Question-1

What is absorption spectrum and action spectrum?

Solution:

Absorption spectrum: A curve obtained by plotting the amount of absorption of different wavelengths of light by a particular pigment is called absorption spectrum.

Action spectrum: The curve obtained by plotting the relative rates of photosynthesis at different wavelengths of light is called action spectrum.

Question-2

Name the first formed category of photosynthetic organisms.

Solution:

Cyanobacteria is the first formed category of photosynthetic organisms.

Question-3

What is the role of carotenoids in photosynthesis?

Solution:

Carotenoids have two major roles in photosynthesis:

(i) Carotenoids absorb radiant energy in the mid-region of the visible spectrum and hand over the same to the chlorophyll, thus, functioning as accessory pigments.

(ii) They protect chlorophyll molecules from photo-oxidation by picking up nascent oxygen and changing the same into a harmless molecular state.

Question-4

Name the various photosynthetic pigments.

Solution:

Chlorophyll a, chlorophyll b, Carotene and Xanthophyll are the various photosynthetic pigments.

Question-5

Differentiate between photorespiration and dark respiration.

Solution:

Photorespiration	Dark respiration
(i) It occurs only inside photosynthetic cells.	(ii) it occurs in all living cells.
(ii) It takes place only in the presence of light.	(ii) It occurs in both light and dark.
(iii) The substrate is RuBP.	(iii) The substrate is commonly glucose though other food materials may also be used
(iv) The substrate is always recently formed.	(iv) The substrate may be recently formed or be a stored one.
(v) The end products are CO_2 and PGA.	(v) The end products are CO_2 and water.
(vi) Both the end products are reutilized in photosynthesis.	(vi) The end products are not recycled in respiration.
(vii) It occurs in chloroplasts, peroxisomes and mitochondria.	(vii) It occurs in cytoplasm and mitochondria.
(viii) Toxic H_2O_2 is produced during the process.	(viii) H_2O_2 is not produced.
(ix) It is a wasteful process and does not produce energy.	(ix) It produces energy for cellular maintenance, synthesis and work.
(x) It increases with the increase in the concentration of oxygen.	(x) It is not influenced by change in oxygen concentration.

Question-6

What is the main function of chlorophyll pigment ?

Solution:

The main function of chlorophyll pigment is to absorb light of specific wavelength in the visible region.

Question-7

Where would you find the pigment in the chloroplast ?

Solution:

The pigment is seen in the thylakoid membrane of the chloroplast.

Question-8

Write the significance of C_4 pathway.

Solution:

The significance of C_4 pathway is as follows:

(i) C_4 plants have closely packed mesophyll cells, which provide a smaller area for better utilization of available water and reduction of the intensity of solar radiations. Thus, C_4 plants are better adapted to tropical climates.

(ii) They are able to maintain high photosynthetic rates under low concentration of CO_2 because the latter have greater affinity for phosphoenol pyruvic acid.

(iii) They do not show photorespiration. Hence, their photosynthetic rate is quite high.

(iv) They can tolerate saline soils because of the presence of C_4 organic acids.

(v) They are adapted to the high temperatures and intense radiation of tropical

Question-9

What is the importance of photosynthesis?

Solution:

Photosynthesis is important in the following aspects:

(i) Photosynthesis is the only known process on Earth by which autotrophic organisms trap solar energy and convert it into food for rest of the organisms.

(ii) All useful plant products such as fodder, timber, firewood, fibres, resin, rubber, drugs, etc., are produced by the process of photosynthesis.

(iii) Coal, petroleum and natural gas are fossil fuels formed by photosynthetic organisms, which lived millions of years ago and got buried under the rocks. These form an important source of energy that is used to run many of our machines.

(iv) Photosynthesis is the only known process by which oxygen is added to the atmosphere, to compensate for oxygen being used by organisms and burning of organic fuels.

(v) Photosynthesis keeps the concentration of CO_2 and O_2 constant in the atmosphere by absorbing CO_2 and releasing O_2.

Question-10

Where are photosynthetic pigments located in the cyanobacteria ?

Solution:

The photosynthetic pigments are located on the membrane of cyanobacteria.

Question-11

Distinguish between photosynthesis and chemosynthesis.

