis of words indicated in the brackets.

(a) Light reaction and Dark reaction (end products)

(b) Producers and Consumers (organisms)

(c) Grass and Grasshopper (mode of nutrition)

(d) Stoma and Stroma (structure)

Answer

(a) Differences between light reaction and dark reaction (end products) —

Light Reaction	**Dark Reaction**
ATP and NADPH are the end products of this reaction.	Glucose is the main product formed during dark reaction.
The water molecule split into hydrogen and oxygen.	No splitting of water.

(b) Differences between producers and consumers (organisms) —

Producers	**Consumers**
They are autotrophs.	They are heterotrophs.
They can convert inorganic substances into organic substances.	They cannot convert inorganic substances into organic substances.
It includes green plants and photosynthetic micro-organisms.	It includes herbivores and carnivores.
For example — green plants	For example — Animals

(c) Differences between grass and grasshopper (mode of nutrition) —

Grass	Grasshopper
Green grass being a producer is capable of producing its own food by photosynthesis.	Grasshopper is a primary consumer (herbivore) and directly feeds on producers like grass.

(d) Differences between stoma and stroma (structure) —

Stoma	Stroma
A stoma is a microscopic pore surrounded by two specialized guard cells found in the leaves and stems. Its main function is gaseous exchange.	Stroma is the colourless ground substance found in the chloroplast. It is the site of the light independent reactions of photosynthesis.

Question 5

How would you demonstrate that green plants release oxygen when exposed to light?

Answer

Place some water plants (Elodea or Hydrilla) in a beaker containing pond water and cover them by a short-stemmed funnel.

1. Invert a test-tube full of water over the stem of the funnel. (Ensure that the level of water in the beaker is above the level of stem of the inverted funnel).
2. Place the apparatus in the sun for a few hours. Bubbles of the gas will collect in the test-tube.
3. Test the gas in the test-tube. A glowing splinter bursts into flame which shows the presence of oxygen.

Question 6

Describe the main chemical changes which occur during photosynthesis in

1. Light reaction
2. Dark reaction

Answer

Light reaction

The light reaction occurs in two main steps:

Step 1 — Activation of chlorophyll
The chlorophyll on exposure to light energy becomes activated by absorbing photons.

Step 2 — Splitting of Water
The absorbed energy is used in splitting the water molecule (H_2O) into its two components (Hydrogen and Oxygen) and releasing electrons.

$$2H_2O \longrightarrow energy\ of\ 4\ photons 4H^+ + 4e^- + O_2$$

This reaction is known as photolysis of water.

End result of the products of photolysis
The hydrogen ions (H^+) are picked up by a compound NADP (Nicotinamide adenine dinucleotide phosphate) to form NADPH.

$$NADP^+ + e^- + H^+ \longrightarrow enzyme NADPH$$

The oxygen (O) component is given out as molecular oxygen (O_2).

$$2O \longrightarrow O_2$$

The electrons (e^-) are used in converting ADP (adenosine diphosphate) into energy rich compound ATP (adenosine triphosphate) by adding one phosphate group P_i (inorganic phosphate).

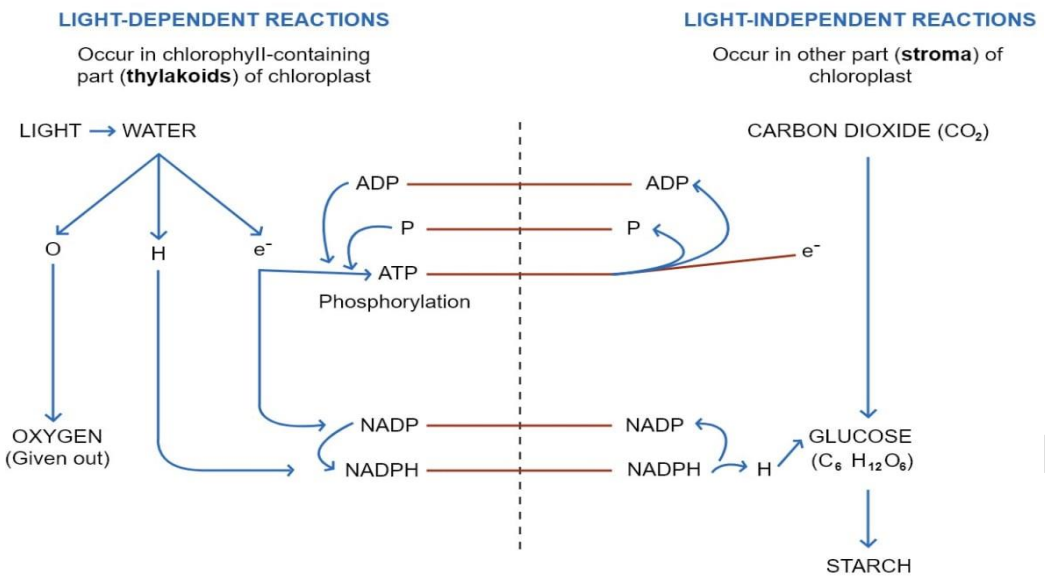
$$ADP + P_i \text{ (inorganic phosphate)} \longrightarrow ATP$$

This process is called photophosphorylation.

