BIOLOGY

Important Questions

➢ Multiple Choice Questions:

Question 1. Kranz anatomy is found in or is typical of

(a) C_3 plants

(b) C_4 plants

(c) C_2 plants

(d) Succulents (CAM Plants)

Question 2. A cell that lacks chloroplast does not

(a) Utlize carbohydrates

(b) Evolve carbon dioxide

(c) Require water

(d) Liberate oxygen

Question 3. Energy is transformed from the light reaction step to the dark reaction step by

(a) ATP

(b) RUBP

(c) ADP

(d) Chlorophyll

Question 4. Translocation of carbohydrates or sugars (photosynthetic products) in flowering plants occurs in the form of

(a) Glucose

(b) Starch

(c) Maltose

(d) Sucrose

Question 5. Photo-respiration is induced by

(a) High oxygen content

(b) High temperature

(c) High light intensity

(d) High CO_2 content

Question 6. AH vegetation is only due to

(a) Oxygen

(b) CO_2

(c) Water

(d) Hydrogen

Question 7. Site of dark reaction is

(a) Granum

(b) Unit membrane

(c) Lamella

(d) Stroma

Question 8. All vegetation is only due to water was proved experimentally by

(a) Aristotle

(b) Van Helmont

(c) Joseph

(d) Stephen Hales

Question 9. Vegetation always purifies the air was proved experimentally first by

(a) Liebig

(b) Warburg

(c) Stephen Hales

(d) Joseph Priestly

Question 10. Reduction of NADP+ to NADPH occurs during

(a) PSI

(b) Calvin Cycle

(c) Cyclic photophosphorylation

(d) Non cyclic photophosphorylaction

Question 11. Wastage of energy is associated with

(a) Krebs cycle

(b) Photorespiration

(c) Photosynthesis

(d) Glycolysis

Question 12. Green plants convert solar energy into chemical energy of organic matter was proved by

(a) Joseph Priestly

(b) Van Mayer

(c) Semebier

(d) Lavoisier

Question 13. When the rate of translocation is slow, the rate of photosyntheis shall

(a) Increase

(b) Decrease

(c) Remain Unaffected

(d) Become Zero

Question 14. The first visible product of photosynthesis is

(a) Starch

(b) Glycogen

(c) Sugar

(d) Fatty acids

Question 15. The enzyme ribulose biphosphate carboxylase oxygenase is located in

(a) Mitochondria

(b) Chloroplasts

(c) Golgi bodies

(d) peroxisomes

➢ Fill In the Blanks:

1. All animals including human beings depend on ..... for their food.
2. Green plants carry out ..... process by which they use light energy to derive the synthesis of organic compounds.
3. Photosynthesis is important for life due to two reasons: It is the ..... by which all food gets synthesised on earth and is also responsible for the release of ..... into the atmosphere by plants.
4. A first ....., ... of photosynthesis was thus described.
5. A milestone contribution to the understanding of ..... was that made by a microbiologist, ... (1897-1985), who based on his studies of ..... and green .....
6. The membrane system is responsible for trapping the light energy and synthesising of ..... and .....

➢ True or False:

1. Water stress causes the stomata to close hence reducing the CO_2 availability.
2. Tropical plants have a higher temperature optimum than that of the plants adapted to temperate climates.
3. The C_4 plants show saturation at about 450 µ. L-1 while C_3 responds to increased CO_2 concentration and saturation is seen only beyond 360µ. L-1
4. Green plants carry out 'photosynthesis', a physico-chemical process by which they use light energy to drive the synthesis of organic compounds.
5. Julius Von Sachs in 1770's performed a series of experiment that revealed the essential role of air in growth of green plants.
6. Joseph Priestlay showed that sunlight is essential to the plant process that somehow purifies the air fouled by burning candles or breathing animals.

➢ Very Short Question:

1. What is the full form of NADP?
2. What are the complete photosynthetic units of plants?
3. Give one difference between chlorophyll 'a' and chlorophyll 'b'.
4. How many ATP molecules are required for the synthesis of one molecule of glucose in the C_3 pathway?
5. In which part of the leaves chlorophyll is found?
6. What is the primary acceptor of CO_2 in the C_3 plant?
7. In which part of chloroplast light reaction takes place?
8. What is the relation between photosynthetic units and reaction centers?
9. What is the compensation point?
10. What is Kranz's anatomy?

➢ Short Questions:

1. Expand the abbreviation RuBP. What is its role in photosynthesis?
2. What is the porphyrin system?
3. What are the two main functions of pigments other than chlorophyll in green leaves?
4. What is the significance of chlorophyll-a in photosynthesis carried out by higher plants?
5. What are the steps that are common to C_3 and C_4 photosynthesis?
6. What is the coupling factor in photosynthesis?
7. What is 3 – PGA?
8. What is the Emerson effect or photosynthetic enhancement?

➢ Long Questions:

1. What is photorespiration? Describe the process in detail and link it with the Calvin cycle.
2. Describe carbon reactions of the C_3 pathway. Does this pathway operate also in C_4 plants?
3. Describe briefly the experiment conducted by the scientist, T.W. Englemann.
4. What is a photosystem? Which is the pigment that acts as a reaction center? Describe the interaction of photosystem 1 and photosystem II.

Assertion Reason Question-

1. In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

   (a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

   (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion

   (c) If Assertion is true but Reason is false.

   (d) If both Assertion and Reason are false.

   Assertion: Chloroplasts mostly occur in mesophyll cells along their walls inside the leaves.

   Reason: The membrane system of chloroplast is responsible for trapping the light energy and a for the synthesis of ATP and NADPH.

2. In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

   (a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

   (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion

   (c) If Assertion is true but Reason is false.

   (d) If both Assertion and Reason are false.

   Assertion: Rhoeo leaves contain anthocyanin pigments in epidermal cells.

   Reason: Anthocyanins are accessory photosynthetic pigments. [AIIMS 2002]

✓ Answer Key-

➢ Multiple Choice Answers:

1. (b) C_4 plants
2. (d) Liberate oxygen
3. (a) ATP
4. (d) Sucrose
5. (a) High oxygen content

6. (c) Water
7. (d) Stroma
8. (b) Van Helmont
9. (d) Joseph Priestly
10. (d) Non cyclic photophosphorylaction
11. (b) Photorespiration
12. (b) Van Mayer
13. (b) Decrease
14. (b) Starch
15. (b) Chloroplasts

➢ Fill In the Blanks:

1. plants
2. Answer: photosynthesis a physico chemical
3. Answer: mechanism, oxygen
4. Answer: action, spectrum
5. Answer: photosynthesis, Cornelius van Niel, purple, bacteria
6. ATP, NADPH

➢ True or False:

1. True
2. True
3. True
4. True
5. False
6. Falae

➢ Very Short Answers:

1. Answer: Nicotinamide Adenine Dinucleotide phosphate.
2. Answer: Chloroplasts.
3. Answer: Chlorophyll (a) has a methyl group (CH_3) whereas chlorophyll (b) has an aldehyde group (CHO).
4. Answer: 18 ATP molecules are required for the synthesis of one molecule of glucose.

5. Answer: In the thylakoid membrane of the chloroplast.
6. Answer: RiBulose 1.5 biphosphate (RuBP).
7. Answer: Grana.
8. Answer: A photosynthetic unit consists of P6g0 and P700 reaction centers of photosystems.
9. Answer: The point at which the rate of photosynthesis is equal to the rate of respiration.
10. Answer: It is a type of leaf structure in which the vascular bundle is surrounded by bundle sheath and mesophyll cells.

➢ Short Answer:

1. Answer: The full form of RuBP is ribulose 1,5 biphosphate; RuBP is the first acceptor of atmospheric CO_2 during the dark reaction of photosynthesis. The reaction is called carboxylation.

$$6\ RuBP + 6\ CO_2 + 6\ H_2O \longrightarrow \text{Unstable 6C compond} \longrightarrow 3\ PGA.$$

   RuBP is regenerated during the final formation of sugar molecules.

2. Answer: The porphyrin system consists of

   i. A complex ring structure of alternating single and double bonds called a porphyrin ring having four pyrrole rings containing a magnesium atom in the center.

   ii. A lengthy hydrocarbon tail attached to the porphyrin group called phytol.

3. Answer: The functions of pigments other than chlorophyll are:

   i. to absorb light energy and transfer it to chlorophyll for photosynthesis.

   ii. to protect the chlorophyll molecule from photooxidation.

4. Answer: In higher plants, all the pigments carotenes, xanthophylls, and chlorophyll-b transfer the absorbed solar energy to chlorophyll-a. It is the chlorophyll-a molecule, which initiates the process of photosynthesis.

5. Answer: The following steps are common in both C_3 and C_4 photosynthesis.

   i. Photolysis of H_2O and photophosphorylation in the light reaction.

   ii. The dark reaction occurs in the stroma in both cases.

   iii. Carboxylation-but in C_3 plants CO_2 acceptor is RuBP whereas in C_4 it is phosphoenolpyruvic acid.

   iv. The Calvin cycle resulting in the formation of starch occurs in both C_3 and C_4 photosynthesis.

6. Answer: These are similar to the F_0 - F_1 complex of mitochondria present in appressed and non-appressed regions, granular and stromal thylakoids. These participate in the

photophosphorylation process.

7. Answer: It is a protein molecule located on the outer surface of the thylakoid membrane. It is the first stable intermediate product of photosynthesis. It comprises 16% of the chloroplast protein, which is the most abundant protein of the biological world on earth.
8. Answer: Emerson in 1957 showed that the rate of photosynthesis can be increased if monochromatic beams of two different wavelengths i.e. long and short are used simultaneously around a trap center in a photosynthetic unit. This phenomenon is known as the Emerson effect or photosynthetic enhancement.

➢ Long Answer:

1. Answer: Enzyme Rubisco catalyzes the carboxylation reaction where CO_2 combines with RuBP. This enzyme catalyzes the combination of O_2 with RuBP called oxygenation. Respiration that is initiated in chloroplasts and occurs in light only is called photorespiration.

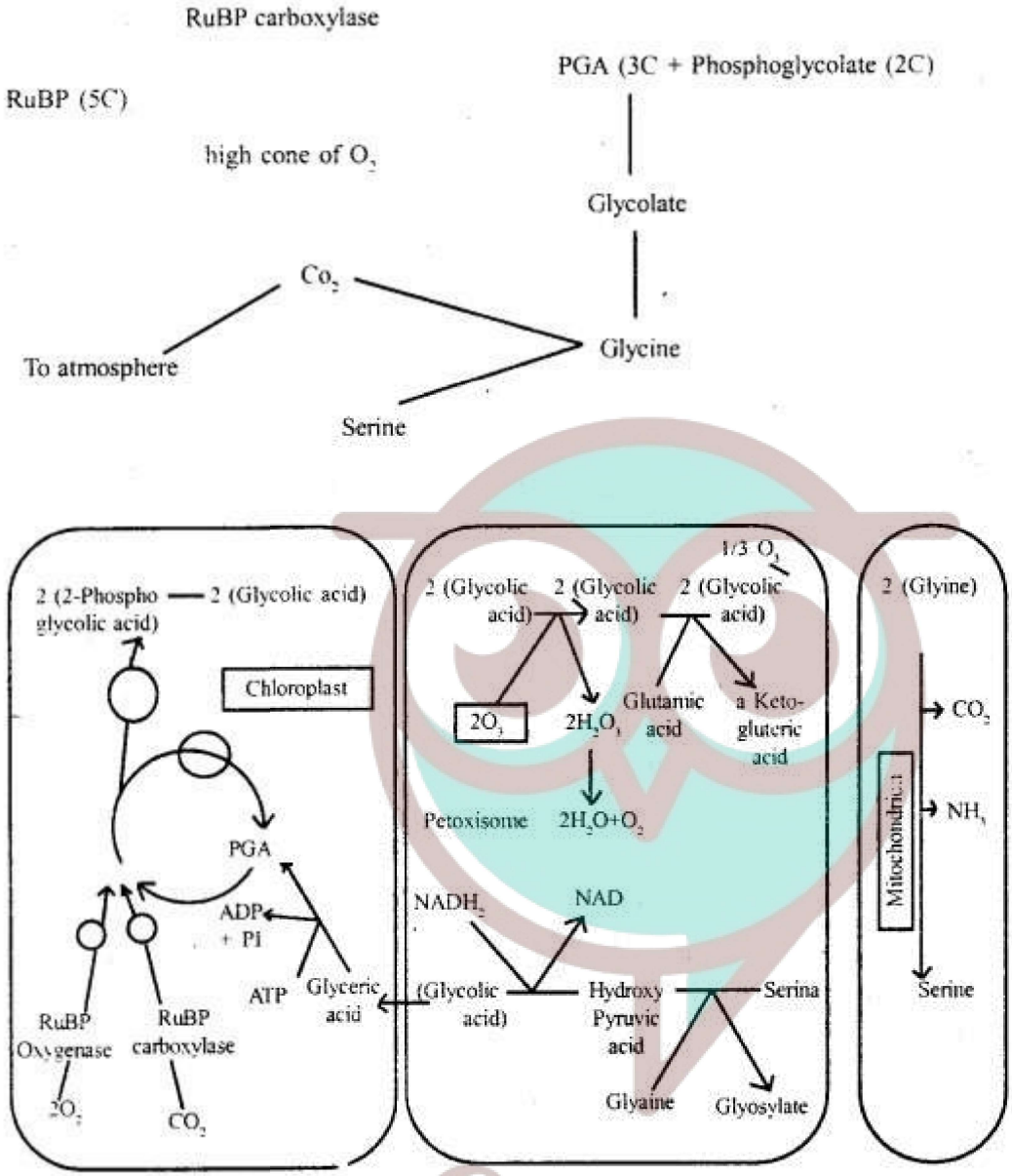
   The oxygenation of RuBP in presence of O_2 is the first of photorespiration, which leads to the formation of one molecule of phosphoglycolate, a two-carbon compound, and one molecule of PGA. While PGA is used up in the Calvin cycle, the phosphoglycolate is dephosphorylated to for glycolate in the chloroplast and in turn diffused to peroxide, where it is oxidized to glyoxylate.

   In the peroxide, the glyoxylate is used to form amino acid and glycine-calycine enters mitochondria where two glycine molecules (4 carbon) give rise to one molecule of serine (3 carbon) and one CO_2 (one carbon). The serine is taken up by peroxisome and converted into glycerate. The glycerate enters the chloroplast where it is phosphorylated to form PGA. PGA molecules enter the Calvin cycle to make carbohydrates releasing one molecule of CO_2 In mitochondria photorespiration is also called the photosynthetic carbon oxidation cycle

   Increased O_2 level increases photorespiration whereas increased CO_2 level increases photorespiration (and increases C_2 photosynthesis).

   In C_3 plants photosynthesis occurs only in one cell type i.e. mesophyll cells. Both light reactions and carbon reactions occur in mesophyll cells in C_3 plants. In C_4 plant photosynthesis requires th presence of two types of photosynthesis cells that is mesophyll cells and bundle sheath cells. Th C_4 plants contain dimorphic chloroplasts, which means chloroplasts in mesophyll cells are granular. Therefore C_2 pathway does not operate in the C_4 pathway.

   All the important changes can be summarised as



2. Answer: The reactions catalyzing the assimilation of CO_2 to carbohydrates take place in the stroma where all the necessary enzymes are localized. These reactions are referred to as 'carbo reactions' (also called dark reactions) leading to the photosynthetic reduction of carbon to carbohydrates.

   In the first phase of carbon reaction, CO_2 enters the leaf through the stroma. This CO_2 is accepte by a 5-carbon molecule, ribulose-1-5 bisphosphate (RuBP) already present in the leaf. It forms two molecules of 3-carbon, compound, 3- phosphoglycerate (PGA). This 3-carbon molecule is th first stable product of this pathway and hence it is called C, PATHWAY.

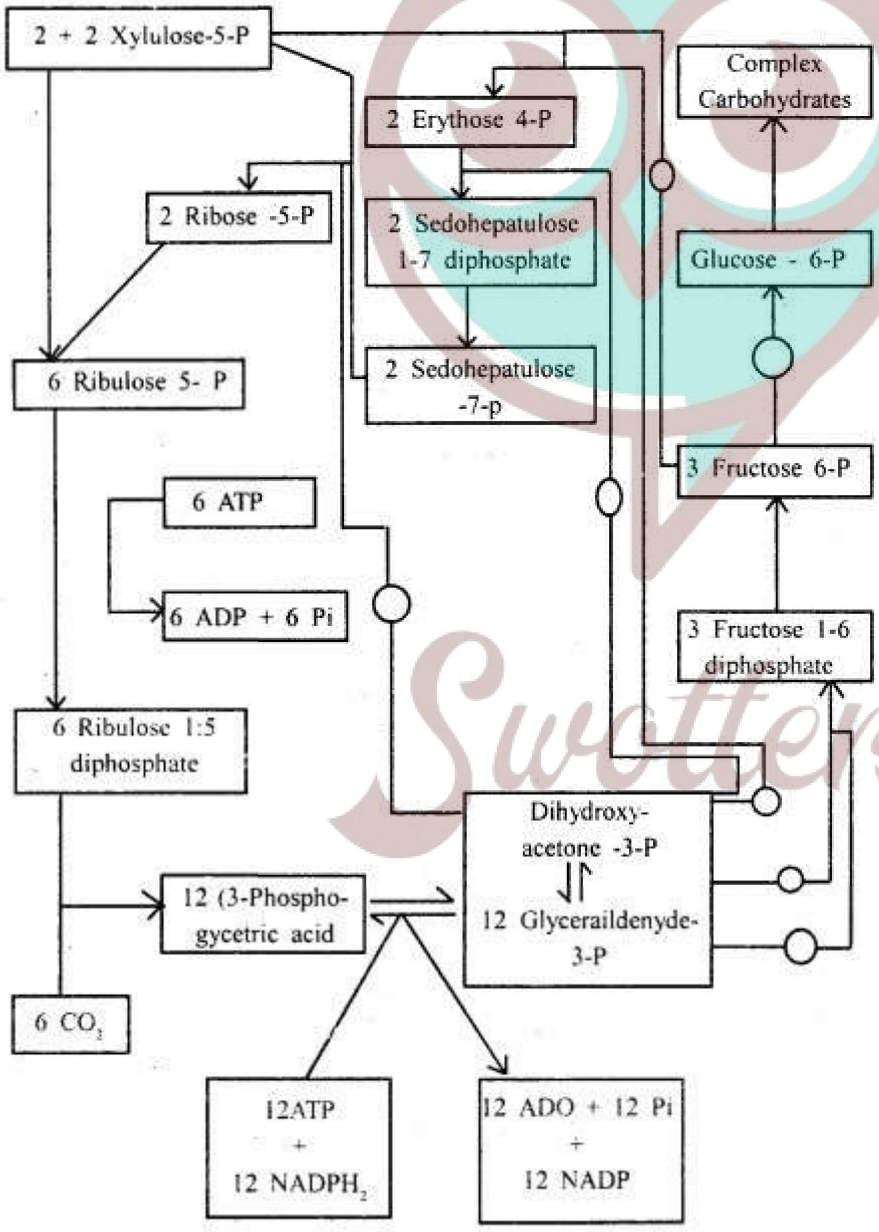
   The formation of (PGA) with CO_2 combining with RuBP is called carboxylation. This reaction is catalyzed by an enzyme called ribulose bisphosphate carboxylase (Rubisco). This enzyme also possesses oxygenase activity and hence abbreviated as Rubisco. This activity allows O, to compe with CO_2 for combining with RuBP.

   After the carboxylation reduction of PGA occurs and ATP and NADPH, formed during

photochemical reactions with the reduction of PGA, glyceraldehyde-3 phosphate-a carbohydrat is formed. These 3-carbon molecules, also called triose phosphates act as precursors for the synthesis of sucrose and starch. To complete the cycle, and to continue it, regeneration of the 5 carbon acceptor molecule, that is RuBP takes place.

The C_3 type of carbon reaction occurs in the stroma of the chloroplast. This pathway is called th Calvin cycle.

The CO_2 concentrating mechanism is called the C_4 pathway. Operation of the C_4 pathway requir the cooperation of both cell-type mesophyll and bundle sheath cells. The objective of the C. pathway is to build up a high concentration of CO_2 which suppresses photorespiration. This C. pathway is more efficient than the C_3 pathway. Hence C? pathway does not operate C4 plants. (See the table)

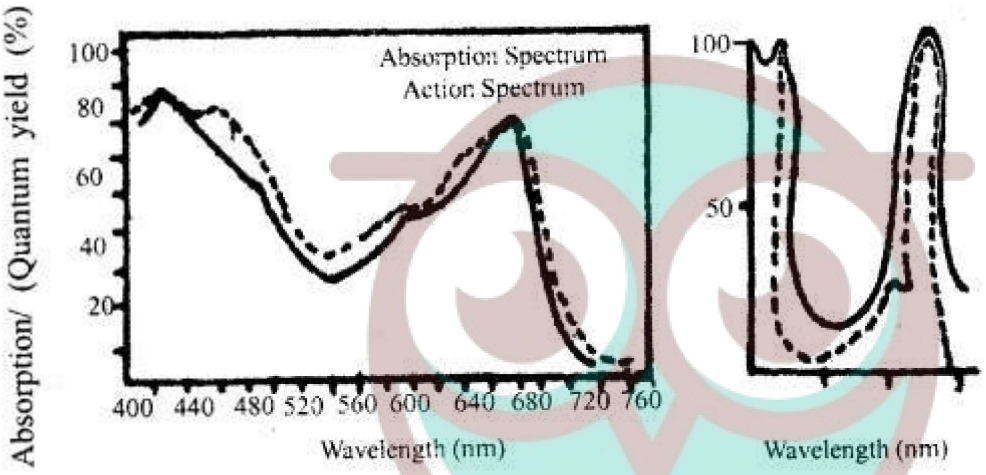


Schematic representation of C_3 pathway Calvin cycle.

3. Answer: T.W. Englemann plotted the action spectrum of photosynthesis.

   Photosynthesis can occur in visible light of wavelength varying between 390 to 763 nm. The rat of photosynthesis is not uniform in light of all wavelengths.

   It varies depending upon their relative absorption by chlorophyll pigments. The graph showing the relative yield or rate of photosynthesis in plants exposed to monochromic light of different wavelengths is termed as ACTION SPECTRUM. The rate of photosynthesis, as shown in the actio spectrum is maximum in the blue region of light.

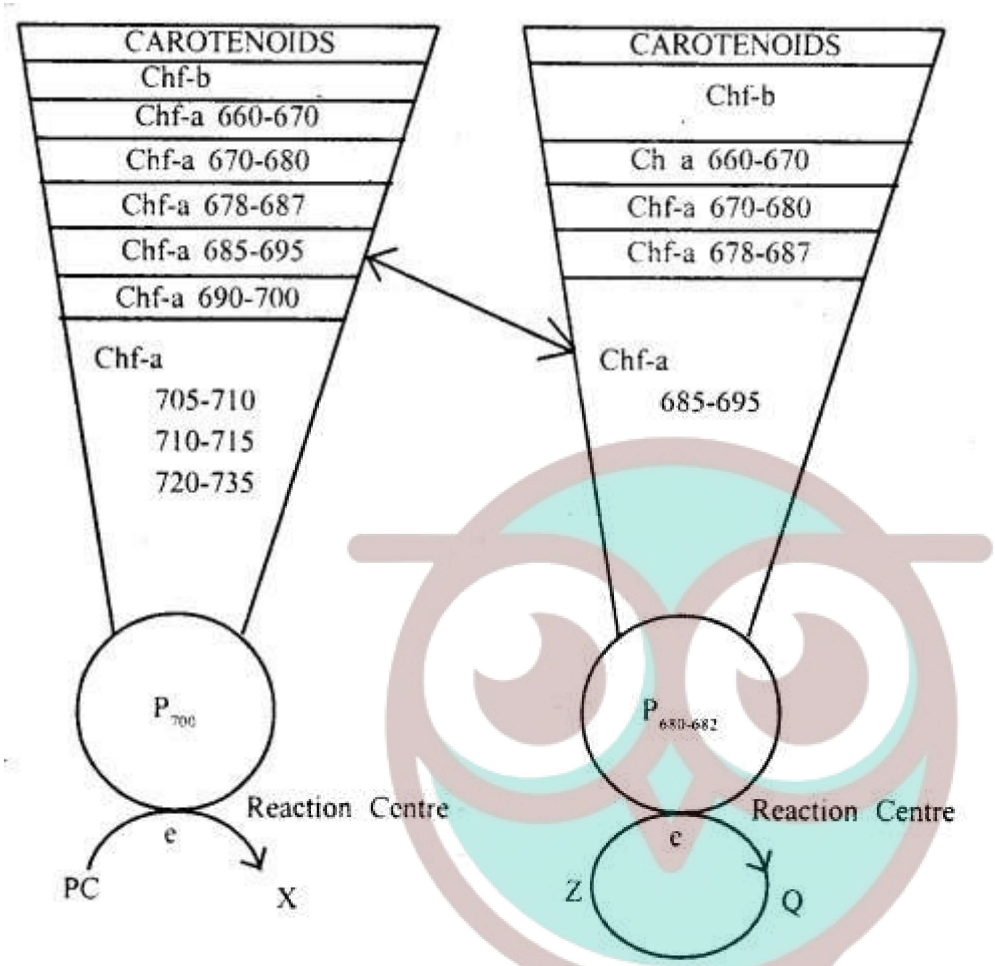


   Curves showing a comparison of absorption and action spectra of chlorophyll pigments during photosynthesis

4. Answer: The light is entrapped by a group of chlorophyll molecules which together constitute a photosystem. Each pigment system has a trap or reaction center, which is either P700 or P680 a In this 'P' stands for pigment and figures 680 and 700 for the wavelength of light. Chlorophyll molecule acts as a trap center with the transfer of high energy electron to electron transport system (ETS).

   The high-energy electrons return rapidly to their normal low energy orbitals in the absence of light and the excited chlorophyll molecule reverts to its original stable condition. These two photosystems: photosystem-I and photosystem-11 exist with different forms of chlorophyll 'a' a the reaction center. The PS-II is located in the appressed regions of grana thylakoids and the PS in the stroma thylakoids and non-appressed regions of grana.

   The function of two photosystems that interact with each other is to trap light energy and conv it to chemical energy (ATP). This chemical energy stored in the form of ATP is used by living cells



Distribution of pigment in photosystem I and Photosystem II.

Assertion Reason Answer-

1. (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion

   Explanation: Chloroplasts function as the site of photosynthesis in eukaryotic photoautotrophs Inside the leaves, the chloroplasts occur mostly in the mesophyll cells along their walls for easy diffusion of gases and receiving optimum quantity of incident light. Within the chloroplast there the membranous system consisting of grana, the stroma lamellae, and the fluid stroma. The membrane system is responsible for trapping the light energy and also for the synthesis of ATP and NADPH.

2. (c) If Assertion is true but Reason is false.

   Explanation: Anthocyanin pigments only give colouration since the epidermal cells mainly have potential colouring pigments. It is responsible for blue, red, pink and purple colours, observed i different parts of plants such as petals, stamens and fruits etc.

   Anthocyanins are also important for attracting insects for pollination and seed dispersal. Hence anthocyanin pigments are not accessory photosynthetic pigments.