CBSE Class 11 Biology

Important Questions

Chapter 13

Photosynthesis in Higher Plants

1 Marks Questions

1.Expand NADP.

Ans. Nicotinamide adenine dinucleotide phosphate.

2.Name one plant that carries out photosynthesis at night?

Ans. Opuntia, chenopodium.

3.Name the cell – organelles involved in photorespiration.

Ans. Mitcohondria, chloroplast and peroxisomes.

4.Why photosynthesis important?

Ans. (a) Primary source of all food on earth.

(b) O_2 is released by green plants into the atmosphere.

5.Define photosynthesis?

Ans. Photosynthesis is an anabolic endergonic as well as oxidation reduction process in which green plants manufacture food by raw materials in sunlight.

6.What is the site for photosynthesis in Opuntia?

Ans. Stem

7.Explain chlorophyll is an essential photosynthetic pigment?

Ans. Chlorophyll – b and other pigments of a reaction centre or photosystem absorb solar energy and transfer it to chlorophyll–a. Ultimately it is chlorophyll–a that initiates photosynthesis process.

8.What is the end product of light reaction?

Ans. ATP, $NADPH_2$ and O_2

9.Give examples of photosynthetic micro – organisms which also fixes atmospheric nitrogen?

Ans. Anabaena, Notec.

10.Name two photosynthetic pigments belonging to Carotenoids.

Ans. Carotene and Xanthophyll.

11.How many molecules of ATP are required for synthesis of one molecule of glucose in C_3 and C_4 Pathways ?

Ans. In C_3 pathway = 18 ATP molecules

In C_4 pathway = 30 ATP molecules

12.What part of sunlight is most suitable for photosynthesis?

Ans. Blue and red regions of the light spectrum are the most effective in photosynthesis.

13.Which one of the photosystems can carry on photophosphorylation independently?

Ans. PS-I.

14.Name two plants that can catty out photosynthesis at night.

Ans. Opuntia, Chenopodium, Bougainvillea.

15.Name the enzyme which is found abundantly in the world.

Ans. RuBisCO.

16.Name the scientist who Proposed the C_4 pathway.

Ans. Hatch and Slack.

17.Where does carbon fixation occur in chloroplast.

Ans. Carbon fixation takes place in stroma.

18.Which compound acts as CO, acceptor in Calvin cycle?

Ans. Ribulose 1,5 bisphosphate.

19.Name the end products of light reaction.

Ans. ATP, NADPH and O_2 .

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2 Marks Questions

1.What is red Drop?

Ans. It is the occasional fall in photosynthetic yield beyond red region of spectrum. This is also called Emerson effect.

2.What are the enzymes that catalyze the dark reaction of carbon fixation located?

Ans. The stroma contains enzymes which are capable of utilizing ATP and $NADPH_2$ 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.

3.What are the two main functions of pigments other than chlorophyll in green leaves?

Ans. **(i)** To absorb light energy and transfer it to chlorophyll for photosynthesis.

(ii) To protect the chlorophyll molecule from photo oxidation.

4.Differentiate between respiration and photorespiration.

Ans.

	Respiration	**Photorespiration**
1.	It occurs in all plants (C_3 and C_4)	It occurs in C_3 plants only.
2.	Glucose is the substrate of this reaction.	Glycolate is the substrate which is connected into Glycine, NH_3 and CO_2 in peroxisomes.

5.Explain the role of water in photosynthesis.

Ans. (i) It is a reactant in light reaction.

(ii) Water stress causes closure of stomata.

(iii) It reduces the availability of CO_2

(iv) Reduces surface area of leaves.

6.What is the law of limiting factor?

Ans. This law states that "if a chemical process is affected by more than one factor which is nearest to its minimal value; then the rate will be determined by the factor which is nearest to its minimal value; it is the factor that directly affects process if its quantity is changed".

7.Compare between chlorophyll 'a' and chlorophyll 'b'?

Ans.

	Chlorophyll a	**Chlorophyll b**
1.	Chlorophyll a has methyl group at the 3^{rd} carbon position of II pyrrole ring of porphyrin head.	It has an aldhyde group at the 3^{rd} carbon position of II pyrrole ring or porphyrin head.
2.	It shows maximum absorption at 429 nm (blue) and 660 nm (red) wavelength.	It shaves maximum absorption at 453 nm (blue) and 642 nm (red) wavelengths.
3.	It is highly soluble in petroleum, ether.	It is highly soluble in methyl alcohol.
4.	It is blue – green in colors.	It is yellow green in colors.