Dark reaction

The reactions in this phase do not require light energy and occur simultaneously with the light reaction. The time gap between the light and dark reaction is less than one thousandth of a second. In the dark reaction, ATP and NADPH molecules (produced during light reaction) are used to produce glucose ($C_6H_{12}O_6$) from carbon dioxide. Fixation and reduction of carbon dioxide occurs in the stroma of the chloroplast through a series of reactions. The glucose produced is either immediately used up by the cells or stored in the form of starch.

Below is the summary of events in Light reaction and Light independent reactions of photosynthesis:



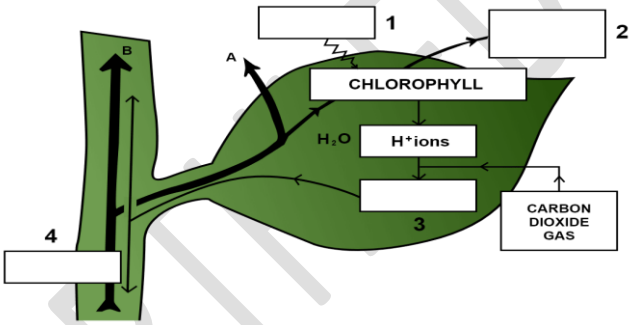
Structured / Application / Skill Type

Question 1

Given below is a schematic diagram to illustrate some aspects of photosynthesis.

(a) **Fill up** the gaps, in blank spaces (1-4), by writing the names of the correct items.

(b) **What phenomenon** do the thick arrows A and B indicate?



Answer

(a) Blank spaces (1-4) are labelled below:

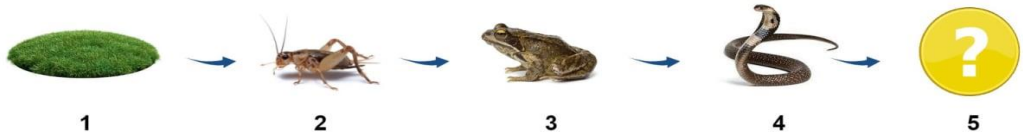
- 1 → Sunlight
- 2 → Oxygen
- 3 → Glucose
- 4 → Xylem

(b) Phenomena represented by thick arrows A and B are:

- A → Transpiration
- B → Translocation

Question 2

Given below is the representation of a certain phenomenon in nature with four organisms 1-4.



(a) Name the phenomenon represented.

(b) Name any one organism that could be shown at No .5

(c) Name the biological process which was the starting point of the whole chain.

(d) Name one natural element which all the organisms 2-4 and even 5 are getting from No. 1 for their survival.

Answer

(a) Food chain

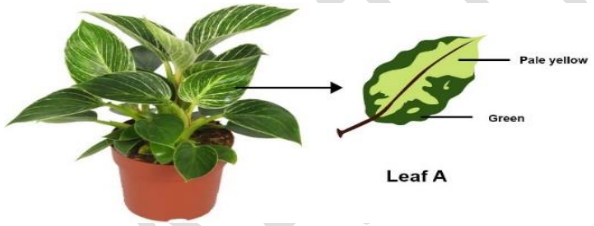
(b) Hawk, Eagle

(c) Photosynthesis

(d) Oxygen

Question 3

A potted plant with variegated leaves was taken in order to prove a factor necessary for photosynthesis. The potted plant was kept in the dark for 24 hours and then placed in bright sunlight for a few hours. Observe the diagram and answer the questions:



(a) What aspect of photosynthesis is being tested in the above diagram?

(b) Why was the plant placed in the dark before beginning the experiment?

(c) Write a balanced chemical equation to represent the process of photosynthesis.

(d) What will be the result of starch test when performed on leaf A shown in the diagram?

(e) Draw a neat and labelled diagram of a chloroplast.

Answer

(a) The above experiment is conducted to show that chlorophyll is necessary for photosynthesis.

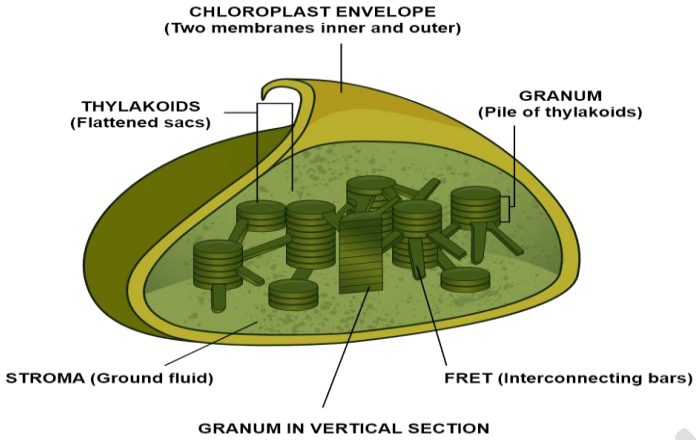
(b) The plant was placed in the dark before beginning the experiment to destarch the leaves.

