

## CHAPTER – 6 PHOTOSYNTHESIS

### P. 76 CHECK YOUR PROGRESS 1

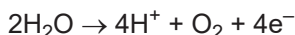
A. State whether the following statements are True (T) or False (F).

- |      |      |      |      |
|------|------|------|------|
| 1. T | 2. F | 3. T | 4. T |
| 5. F | 6. T |      |      |

### P. 79 CHECK YOUR PROGRESS 2

A. Answer these questions.

- The 6 molecules of  $H_2O$  liberated at the end of the reaction are those that have been reformed.
- Photophosphorylation is the conversion of ADP to ATP using the energy of sunlight by activation of photosystem-II.
  - Photolysis is the splitting of water molecules in the presence of light into proton, electron and oxygen. It takes place during non-cyclic photophosphorylation.
- This reaction occurs in the thylakoids of grana in chloroplasts.
- Splitting of water (photolysis): The splitting of water also known as photolysis ('photo' means light and 'lysis' means breaking) takes place in light reaction during which, water is broken down into highly reactive hydrogen (H) ions and oxygen.



The free oxygen is the oxygen gas given off during photosynthesis.

- $NADP^+ + 2e^- + H^+ \rightarrow NADPH$
- $H_2O$  is the source of oxygen during photosynthesis.
- Dark reaction is the biosynthetic phase of photosynthesis. The dark reaction occurs in the stroma of chloroplasts. This reaction does not require light energy, but it does not mean that it occurs during dark only. This is a light independent reaction.
- Photophosphorylation

### P. 83 CHECK YOUR PROGRESS 3

- A. 1. Boiling will kill protoplasm and enzymes in the leaf, so that no further chemical change takes place.
- Potassium hydroxide absorbs the carbon dioxide.
  - Leaf becomes colourless or pale yellow due to the removal of chlorophyll.
  - A plant is kept in darkness for 2–3 days before conducting an experiment on photosynthesis to destarch its leaves.

## P. 84 EXERCISES

### I. Multiple-Choice Questions

A. Choose the most appropriate answer.

- |      |       |       |       |
|------|-------|-------|-------|
| 1. d | 2. d  | 3. a  | 4. b  |
| 5. b | 6. c  | 7. a  | 8. a  |
| 9. a | 10. b | 11. c | 12. d |

### II. Assertion–Reason Type Questions

- A. 1. c                      2. a                      3. a                      4. c

### III. Very Short Answer Type Questions

A. Name the following.

- Thylakoids of grana in chloroplast
- Oxygen
- Compensation point
- Glucose
- Stroma of chloroplast
- Thylakoids of grana
- Stroma
- Photophosphorylation

B. Given below is a set of five terms. Rewrite the terms in the correct order so as to be in logical sequence with regard to photosynthesis.

Grana, photons, water molecules, hydrogen and hydroxyl ions,  $O_2$ .

C. Complete the following statements by filling in the blanks with appropriate word from the choices given in brackets.

- |                 |                        |
|-----------------|------------------------|
| 1. grana        | 2. iodine              |
| 3. increase     | 4. photochemical phase |
| 5. Calvin cycle | 6. chloroplast         |

D. Match the items in column A with those in column B and write down the matching pairs.

- |      |      |      |      |
|------|------|------|------|
| 1. a | 2. b | 3. c | 4. d |
| 5. e |      |      |      |

E. Note the relationship between the first two words and suggest the suitable word/words for the fourth place.

Cristae : Mitochondria :: Thylakoid : Chloroplast

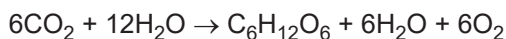
### IV. Short Answer Type Questions

A. Comment on the following statements.

- Plants manufacture food by the process of photosynthesis. They require chlorophyll for photosynthesis. These green plants are consumed by herbivores such as deers, wild

buffaloes, zebras. These herbivores are in turn consumed by carnivores such as tigers for their living. Therefore it can be said that a tiger owes its existence to chlorophyll.

2. The overall chemical equation of photosynthesis is as follows:



In this process, using light energy from sunlight, carbon dioxide and water are combined in the chloroplast with the help of a number of enzymes to yield sugar (glucose) which readily converts into starch. The oxygen evolved in the process is given out in the atmosphere through the stomata as a waste or by-product.

3. Plants kept in dark place use the starch already stored in its leaves during respiration. The plant will use up all the starch stored in its leaves in about three days time. So, after about three days, the plant leaves will not have any starch left in them and we say that the leaves have been destarched. This plant with destarched leaves can now be used in the photosynthesis experiments. Since the presence of starch is regarded as an evidence of photosynthesis, the experimental plant should be destarched before the experiment is started.
4. Water is one of the raw materials used in photosynthesis. The amount of water utilized in photosynthetic reactions is quite small. Therefore, water rarely becomes a limiting factor for photosynthesis. However, water deficit stress reduces the rate of photosynthesis by affecting the process indirectly.
5. At night, since photosynthesis does not occur, oxygen is not being produced by the trees. In addition to this, the trees continue respiring thereby releasing  $\text{CO}_2$ . Therefore, sleeping under a tree at night is not advisable.
6. During the process of photolysis under light reaction, the water molecule splits up to release  $\text{H}^+$  and  $\text{OH}^-$  ions. These  $\text{OH}^-$  react to liberate oxygen. Thus we can say that oxygen liberated during photosynthesis comes from water.
7. The survival of almost all living organisms directly or indirectly depends upon the food made by the plants. Besides oxygen which is essential for the survival of all living organisms is produced during photosynthesis.