8.What is kranz anatomy?

Ans. Kranz Anatomy – The anatomy in which, the vein of the leaf is surrounded by the bundle sheath containing a member of chloroplasts, having a bull form cells in upper epidermis is known as "Kranz anatomy".

9.Give advantages of C_4 cycle over C_3 Cycle.

Ans. (i) C_4 cycle is more efficient than C_3 cycle.

(ii) The photorespiration is lacking in C_4 plants.

(iii) C_4 cycle can use CO_2 at very low concentrations in comparison to C_3 plants.

(iv) C_4 cycle operates in plants adapted to high integrity of light, high temperature and low water availability, C_3 cycle cannot operate under these conditions at all.

10. Why does the rate of photosynthesis decline in the presence of continuous light?

Ans. Increase in incident light beyond point causes the breakdown of chlorophyll.

11. Why do green plants start evolving carbon dioxide instead of oxygen on a hot sunny day?

Ans. On a hot sunny day, enzyme RuBP carhoxylase becomes active and its affinity for CO decreases and to increases. Cons more and more photosynthetically fixed carbon is lost by photorespiration.

12. Fit! in the space, left blank in the given table to bring the difference between C_3 and C_4 plants:

S.No	Characterisitcs	C_3 plants	C_4 plants
1.	Cell type	Mesophy II	.....(a).... And mesophy II
2.	CO_2 acceptor	......(b).....	Phosphoenol pyruvate (PEP)
3.	First CO_2 fixation product	3- PGA	.....(c).....
4.	Optimum temperature	......(d).....	$30^\circ C$ to $45^\circ C$

Ans. (a) Bundle sheath

(b) RuBP

(c) OAA (oxaloacetic acid)

(d) $20°C - 25°C$

13. State two functions of accessory pigments found in thylakoids.

Ans. (a) Absorption of light and transfer of energy to chlorophyll 'a'.

(b) Protect chlorophyll 'a' from photooxidation.

14. Why do C_4 plants are more expensive than C_3 plants.

Ans. Because they require more energy (30 ATPs) in synthesizing one glucose molecule as compared to C_3 (18 ATPs.)

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3 Marks Questions

1. Explain -There is no oxygen evolution in bacterial photosynthesis.

Ans. In bacterial photosynthesis, the raw material for the supply of proton is H_2S than H_2O Thus, these is production of S than O_2 during splitting in light reaction.

$2H_2S \rightarrow 2HS^{+} + 2H^{+}$

$HS + HS \rightarrow H_2S + S$

2. What is the advantage of using chlorella rather than a higher plant?

Ans. Photosynthesis in chlorella and higher plants is biochemically similar but chlorella was used by Melvin Calvin (1954) due to following reasons –

(i) Chlorella culture is a chloroplast culture as a large volume of every cell is occupied by a single chloroplast.

(ii)A synchroneous culture may easily be obtained in a short span of time.

(iii) Cells are very quickly exposed to radioactive carbondioxcide and are quickly killed; thus handling chlorella for experiments is easier.

3. What is the advantage of having more than one pigment molecule in a photo centre?

Ans. Light reaction depends upon the amount of solar energy trapped by the pigment. Energy trapped by a single pigment molecule is not enough to start the initial reaction which may occur in light. Hence, a number of pigment molecules provide protection to the chlorophyll molecule against photo oxidation.

4. Why are C_4 plant preferred in the tropical region?

Ans. C_4 plants utilize 30 ATP's to produce one molecule of glucose favoured in tropical region. In these plants photorespiration is the mechanism not to lose the photosynthetic carbon. In the process of photorespiration RuBP is catabolised to a 3-carbon atom compound instead of combining with CO_2. More than 50% CO_2 fixed by photosynthesis is lost in photorespiration. Photorespiration acts to undo the work of photosynthesis as no energy rich compound is produced during this process. Thus C_4 plants are better photosynthesizes than C_3 plants and C_4 pathway is of adaptive advantage in tropical region and thus these plants are preferred.

5. Distinguish between photo system – I and Photo system – II

Ans.

	Photosystem – I	**Photosystem – II**
1.	It is the cluster of pigment molecules which absorb light wavelengths at or below 700nm.	It is the cluster of pigment molecules which absorb light wavelength at or below 680nm.
2.	The light absorbed by any pigment molecule of the cluster is transferred to P700, which is the reaction centre.	The light absorbed by any pigment molecule of the cluster is transferred to P680 which is the reaction centre.
3.	It has a high ratio of chlorophyll – a to chlorophyll – b.	It contains relatively more chlorophyll – b than chlorophyll – a.

6. How does temperature affect photosynthesis?

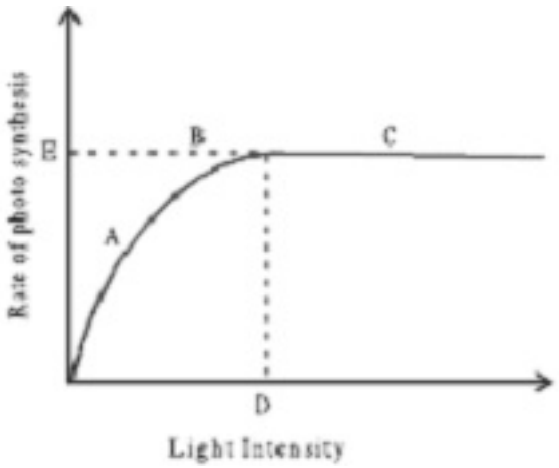
Ans. The dark reactions are temperature controlled. The C_4 plants respond to higher temperatures, C_4 plants exhibit high rate of photosynthesis. C_3 have much low temperature optimum. Tropical plants have higher temperature for photosynthesis.

7. The figure shows the effect of light on the rate of photosynthesis Based on the graph, answer the following questions:

(1) At which point(s) A, B or C in the curve, light i a limiting factor?

(ii) What could he the limiting f in region A ?

(iii) What do region C and D represent on the curve ?



Ans. (i) 'B'

(ii) CO_2 and temperature

(iii) 'C' represents to constant rate of photosynthesis, D is the light saturation intensity at which rate of photosynthesis is m

8. What are the steps that are common to C_3 and C_4 photosynthesis ?

Ans. Hints

(a) Photolysis of and photophosphorylation occurs in both C and plants.

(b) in both, &irk reaction occurs in stroma.

(c) Calvin cycle results in the formation of starch in both the plants.

(d) During dark reaction both types of plants undergo the phases of carboxylation and regeneration.

9. Two potted plants were kept in an oxygen free environment in transparent containers, one ii total darkness and the other in sunlight. Which one of the two i likely to survive more ? Justify your answer by giving the reason.

Ans. Hints:

• The plant in sunlight will survive for longer p:riod.

• Light is essential for photosynthesis.

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5 Marks Questions

1.(a) suggest some habitats or natural circumstances in which

(i) Light intensity

(ii) CO_2 concentration

(iii) temperature might be limiting factors in photosynthesis.

(b) In C_4 plants which type of chloroplast is specialized for light reactions and which for dark reactions?

(c) Why is it an advantage that bundle sheath chloroplast lack grana?

Ans. (a) Some situations are –

(i) In a shaded community; dawn and twilight in a warm climate.

(ii) Carbon dioxide is normally limiting, but it may be more so in a crowded stand of plants under sunny, warm conditions.

(iii) On a bright day winter.

(b) Mesophyll chloroplast for light reaction.

Bundle sheath chloroplast for dark reaction.

(c) Oxygen production is related to grana and oxygen would compete with CO_2 for RuBP carboxylase and stimulate photorespiration. Grana occupy a large area of the chloroplast. In their absence in the bundle sheath there is more stroma, and so more RuBP carboxylase and more storage space for starch.

2.Briefly explain the chemisomotic hypothesis?

Ans. Chemiosmotic hypothesis explained the mechanism of ATP synthesis in chloroplast. In photosynthesis, ATP synthesis is linked to development of proton gradient across a membrane. These are membrane of thylakoids. The proton accumulation is towards the inside of the membrane (in the lumen).

The processes which occur during activation of electrons and their transport to determine the steps that causes a proton gradient to develop. ATP synthesis is linked to development of proton gradient.