Solution:

Photosynthesis	Chemosynthesis
(i) Photosynthesis occurs in all the chlorophyll-containing organisms such as algae, green bacteria and higher plants.	(i) Chemosynthesis occurs only in some colourless, aerobic bacteria.
(ii) This process involves the participation of chlorophyll and sunlight.	(ii) This process occurs without the participation of chlorophyll and sunlight.
(iii) In photosynthesis, light energy is converted into chemical energy stored in the form of carbohydrates.	(iii) In this process, the chemical energy released during oxidation of inorganic substances is used to synthesize carbohydrates.
(iv) This process involves pigment systems to absorb light energy.	(iv) This process does not require pigments.
(v) Molecular oxygen is evolved during this process.	(v) Molecular oxygen is not evolved during this process

Question-12

Who proposed C_4 cycle ?

Solution:

M. D.Hatch and C.R. Slack proposed C_4 cycle.

Question-13

Define translocation of photosynthates.

Solution:

The synthesis of carbohydrates, through the process of photosynthesis, occurs in green cells of plants. The non-green cells are, therefore, dependent on photosynthetic cells for their carbohydrate supply. The carbohydrates synthesized in the leaves are distributed to roots and storage organs. The regions, such as green tissues, which synthesize carbohydrates are called source. A source has higher concentration of diffusible carbohydrates. While the regions, such as non-green tissues, where carbohydrates are utilized or stored are known as sink. A sink has a lower concentration of diffusible carbohydrates. Therefore, there is a movement of diffusible carbohydrates from the source to the sink. This long distance movement of carbohydrates synthesized through photosynthesis is called translocation of photosynthates.

Question-14

Give two examples of C_4 plants.

Solution:

The two examples of C_4 plants are, Maize and *Amaranthus*.

Question-15

How do internal factors affect photosynthesis?

Solution:

Internal factors affect photosynthesis in the following ways:

(i) Age of the leaf: As the leaf develops, the rate of photosynthesis increases gradually reaching a maximum at its fully expanded stage. Later photosynthesis gradually decreases with the age of the leaf.

(ii) Leaf anatomy: The rate of photosynthesis is partly influenced by the anatomical features of a leaf. These features include the number and degree of opening of stomata, extent of venation and the volume of intercellular spaces.

(iii) Chlorophyll content: Under normal conditions, chlorophyll content in leaves is not generally a limiting factor in photosynthesis. For example, the sun plants contain less chlorophyll in their leaves than those of shade plants but still exhibit higher rate of photosynthesis over shade plants.

(iv) Protoplasmic factor: Protoplasmic factor, probably enzymatic in nature, seems to be essential for photosynthesis.

Question-16

Name the cell organelles involved in photorespiration.

Solution:

Chloroplast, mitochondria and peroxisomes are the cell organelles involved in photorespiration.

Question-17

Define 'quantum yield'.

Solution:

Quantum yield is defined as the number of oxygen molecules released per photon or quantum of light. Its value is 1/8 to 1/10 i.e. evolution of one molecule of O_2 requires 8-10 quanta.

Question-18

Name the CO_2 acceptor in C_4 cycle.

Solution:

PEP is the CO_2 acceptor in C_4 cycle.

Question-19

Name a plant that can carry out photosynthesis at night.

Solution:

Opuntia is a plant that can carry out photosynthesis at night.

Question-20

Explain Crassulacean Acid Metabolism (CAM).

Solution:

Crassulacean Acid Metabolism refers to a mechanism of photosynthesis that is different from the already discussed C_3 and C_4 pathways. This occurs only in succulents and other plants that normally grow in dry conditions. In CAM plants, CO_2 is taken up by the leaves on green stems through stomata, which remain open at night. However, during the day, the stomata remain closed in these plants to conserve moisture. The CO_2 taken up at night is fixed in the same way as it happens in C_4 plants to form malic acid, which is stored in the vacuole. The malic acid thus formed at night, is used during the day as a source of CO_2 for photosynthesis to proceed via the C_3 pathway. Thus, CAM is a kind of adaptation that allows certain plants to carry out photosynthesis without much loss of water.

Question-21

Name the process by which solar energy is trapped by autotrophic organisms and converted into food for the rest of the organisms.

Solution:

Photosynthesis is the process by which solar energy is trapped by autotrophic organisms and converted into food for the rest of the organisms.

Question-22

What are the disadvantages of photorespiration? Explain how the photorespiratory losses are overcome in plants like sugarcane?

Solution:

The disadvantages of photorespiration are,

(i) No energy rich compound is produced during this process.

(ii) As much as half of the photosynthetically fixed carbon dioxide may be lost by photorespiration.

(iii) It is a loss of the net productivity of green plants.

To overcome the photorespiratory losses plants like sugarcane and tropical plants have developed an additional cycle called as C-4 pathway. C-4 plants consume more than the usual 18 ATP molecules of energy to produce 1 molecule of glucose. C_4 pathway is more energy expensive than C_3 pathway.

Question-23

Give one point of difference between chlorophyll a and chlorophyll b.

Solution:

The chlorophyll a has methyl (CH_3) group at the third carbon position of II pyrrolering of porphyrin head while chlorophyll b has an aldehyde group (CHO) at the same position.

Question-24

Why does chlorophyll appear green in reflected light and red in transmitted light?

Solution:

It is the property of the chlorophyll to absorb certain rays of light. The light is split up into seven colours and these colours form a series called spectrum. The absorption spectrum of chlorophyll is maximum for the red light, 700nm and it appears red in the transmitted light. This absorption spectrum for red light facilitates the process of photosynthesis to the maximum. The chlorophyll appears green in reflected light because green light of sunlight is not absorbed by the chlorophyll but is reflected back.

Question-25

What would be the effect of removing all green plants from the face of the earth?

Solution:

By removing all green plants, there would be no photosynthesis. In the absence of photosynthesis solar energy cannot be converted into food. All other living beings will not get food. Ultimately they will die and this earth will become lifeless.

Question-26

What takes over the function of photosynthesis in Opuntia ?

Solution:

Photosynthesis function is taken over by the stems in Opuntia.

Question-27

Name two photosynthetic pigments belonging to chlorophyll.

Solution:

Chlorophyll a and chlorophyll b are the two photosynthetic pigments belonging to chlorophyll.

Question-28

Photorespiration poses threat to plants, yet it occurs in angiosperms. Why?

Solution:

Photorespiration is a threat to plants because no energy rich compound is produced in this process. Half of the photosynthetically fixed carbon dioxide may be lost by photorespiration. Moreover it is a loss to the net productivity of green and C_3 plants. To overcome the photorespiratory loses in angiosperms like sugarcane, they have developed an additional cycle called as C_4 pathway that requires 30 ATP molecules.

Question-29

Are the enzymes that catalyse the dark reactions of carbon fixation located inside the thylakoids or outside the thylakoids?

Solution:

The stroma contains enzymes, which are capable of utilizing ATP and NADPH2 to produce carbohydrate, during dark reaction. The carbon fixation occurs in the stroma by a series of enzymes catalysed steps which are located outside the thylakoids and not inside the thylakoids.

Question-30

Specify two conditions in which photorespiration may take place in green plants.

Solution:

Presence of oxygen and presence of RuBP carboxylase enzyme.

Question-31

Where does carbon fixation occur in chloroplast?

Solution:

Carbon fixation takes place in the stroma of chloroplast by a series of enzyme catalysed reactions.

Question-32

Cite two examples of photosynthetic microorganisms which also fix atomospheric nitrogen.

Solution:

Photosynthetic microorganisms capable of fixing atmospheric nitrogen are,

(i) Anabaena and

(ii) Nostoc.

Question-33

From where do chemoautotrophs derive energy for synthesis of their food?

Solution:

Chemoautotrophs derive energy for synthesis of their food by oxidizing same inorganic substances and not from sunlight.

Question-34

How many ATP molecules are utilized for the formation of one molecule of glucose through C_4 pathway.

Solution:

30 ATP molecules are utilized for the formation of one molecule of glucose through C_4 pathway.

Question-35

Which wavelengths of visible spectrum is maximally absorbed by chlorophyll and which wavelength of light is least absorbed?

Solution:

Blue and red wavelengths of light are maximally absorbed by chlorophyll pigment and green wavelength is least absorbed.

Question-36

What is the end product of light reaction.

Solution:

ATP, $NADPH_2$ and O_2 are the end product of light reaction.

Question-37

Where do light and dark reactions occur in the chloroplast ?

Solution:

Light reaction occurs in the grana and dark reaction occurs in stroma.

Question-38

What is quantasomes?

Solution:

It is a distinct morphological structural unit in the thylakoids which embodies a photosynthetic unit.