#### B. Answer these questions.

1. Photosynthesis (photo = light; synthesis = combination) may be defined as a biochemical process by which living cells of plants containing

chlorophyll manufacture their own food (glucose) using carbon dioxide and water as raw materials in the presence of sunlight.

$\text{CO}_2$  and  $\text{H}_2\text{O}$  are the raw materials required along with the presence of sunlight.

2. Three adaptations in plants for photosynthesis

- Leaves have large surface area for maximum absorption of light.
- The leaves have large number of stomata to allow rapid exchange of oxygen and  $\text{CO}_2$  gases.
- The leaves are arranged at right angles to the light source so as to trap maximum light.

3. Stomata (singular=stoma) are minute pores present either on the lower or both the surfaces of the leaf to facilitate exchange of gases between the leaf and the atmosphere. Each stoma consists of a stomatal aperture and two surrounding guard cells.

Maximum number of stomata are found in lower surface of the leaves of dicot plant to allow rapid exchange of  $\text{O}_2$  and  $\text{CO}_2$  gases.

4. Water is the source of  $\text{O}_2$  produced during photosynthesis.
5. Photosynthesis provides the free oxygen in Earth's atmosphere that is used by living beings for other metabolic processes. Without it, the current carbon cycle (almost all life on Earth) could not exist. The atmosphere would be full of carbon dioxide which is an unbreathable gas.
6. In normal conditions,  $\text{CO}_2$  is the major limiting factor in photosynthesis. The rate of photosynthesis increases with an increase of  $\text{CO}_2$  concentration. The concentration of  $\text{CO}_2$  in the atmosphere varies from 0.03 – 0.04 percent. A concentration of 0.02 per cent is optimum for increasing the rate of photosynthesis. However over long periods even 0.05 per cent  $\text{CO}_2$  concentration in the atmosphere can increase the rate of photosynthesis, provided the light intensity is also increased to support it.
7. *Hydrilla* is an aquatic plant, which is used in the lab to demonstrate  $\text{O}_2$  liberation during photosynthesis.

#### V. Long Answer Type Questions

##### A. Answer these questions.

1. Refer to figure 6.3a from page 76 of the textbook.
2. Plants perform photosynthesis, where they fix carbon dioxide into sugars and release oxygen

from water, thus being a producer of oxygen, and then consume these sugars using cellular respiration, releasing carbon dioxide from the sugars and taking in oxygen to create water, thus being a consumer of oxygen.

## VI. Structured/Application/Skill Based Questions

- A.** 1. – 1. carbon dioxide; 2. stomata; 3. water; 4. chlorophyll; 5. light; 6.  $6\text{CO}_2$ ; 7.  $12\text{H}_2\text{O}$ ; 8. light energy; 9. chlorophyll; 10.  $\text{C}_6\text{H}_{12}\text{O}_6$ ; 11.  $6\text{H}_2\text{O}$ ; 12.  $6\text{O}_2$ ; 13. chloroplasts; 14. light; 15. dark
2. – 1. kill protoplasm; 2. remove chlorophyll; 3. iodine; 4. blue-black; 5. brown
- B.** 1. Test tube B
2. Test tube D
3. This experiment shows that photosynthesis increases with increase in intensity of light and temperature. Low temperature and unavailability of light limit the photosynthesis process.
- C.** 1. b      2. e      3. a      4. a      5. e
- D.** 1. Light is necessary for photosynthesis.
2. The plant was kept in the dark before the experiment to destarch the leaves.
3. a. The leaf was boiled in water to kill protoplasm and enzymes in it so that no further chemical change takes place.
- b. The leaf was boiled in methylated spirit to remove chlorophyll.
4.  $6\text{CO}_2 + 12\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O} + 6\text{O}_2$
5. Refer to fig 6.2 from page 74 of the textbook.
- E.** 1. The plant was initially kept in darkness for 24 hours to stop the process of photosynthesis and thereby destarch the leaves.
2. Sodium hydroxide absorbs carbon dioxide present in the air.
3. a. iii.      b. v
4. Photosynthesis requires carbon dioxide.
- F.** 1. Destarching a plant means devoiding the leaves of plant of starch.

The plant is destarched by keeping the plant in the dark for 24 hours.

2. To show that light is necessary for photosynthesis:

- Take a potted plant and destarch its leaves by keeping it in dark for 2 days.
- Take a black paper and cut simple 'L' shape in it making a stencil. Cover one leaf on either side with one such paper by clipping it. Leave the set up in daylight for 4–6 hours.
- Detach the leaf and test it for presence of starch. You will observe that only the part of the leaf that could get sunlight through the cut out design and the other exposed parts of the leaf turn blue black with iodine solution, showing the presence of starch in it (Fig. 6.1 Page 82, Textbook). This proves that sunlight is necessary for photosynthesis and in the absence of light leaves cannot manufacture starch.

- G.** 1. To show that oxygen is given out during photosynthesis.

2. The physiological process mentioned in Q(1) is photosynthesis. Photosynthesis is biochemical process by which living cells of plants containing chlorophyll manufacture their own food (glucose) using carbon dioxide and water as raw materials in the presence of sunlight. This process releases oxygen as a by-product.

3. i. Gas (Oxygen)

ii. *Hydrilla* plants

4.  $6\text{CO}_2 + 12\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O} + 6\text{O}_2$

5. The rate of bubbling will increase on addition of a pinch of sodium bicarbonate to the water in the beaker. The addition of sodium bicarbonate results in the release of  $\text{CO}_2$  which is utilized for photosynthesis. The increased amount of  $\text{CO}_2$  will thus results in increase in the rate of release of oxygen as bubbles.

- H.** 1. b      2. b      3. c      4. c      5. b