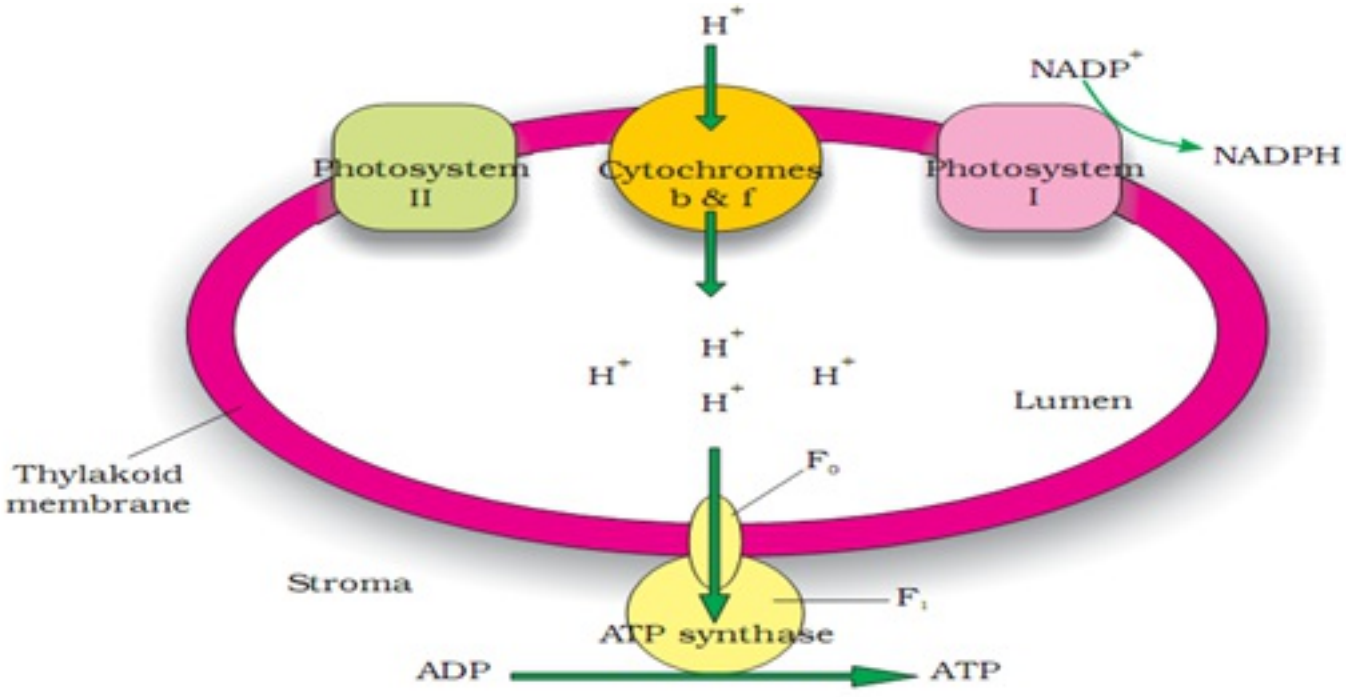

Figure 13.7 ATP synthesis through chemiosmosis

3.Explain the process of bio-synthetic phase of photosynthesis occurring in chloroplast.

Ans. Biosynthetic phase (Dark Reaction) : The process by which carbon – dioxide is reduced to carbohydrates is known as carbon fixation in plants. The fixation of carbon takes place in the stroma of chloroplasts, by a series of enzyme – catalyzed reactions.

C_3 pathway: It is known as Calvin cycle. The path of carbon in the dark reaction was traced by Melvin Calvin through a technique called autoradiography, using 14C, hence this pathway is called Calvin cycle.

Calvin cycle consist of three phases:

(i) Carboxylation **(ii)** Glycolytic reversal **(iii)** Regeneration of RuBP.

(i) Carboxylation – Six molecules of Ribulose 1, 5 biphoshate react with six molecules of carbon-dioxide to form six molecules of carbon dioxide to form six molecules of a short – lived 6C – compound. The reaction is catalysed by RuBP – carboxylase (Rubisco). The six molecules of the 6C – compound break into 12 molecules of 3-phosphoglyceric acid (PGA), a 3C – compound PGA is the first stable compound in this pathway.

(ii) Reduction – 12 molecules of phosphoglyceric acid are converted into 12 molecules of 1,3 diphosphoglycerate and then reduced to phosphogly acetaldehyde (PGAL) using ATP and NADPH molecules respectively. Two molecules of PGAL are diverted for the synthesis of sugar and then into the starch.

(iii) Regeneration of RuBP – For the cycle to continue, the primary acceptor of carbon-dioxide, i.e, RuBP has to regenerated 10 molecules of PGAL, by a series of complex reaction, are converted into 6 molecules of 5C – compound, RuBP. Formation of 6 molecules of RuBP requires six ATP molecules.