(c) Balanced chemical equation representing the process of photosynthesis is given below:

$$6CO_2 + 12H_2O \xrightarrow[\text{chlorophyll}]{\text{light energy}} C_6H_{12}O_6 + 6H_2O + 6O_2 \uparrow$$

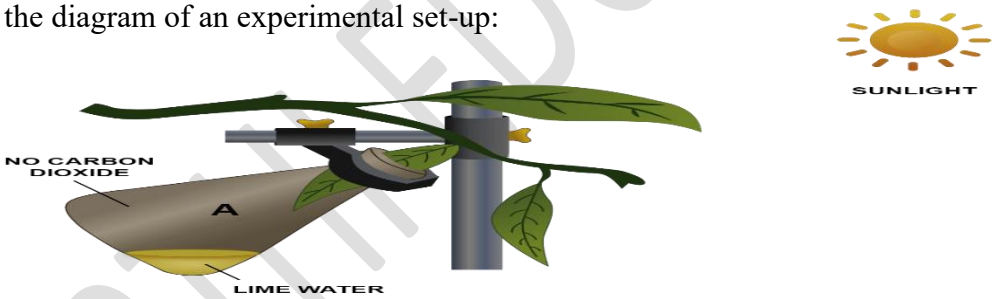
(d) After the starch test on leaf A, only the green parts of the leaf turn bluish, showing the presence of starch.

(e) Below diagram shows Chloroplast with its different parts labelled:



Question 4

Given below is the diagram of an experimental set-up:



a. What is the objective of this experiment?

b. Will it work satisfactorily? Given reason.

c. What alteration (s) will you make in it for obtaining expected result?

d. Would you take any step before starting the experiment? Describe this step and explain its necessity.

Answer

(a) The objective is to prove that carbon dioxide is necessary for photosynthesis.

(b) No, the experiment will not work satisfactorily because, the beaker contains lime water which does not absorb CO_2

(c) To obtain expected result replace the lime water from potassium hydroxide because it absorbs carbon dioxide.

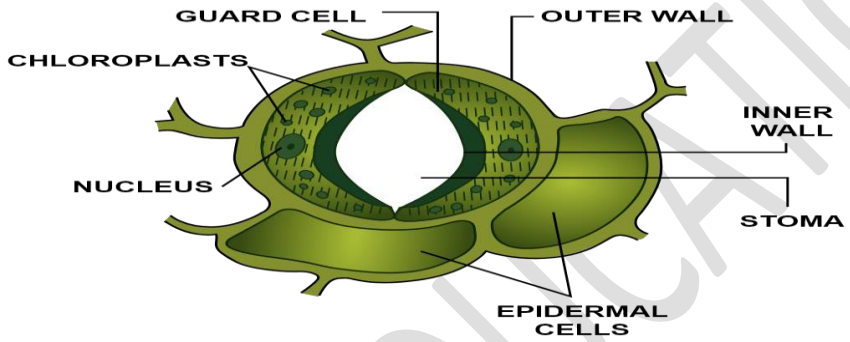
(d) Before starting the experiment, it is necessary to destarch the leaves of the plant by keeping the plant in complete darkness for 48 hours. This is because if the plant is not destarched, then the experiment will give false results because starch stored previously may be detected in the leaf placed in the beaker even if no starch is produced during the experiment.

Question 5

Draw a neat diagram of the stomatal apparatus found in the epidermis of leaves and label the Stoma, Guard cells, Chloroplast, Epidermal cells, Cell wall and Nucleus.

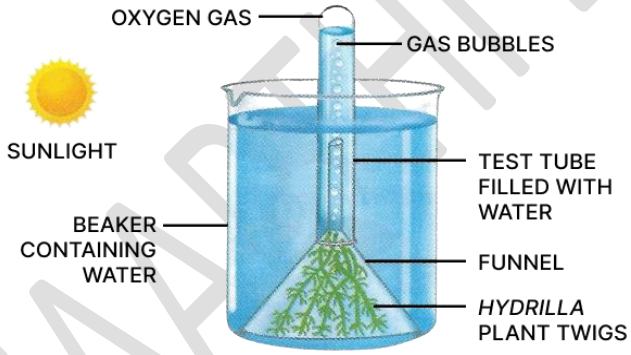
Answer

Below diagram shows the stomatal apparatus found in the epidermis of leaves with all the different parts labelled:



Question 6

Given below is the diagram of an experimental set-up (final stage). Study the same and answer the following questions :



(a) What is the main aim of the experiment?

(b) Oxygen gas shown in the experiment is released from which of the raw materials ?

(c) How would you confirm the presence of oxygen gas?

(d) Name the chemical substance which can be added in water to enhance the process/rate of release of oxygen gas.

(e) Draw a neat and labelled diagram of the same experiment for its initial stage.

Answer

(a) The main aim of the experiment is to show that oxygen is produced during photosynthesis.

(b) Oxygen is released from Water (H_2O).

(c) The gas present in the test tube makes a glowing splinter bursts into flames. This shows the presence of oxygen.

(d) Sodium Bicarbonate

(e) labelled diagram of the same experiment for its initial stage shown below: