Photosynthesis in Higher Plants

Question1

Which of the following are required for the light reaction of Photosynthesis?

A. CO_2
B. O_2
C. H_2O
D. Chlorophyll
E. Light

Choose the correct answer from the options given below:

[NEET 2024 Re]

Options:

A.

A, C, D and E only

B.

C, D and E only

C.

A and B only

D.

A, C and E only

Answer: B

Solution:

For the process of light reaction, water, light and chlorophyll are required. CO_2 is used during the second stage of photosynthesis i.e. dark reaction.

Oxygen is a product of light reaction formed by photolysis of water.

Question2

Which one of the following products diffuses out of the chloroplast during photosynthesis?

[NEET 2024 Re]

Options:

A.

ADP

B.

NADPH

C.

O_2

D.

ATP

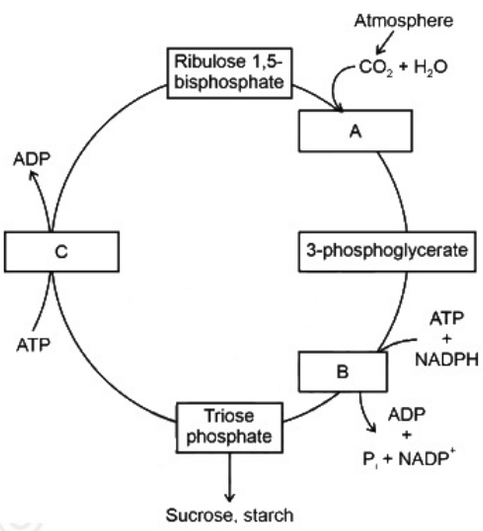
Answer: C

Solution:

Product of light reaction are ATP, NADPH and O_2. Of these O_2 diffuses out of the chloroplast while ATP and NADPH are used to drive the processes leading to synthesis of food, more accurately, sugars.

Question3

Observe the given figure. Identify the different stages labelled with alphabets by selecting the correct option.



[NEET 2024 Re]

Options:

A.

A-Carboxylation, B-Regeneration, C-Reduction

B.

A-Reduction, B-Decarboxylation, C-Regeneration

C.

A-Carboxylation, B-Reduction, C-Regeneration

D.

A-Reduction, B-Carboxylation, C-Regeneration

Answer: C

Solution:

The calvin cycle proceeds in three stages:

(A) Carboxylation, during which CO_2 combines with ribulose-1,5-bisphosphate.

(B) Reduction, during which carbohydrate is formed at the expense of the photochemically made ATP and NADPH.

(C) Regeneration during which the CO_2 acceptor ribulose-1,5-bisphosphate is formed again so that the cycle continues.

Question4

How many molecules of ATP and NADPH are required for every molecule of CO2 fixed in the Calvin cycle?

[NEET 2024]

Options:

A.

2 molecules of ATP and 3 molecules of NADPH

B.

2 molecules of ATP and 2 molecules of NADPH

C.

3 molecules of ATP and 3 molecules of NADPH

D.

3 molecules of ATP and 2 molecules of NADPH

Answer: D

Solution:

For fixation of 1 molecule of CO_2 in Calvin cycle 3 ATP molecules and 2 NADPH molecules are required.

Question5

Which of the following are required for the dark reaction of

photosynthesis?
A. Light
B. Chlorophyll
C. CO2
D. ATP
E. NADPH

Choose the correct answer from the options given below:

[NEET 2024]

Options:

A.

A, B and C only

B.

B, C and D only

C.

C, D and E only

D.

D and E only

Answer: C

Solution:

For dark reaction of photosynthesis there are the requirement of $\left[\begin{array}{l} CO_2 \\ ATP \\ NADPH \end{array}\right.$

Question6

Given below are two statements:
Statement I: In C_3 plants, some O_2 binds to RuBisCO, hence CO_2 fixation is decreased.
Statement II: In C_4 plants, mesophyll cells show very little photorespiration while bundle sheath cells do not show photorespiration.

In the light of the above statements, choose the correct answer from the options given below:

[NEET 2024]

Options:

A.

Both Statement I and Statement II are true

B.

Both Statement I and Statement II are false

C.

Statement I is true but Statement II is false

D.

Statement I is false but Statement II is true

Answer: C

Solution:

In C_3 plant, some O_2 bind to RuBisCO , and hence CO_2 fixation is decreased. Statement II is incorrect, photorespiration does not occur in C_4 plants as they lack RuBisCO in mesophyll. Hence statement I is theonly correct option.

Question7

How many ATP and NADPH2 are required for the synthesis of one molecule of Glucose during Calvin cycle?

[NEET 2023]

Options:

A.

18 ATP and 12$NADPH_2$

B.

12 ATP and 16$NADPH_2$

C.

18 ATP and 16$NADPH_2$

D.

12 ATP and 12$NADPH_2$

Answer: A

Solution:

For every CO_2 molecule entering the Calvin cycle, 3 molecules of ATP and 2 of $NADPH_2$ are required. To make one molecule of glucose, 6 turns of the cycle are required. Thus, ATP and NADPH2 molecules required for synthesis of one molecule of glucose during Calvin cycle will be

$$\rightarrow 6 \times \left[\begin{array}{c} 3\,\mathrm{ATP} \\ 2\mathrm{NADPH}_2 \end{array} \right] = \frac{18\,\mathrm{ATP\ \ and}}{12\mathrm{NADPH}_2}$$

Question8

The reaction centre in PS II has an absorption maxima at

[NEET 2023]

Options:

A.

700 nm

B.

660 nm

C.

780 nm

D.

680 nm

Answer: D

Solution:

Solution:

In PS-I, the reaction centre chlorophyll a has an absorption peak at 700 nm, while in PS-II, reaction centre has an absorption maxima at 680 nm.

Question9

Which of the following combinations is required for chemiosmosis?

[NEET 2023]

Options:

A.

Membrane, proton pump, proton gradient, NADP synthase

B.

Proton pump, electron gradient, ATP synthase

C.

Proton pump, electron gradient, NADP synthase

D.

Membrane, proton pump, proton gradient, ATP synthase

Answer: D

Solution:

Solution:

Chemiosmosis requires a membrane, a proton pump, a proton gradient and ATP synthase.

Question10

	List - I		List - II
(A)	Chlorophyll a	(I)	Yellow to yellow orange
(B)	Chlorophyll b	(II)	Yellow green
(C)	Xanthophyll	(III)	Blue green
(D)	Carotenoid	(IV)	Yellow

Choose the correct answer from the options given below:

[NEET 2023 mpr]

Options:

A.

(A)-(III), (B)-(II), (C)-(IV), (D)-(I)

B.

(A)-(III), (B)-(I), (C)-(IV), (D)-(II)

C.

(A)-(II), (B)-(III), (C)-(I), (D)-(IV)

D.

(A)-(IV), (B)-(III), (C)-(II), (D)-(I)

Answer: A

Solution:

The pigments mentioned in the question have different colors due to their different absorption and reflection of light wavelengths. They are classified as follows :
- Chlorophyll a appears bright or blue green in the chromatogram.
- Chlorophyll b appears yellow green in the chromatogram.
- Xanthophyll appears yellow in the chromatogram.
- Carotenoid appears yellow to yellow-orange in the chromatogram.

So, matching List - I with List - II :
- (A) Chlorophyll a matches with (III) Blue green
- (B) Chlorophyll b matches with (II) Yellow green
- (C) Xanthophyll matches with (IV) Yellow
- (D) Carotenoid matches with (I) Yellow to yellow orange

Therefore, the correct answer is Option A :

- (A)-(III), (B)-(II), (C)-(IV), (D)-(I)

Question11

Given below are two statements :

Statement I :
RuBisCO is the most abundant enzyme in the world.

Statement II :
Photorespiration does not occur in C4 plants.
In the light of the above statements, choose the most appropriate answer from the options given below :

[NEET 2023 mpr]

Options:

A.

Statement I is correct but Statement II is incorrect

B.

Statement I is incorrect but Statement II is correct

C.

Both Statement I and Statement II are correct

D.

Both Statement I and Statement II are incorrect

Answer: C

Solution:

Statement I : As mentioned, RuBisCO (Ribulose-1,5-bisphosphate carboxylase/oxygenase) is indeed the most abundant enzyme in the world and it plays a crucial role in the process of photosynthesis. It catalyzes the first major step of carbon fixation, a process by which atmospheric carbon dioxide is converted by plants into energy-rich molecules such as glucose.

Statement II : In C4 plants, the RuBisCO enzyme is physically separated from the oxygen in the leaf air spaces by concentrating it in bundle sheath cells. This significantly reduces its oxygenase activity and thus the rate of photorespiration, effectively making photorespiration minimal to non-existent under normal conditions. However, under certain conditions, such as extreme drought or high temperatures, photorespiration can occur in C4 plants as well. But in a standard environment, it's largely inhibited, making this statement correct.

Question12

Which out of the following statements is incorrect?

[NEET 2023 mpr]

Options:

A.

Grana lamellae have both PS I and PS II

B.

Cyclic photophosphorylation involves both PS I and PS II

C.

Both ATP and NADPH +H+are synthesised during non-cyclic photophosphorylation.

D.

Stroma lamellae lack PS II and NADP reductase

Answer: B

Solution:

Photosystems I and II are involved in the light-dependent reactions of photosynthesis, occurring in the thylakoid membranes of chloroplasts.

Option A : Grana lamellae (the stacks of thylakoid membranes in chloroplasts) do indeed have both Photosystem I (PS I) and Photosystem II (PS II).

Option C : During non-cyclic photophosphorylation, both ATP (energy currency of the cell) and NADPH (which carries electrons for the light-independent reactions, or the Calvin cycle) are produced. This statement is correct.

Option D : Stroma lamellae (parts of the thylakoid system that interconnect grana) lack PS II and NADP reductase, which are instead located in the grana lamellae. This statement is also correct.

Option B : Cyclic photophosphorylation involves only PS I, not PS II. This is because the primary purpose of cyclic photophosphorylation is to produce additional ATP without producing NADPH. Therefore, this statement is incorrect.

Question13

When one CO_2 molecule is fixed as one molecule of triose phosphate, which of the following photochemically made, high energy chemical intermediates are used in the reduction phase?
[NEET Re-2022]

Options:

A. 2 ATP + 2 NADPH

B. 1 ATP + 1 NADPH

C. 1 ATP + 2 NADPH

D. 2 ATP + 1 NADPH

Answer: A

Solution:

2 ATPs and 2 NADPH are used to fix one molecule of CO_2 into one molecule of triose phosphate.

Question14

Identify the correct statements regarding chemiosmotic hypothesis:
(a) Splitting of the water molecule takes place on the inner side of the membrane.
(b) Protons accumulate within the lumen of the thylakoids.
(c) Primary acceptor of electron transfers the electrons to an electron carrier.
(d) NADP reductase enzyme is located on the stroma side of the membrane.
(e) Protons increase in number in stroma.
Choose the correct answer from the options given below :
[NEET Re-2022]

Options:

A. (b), (c) and (e)

B. (a), (b) and (e)

C. (a), (b) and (d)

D. (b), (c) and (d)

Answer: C

Solution:

Solution:

During light reactions, Statement (c) is incorrect because the electron from primary acceptor is transferred to a proton carrier (PQ) but not an electron carrier. Statement (e) is incorrect as the proton concentration relatively increases in the lumen of thylakoid and decreases on the stromal side.

Question15

Given below are two statements :
Statement I :
The primary CO_2 acceptor in C_4 plants is phosphoenolpyruvate and is found in the mesophyll cells.
Statement II :
Mesophyll cells of C_4 plants lack RuBisCo enzyme. In the light of the above statements, choose the correct answer from the options given below:
[NEET-2022]

Options:

A. Both Statement I and Statement II are correct

B. Both Statement I and Statement II are incorrect

C. Statement I is correct but Statement II is incorrect

D. Statement I is incorrect but Statement II is correct

Answer: A

Solution:

Solution:

The primary CO_2 acceptor is a 3-carbon molecule, phosphoenol pyruvate (PEP) and is present in the mesophyll cells.

Mesophyll cells of C_4 plants lack RuBisCO enzyme.

Question16

Which one of the following is not true regarding the release of energy during ATP synthesis through chemiosmosis? It involves: [NEET-2022]

Options:

A. Breakdown of proton gradient

B. Breakdown of electron gradient

C. Movement of protons across the membrane to the stroma

D. Reduction of NADP to N ADPH $_2$ on the stroma side of the membrane

Answer: B

Solution:

Solution:

Chemiosmosis requires a membrane, a proton pump, a proton gradient and ATP synthase. Energy is used to pump protons across a membrane to create a gradient or a high concentration of protons within the thylakoid lumen.

The NADP reductase enzyme is located on the stroma side of the membrane. Along with the electrons that come from the acceptor of electrons of PS I, protons are necessary for reduction of $NADP^+$to $NADPH + H^+$

The process does not involve breaking of electron gradient.

Question17

What is the role of large bundle sheath cells found around the vascular bundles in C_4 plants? [NEET-2022]

Options:

A. To provide the site for photorespiratory pathway

B. To increase the number of chloroplast for the operation of Calvin cycle

C. To enable the plant to tolerate high temperature

D. To protect the vascular tissue from high light intensity

Answer: B

Solution:

Solution:

The large cells around the vascular bundles of mathrm C_4 plants form bundle sheath. These cells have large number of chloroplasts to perform calvin cycle.

Question18

The first stable product of CO_2 fixation in Sorghum is [NEET 2021]

Options:

A. Pyruvic acid

B. Oxaloacetic acid

C. Succinic acid

D. Phosphoglyceric acid

Answer: B

Solution:

- Sorghum is a C_4 plant. The first stable product of CO_2 fixation in Sorghum is oxaloacetic acid.
- The first stable product in C_3 cycle is 3-phosphoglyceric acid.
- Pyruvic acid is the end product of glycolysis.
- Succinic acid is an intermediate product in krebs cycle.

Question19

Which of the following statements is incorrect? [NEET 2021]

Options:

A. Both ATP and NADPH + H^+ are synthesized during non-cyclic photophosphorylation

B. Stroma lamellae have PS I only and lack NADP reductase

C. Grana lamellae have both PS I and PS II

D. Cyclic photophosphorylation involves both PS I and PS II

Answer: D

Solution:

Solution:
• Cyclic photophosphorylation involves only PS I.
Both PS I and PS II are involved in non-cyclic photophosphorylation where both ATP and NADPH + H^+ are synthesized.
• Both PS I and PS II are found on grana lamellae whereas stroma lamellae have PS I only and lack NADP reductase.

Question20

In light reaction, plastoquinone facilitates the transfer of electrons from [2020]

Options:

A. $Cytb_6$ f complex to PS-I

B. PS-I to $NADP^+$

C. PS-I to ATP synthase

D. PS-II to $Cytb_6$ f complex

Answer: D

Solution:

Solution:
(d) After excitement, e^- is passed from PS-II (P_{680}) to primary electron acceptor (Pheophytin). From primary e^- acceptor, e^- is passed to plastoquinone. Plastoquinone (PQ) in turn transfer its e^- to $Cytb_6f$ complex. Therefore plastoquinone facilitates the transfer of electrons from PS-II to Cyt b_6f complex.

Question21

The oxygenation activity of RuBisCo enzyme in photorespiration leads to the formation of [2020]

Options:

A. 2 molecules of 3-C compound

B. 1 molecule of 3-C compound

C. 1 molecule of 6-C compound

D. 1 molecule of 3-C compound and 1 molecule of 2-C compound

Answer: D

Solution:

Solution:
The oxygenation activity of RuBisco enzyme in photorespiration leads to the formation of 1 molecule of $3-$ phosphoglyceric acid (3-C compound) and 1 molecule of phosphoglycolate (2-C compound)

Question22

In Hatch and Slack pathway, the primary CO2 acceptor is [2019]

Options:

A. Rubisco

B. Oxaloacetic acid

C. Phosphoglyceric acid

D. Phosphoenol pyruvate

Answer: D

Solution:

Solution:
(d) Hatch and Slack pathway is a cyclic pathway for CO_2 fixation. The primary CO_2 acceptor is a 3-carbon compound phosphoenol pyruvate (PEP) which is present in mesophyll cells.
PEP is converted to oxaloacetic acid (OAA), which is then further converted into a 4-carbon compound such as malic acid or aspartic acid, which is then transported to the bundle sheath cells. In the bundle sheath cells, it is again broken down into a 3-carbon compound with the release of CO_2. The CO_2 released enters the Calvin cycle in the bundle sheath cells, while the 3-carbon compound is transported back to the mesophyll cells. In the mesophyll cells, the 3-carbon compound is converted back to PEP, thus completing the cycle.

Question23

Oxygen is not produced during photosynthesis by [2018]

Options:

A. Green sulphur bacteria

B. Nostoc

C. Chara

D. Cycas

Answer: A

Solution:

Solution:
(a) Green sulphur bacteria do not use H_2O as source of proton, therefore they do not evolve O_2

Question24

Which of the following is not a product of light reaction of photosynthesis?
[2018]

Options:

A. ATP

B. NADH

C. Oxygen

D. NADPH

Answer: B

Solution:

Solution:
(b) The light reactions of photosynthesis take place on the thylakoid membranes of the chloroplast. During light reactions of photosynthesis, light is absorbed and the energy is used to drive electrons from water to generate NADPH and to drive protons across a membrane. These protons return through ATP synthase to make ATP. ATP, NADPH and oxygen are products of light reaction, while NADH is a product of respiration process.

Question25

With reference to factors affecting the rate of photosynthesis, which of the following statements is not correct?
(NEET 2017)

Options:

A. Increasing atmospheric CO_2 concentration up to 0.05% can enhance CO_2 fixation rate.

B. C_3 plants respond to higher temperature with enhanced photosynthesis while C_4 plants have much lower temperature optimum.

C. Tomato is a greenhouse crop which can be grown in CO_2 -enriched atmosphere for higher yield.

D. Light saturation for CO_2 fixation occurs at 10% of full sunlight

Answer: B

Solution:

Solution:
(b): C_4 plants respond to higher temperature with enhanced photosynthesis while C_3 plants have lower temperature optimum.

Question26

Phosphoenol pyruvate (PEP) is the primary CO_2 acceptor in (NEET 2017)

Options:

A. C_4 plants

B. C_2 plants

C. C_3 and C_4 plants

D. C_3 plants

Answer: A

Solution:

Solution:
In C_4 plants, initial fixation of CO_2 or carboxylation occurs in mesophyll cells. The chloroplasts of mesophyll cells possess enzyme PEP carboxylase (or PEP case) for initial fixation of CO_2. The primary acceptor of CO_2 is phosphoenol pyruvate or PEP. It combines with CO_2 in the presence of PEP carboxylase (or PEP case) to form oxaloacetic acid or oxallocetate (OAA).

Question27

The process which makes major difference between C_3 and C_4 plants is (NEET II 2016)

Options:

A. glycolysis

B. Calym cycle

C. photorespiration

D. respiration

Answer: C

Solution:

(c) : Photorespiration is the light dependent process of oxygenation of ribulose biphosphate (RuBP) and release of carbon dioxide by the photosynthetic organs of a plant. It leads to oxidation of considerable amount of photosynthetic products to CO_2 and H_2O without the production of useful energy. Photorespiration occurs only in C_3 plants because at high temperature and high oxygen concentration RuBP carboxylase changes to RuBP oxygenase. Photorespiration is absent in C_4 plants. Peroxisome and mitochondria are required for completing the process.

Question28

Water vapour comes out from the plant leaf through the stomatal opening. Through the same stomatal opening carbon dioxide diffuses into the plant during photosynthesis. Reason out the above statements using one of following options.
(NEET II 2016)

Options:

A. The above processes happen only during night time.

B. One process occurs during day time and the other at night.

C. Both processes cannot happen simultaneously.

D. Both processes can happen together because the diffusion coefficient of water and CO_2 is different

Answer: D

Question29

In a chloroplast the highest number of protons are found in
(NEET I 2016)

Options:

A. intermembrane space

B. antennae complex

C. stroma

D. lumen of thylakoids.

Answer: D

Solution:

(d) : Proton concentration is higher in the lumen of thylakoid due to photolysis of water, H^+ pumping and NADP reductase activity in stroma. During the light-dependent reaction, protons are pumped across the thylakoid membrane into the lumen making it acidic down to pH 4.

Question30

Emerson's enhancement effect and Red drop have been instrumental in the discovery of
(NEET II 2016)

Options:

A. photophosphorylation and cyclic electron transport

B. oxidative phosphorylation

C. photophosphorylation and non-cyclic electron transport

D. two photosystems operating simultaneously.

Answer: D

Solution:

Solution:
(d) : Emerson et al. (1957) found that if light of shorter wavelengths was provided at the same time as the longer red wavelengths, photosynthesis was even faster than the sum of the two rates with either colour alone. This synergism or enhancement became known as the Emerson enhancement effect. The two separate groups of pigments or photosystems cooperate in photosynthesis and that such long red wavelengths are absorbed only by one photosystem, called photosystem (PS I). The second photosystem, photosystem II (PS II), absorbs wavelengths shorter than 690nm, and for maximum photosynthesis wavelengths absorbed by both systems must function together. The two photosystems normally cooperate to cause photosynthesis at all wavelengths shorter than 690nm because both photosystems absorb those wavelengths. The importance of Emerson's work is that it suggested the presence of tyo distinct photosystems.

Question31

A plant in your garden avoids photorespiratory losses, has improved water use efficiency, shows high rates of photosynthesis at high temperatures and has improved efficiency of nitrogen utilisation. In

which of the following physiological groups would you assign this plant? (NEET I 2016)

Options:

A. CAM

B. Nitrogen fixer

C. C_3

D. C_4

Answer: D

Solution:

Solution:
(d) : C_4 plants are adapted to hot and dry climate and lack photorespiration due to Kranz anatomy and have greater productivity of biomass.

Question32

Water soluble pigments found in plant cell vacuoles are (NEET I 2016)

Options:

A. carotenoids

B. anthocyanins

C. xanthophylls

D. chlorophylls.

Answer: B

Solution:

Solution:
(b) : Anthocyanins are water soluble pigments, which commonly occur in membrane enclosed vacuoles. They are responsible for colour of fruits and flower petals.

Question33

In photosynthesis, the light-independent reactions take place at (2015)

Options:

A. photosystem II

B. stromal matrix

C. thylakoid lumen

D. photosystem I.

Answer: B

Solution:

Solution:
(b) : The light-independent reactions (dark or Blackman's reactions) of photosynthesis take place in stroma or matrix of chloroplasts. These reactions are enzymatic reactions which catalyse assimilation of CO_2 into carbohydrates.

Question34

Chromatophores take part in (2015)

Options:

A. movement

B. respiration

C. photosynthesis

D. growth

Answer: C

Solution:

Solution:
(c) : Chromatophores are the internal membrane systems of photosynthetic forms which possess photosynthetic pigments. They occur in photoautotrophic bacteria, e.g., purple bacteria and green bacteria.

Question35

A process that makes important difference between C_3 and C_4 plants is (2012)

Options:

A. transpiration

B. glycolysis

C. photosynthesis

D. photorespiration

Answer: D

Solution:

Solution:
(d) : Photorespiration is the light dependent process of oxygenation of ribulose biphosphate (RuBP) and release of carbon dioxide by the photosynthetic organs of a plant. It leads to oxidation of considerable amount of photosynthetic products to CO_2 and H_2O without the production of useful energy. Photorespiration occurs only in C_3 plants because at high temperature and high oxygen concentration RuBP carboxylase changes to RuBP oxygenase. Photorespiration is absent in C_4 plants. Peroxisome and mitochondria are required for completing the process.

Question36

The correct sequence of cell organelles during photorespiration is (2012)

Options:

A. chloroplast, Golgi-bodies, mitochondria

B. chloroplast, rough endoplasmic reticulum, dictyosomes

C. chloroplast, mitochondria, peroxisome

D. chloroplast, vacuole, peroxisome

Answer: C

Solution:

Solution:
(c) : Photorespiration is the light dependent process of oxygenation of ribulose biphosphate (RuBP) and release of carbon dioxide by the photosynthetic organs of a plant. It leads to oxidation of considerable amount of photosynthetic products to CO_2 and H_2O without the production of useful energy. Photorespiration occurs only in C_3 plants because at high temperature and high oxygen concentration RuBP carboxylase changes to RuBP oxygenase. Photorespiration is absent in C_4 plants. Peroxisome and mitochondria are required for completing the process.

Question37

Read the following four statements (A − D).
(A) Both photophosphorylation and oxidative phosphorylation involve uphill transport of protons across the membrane.

(B) In dicot stems, a new cambium originates from cells of pericycle at the time of secondary growth.
(C) Stamens in flowers of Gloriosa and Petunia are polyandrous.
(D) Symbiotic nitrogen fixers occur in free living state also in soil.
How many of the above statements are right?
(Mains 2012)

Options:

A. Two

B. Three

C. Four

D. One

Answer: A

Solution:

Solution:
Polyandrous condition (having large and indefinite number of stamens) is present in Gloriosa (family liliaceae) and Petunia (family solanaceae).
Nitrogen fixation is the conversion of inert atmospheric nitrogen into utilisable compounds of nitrogen like nitrate, ammonia, amino acids, etc.
Biological nitrogen fixation is performed by free living and symbiotic bacteria and cyanobacteria.
Symbiotic nitrogen fixers occur in association with roots of higher plants.
For e.g., Rhizobium is nitrogen fixing bacterial symbiont of papilionaceous roots and Frankia is symbiont in root nodules of several nonleguminous plants like Casuarina.
Both Rhizobium and Frankia live free as aerobes in the soil and develop the ability to fix nitrogen only as symbionts when they become anaerobic.

Question38

CAM helps the plants in
(Mains 2011)

Options:

A. conserving water

B. secondary growth

C. disease resistance

D. reproduction.

Answer: A

Solution:

(a) : Crassulacean acid metabolism (CAM) is photosynthesis by the C_4 pathway in which carbondioxide is taken up during

the night, when the plant's stomata are open and fixed into malic acid. During the day, when the stomata are closed, carbon dioxide is released from malic acid for use in the Calvin cycle. This is important for plants that live in arid conditions as it enables them to keep their stomata closed during the day to reduce water loss from evaporation. Crassulacean acid metabolism is common in succulent plants of desert regions, including cacti and spurges and in certain ferns.

Question39

In kranz anatomy, the bundle sheath cells have (Mains 2011)

Options:

A. thin walls, many intercellular spaces and no chloroplasts

B. thick walls, no intercellular spaces and large number of chloroplasts

C. thin walls, no intercellular spaces and several chloroplasts

D. thick walls, many intercellular spaces and few chloroplasts

Answer: B

Solution:

Solution:
(b) : The C_4 plants are adapted to dry tropical regions and have greater productivity of biomass. They have special type of leaf anatomy known as Kranz anatomy. In this type of anatomy the bundle sheath cells form several layers around the vascular bundles; they are characterised by having a large number of chloroplasts, thick walls impervious to gaseous exchange and no intercellular spaces.

Question40

Which one of the following is essential for photolysis of water? (Mains 2011)

Options:

A. Manganese

B. Zinc

C. Copper

D. Boron

Answer: A

Solution:

(a) : Manganese (Mn^{2+}) is used for photolysis of water to produce oxygen and electrons during light reaction of photosynthesis. It is the phenomenon of breaking up of water into hydrogen and oxygen in the illuminated chloroplast. It acts as an essential cofactor.

Question41

PGA as the first CO_2 fixation product was discovered in photosynthesis of
(Mains 2010)

Options:

A. bryophyte

B. gymnosperm

C. angiosperm

D. alga

Answer: D

Solution:

Solution:
(d) : Calvin, Benson and their colleagues in California, U.S.A. fed Chlorella and Scenedesmus with radioactive ^{14}C in carbon dioxide. Radioactive carbon, ^{14}C has a half life of 5568 years. Therefore, the path of CO_2 fixation can be easily traced with its help. Algal suspension, illuminated and carrying out photosynthesis with normal carbon dioxide, was supplied $^{14}CO_2$. The alga was killed at intervals in near boiling methanol. It immediately stopped photosynthesis activity due to denaturation of enzymes. Alcohol was evaporated and after crushing the alga, the product was made into paste. The paste was placed on paper chromatogram and the different compounds were separated by two dimensional chromatography. The radioactive compounds were identified by comparing their position on the chromatogram with standard chemicals. Calvin and co-workers found that after three seconds, radioactivity appeared in phosphoglyceric acid or PGA. Phosphoglyceric acid is, therefore, the first stable product of photosynthesis.

Question42

C_4 plants are more efficient in photosynthesis than C_3 plants due to
(2010)

Options:

A. higher leaf area

B. presence of larger number of chloroplasts in the leaf cells

C. presence of thin cuticle

D. lower rate of photorespiration.

Answer: D

Solution:

(d) : Rate of net photosynthesis in C_3 plants is $15 - 35 mg\ CO_2$ / $d\ m^2$ / hr while in C_4 plants it $40 - 80 mg\ CO_2$ / $d\ m^2$ / hr. This variation in rate is due to photorespiration. Photorespiration is an inhibitory process which decreases the rate of photosynthesis. In excess of oxygen RuBP carboxylase converts to RuBP oxygenase. As a result glycolate synthesis is enhanced and leads to begin photorespiration. Photorespiration is negligible or absent in C_4 plants and present only in C_3 plants. So C_4 plants are photosynthetically more efficient.

Question43

Read the following four statements, (i), (ii), (iii) and (iv) and select the right option having both correct statements.
Statements :
(i) Z scheme of light reaction takes place in presence of PSI only.
(ii) Only PSI is functional in cyclic photophosphorylation.
(iii) Cyclic photophosphorylation results into synthesis of ATP and NADPH $_2$.
(iv) Stroma lamellae lack PSII as well as NADP.
(Mains 2010)

Options:

A. (ii) and (iv)

B. (i) and (ii)

C. (ii) and (iii)

D. (iii) and (iv)

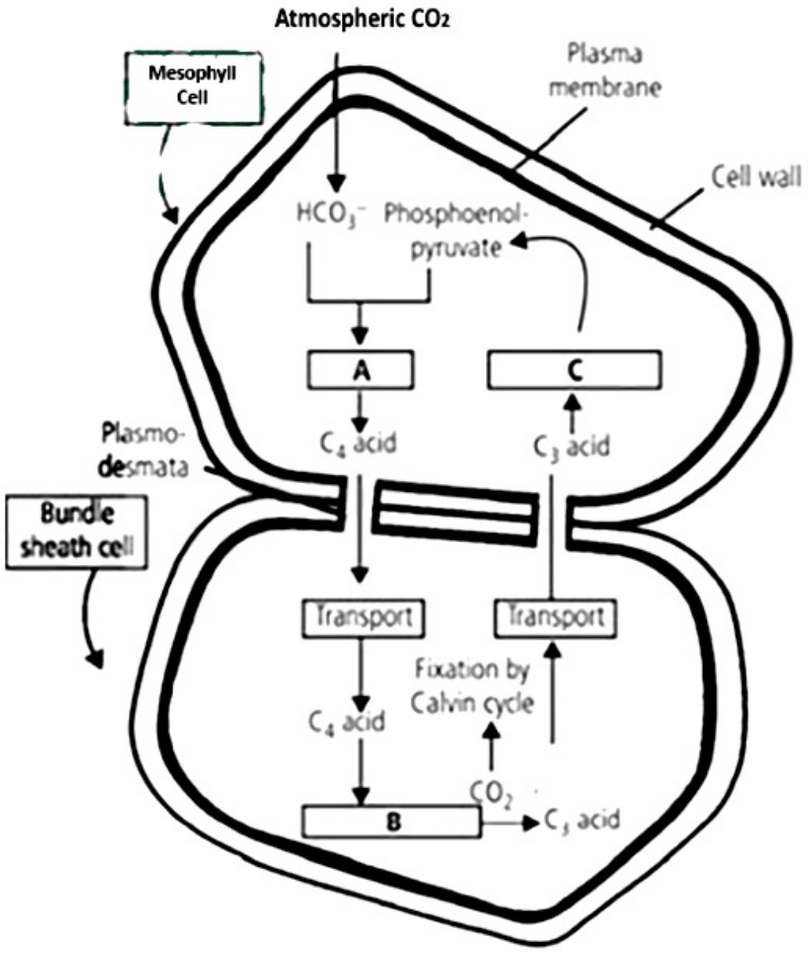
Answer: A

Solution:

Solution:
(a) : Z scheme involves both PSI and PSII to transfer electron excited by light starting from PSII uphill to the acceptor, down to the electron transport chain to PSI, which further comprise of excitation of electrons, transfer to another acceptor and finally down hill to $NADP^+$ causing reduction of it to $NADPH + H^+$. Stroma lamella contains PSI only.

Question44

Study the pathway given below: In which of the following options correct words for all the three blanks A, B and C are indicated?



	A	B	C
(a)	Decarboxylation	Reduction	Regeneration
(b)	Fixation	Transamination	Regeneration
(c)	Fixation	Decarboxylation	Regeneration
(d)	Carboxylation	Decarboxylation	Reduction

(Mains 2010)

Options:

A. (a)

B. (b)

C. (c)

D. (d)

Answer: C

Solution:

Solution:
(c) : A - Fixation of CO_2 by PEP carboxylase
B – Decarboxylation
C – Regeneration

Question45

Kranz anatomy is one of the characteristics of the leaves of (Mains 2010)

Options:

A. potato

B. wheat

C. sugarcane

D. mustard.

Answer: C

Solution:

Solution:
(c) : In kranz anatomy, the mesophyll is undifferentiated and its cells occur in concentric layers around vascular bundles. Vascular bundles are surrounded by large sized bundle sheath cells which are arranged in a wreath-like manner in one to several layers. C_4 plants, both monocots and dicots, such as sugarcane, maize, sorghum have kranz anatomy in leaf.

Question46

Cyclic photophosphorylation results in the formation of (2009)

Options:

A. ATP and NADPH

B. ATP, NADPH and O_2

C. ATP

D. NADPH

Answer: C

Solution:

(c) : In cyclic photophosphorylation, 2 molecules of ATP are synthesised which are used in dark reaction. Cyclic photophosphorylation is not concerned with photolysis of water. So O_2 is not evolved and NADPH is also not produced.

Question47

Stroma in the chloroplasts of higher plant contains (2009)

Options:

A. light-dependent reaction enzymes

B. ribosomes

C. chlorophyll

D. light-independent reaction enzymes

Answer: D

Solution:

Solution:
(d) : The dark reactions of photosynthesis is purely enzymatic and slower than the primary photochemical reaction. It takes place in stroma portion of the chloroplast and is independent of light i.e., it can occur either in presence or in absence of light provided that assimilatory power is available.

Question48

Electrons from excited chlorophyll molecule of photosystem II are accepted first by (2008)

Options:

A. quinone

B. ferredoxin

C. cytochrome- b

D. cytochrome-f.

Answer: A

Solution:

(a) : The electrons released during photolysis of water are picked up by P_{680} photocentre of photosystem II. The electron extruded by the photocentre of photosystem II picked up by the quencher phaeophytin. From here the electron passes over a series of carriers in a downhill journey losing its energy at every step. The major carriers are plastoquinone (PQ), cytochrome $b-f$ complex and plastocyanin (PC). While passing over cytochrome complex, the electron loses sufficient energy for the creation of proton gradient and synthesis of ATP from ADP and inorganic phosphate. The process is called photophosphorylation (noncyclic).

Question49

The C_4 plants are photosynthetically more efficient than C_3 plants because
(2008)

Options:

A. the CO_2 efflux is not prevented

B. they have more chloroplasts

C. the CO_2 compensation point is more

D. CO_2 generated during photorespiration is trapped and recycled through PEP carboxylase

Answer: B

Solution:

Solution:
(b) : C_4 plants are photosynthetically more efficient than C_3 plants because C_4 plant contain two types of chloroplast i.e., bundle sheath chloroplast and mesophyll chloroplast. So such plants operate a dicarboxylic acid cycle in addition to Calvin cycle. CO_2 acceptor molecule (PEP) is present in large bundle sheath cell which has higher efficiency in picking up CO_2. Thus, photosynthesis continues even at low CO_2 concentration and the rate of photorespiration is also negligible.

Question50

In leaves of C_4 plants malic acid synthesis during CO_2 fixation occurs in
(2008)

Options:

A. bundle sheath

B. guard cells

C. epidermal cells

D. mesophyll cells

Answer: D

Solution:

Solution:
(d) : C_4 plants show kranz anatomy i.e. the mesophyll is undifferentiated and its cells occur in concentric layers around vascular bundle, which is surrounded by large sized bundle sheath cells, in a wreath like manner. In this type of plants, the initial fixation of CO_2 occur in mesophyll cell. The primary acceptor (phosphoenol pyruvate) combines with CO_2 to form oxaloacetic acid which later reduces to malic acid. Malic acid is then translocated to bundle sheath cell for further decarboxylation.

Question51

In the leaves of C_4 plants, malic acid formation during CO_2 fixation occurs in the cells of
(2007)

Options:

A. bundle sheath

B. phloem

C. epidermis

D. mesophyll

Answer: D

Solution:

Solution:
(d) In C_4 plants, C_4 cycle occurs in mesophyll cells and C_3 - cycle occurs in bundle sheath cells.

Question52

The first acceptor of electrons from an excited chlorophyll molecule of photosystem II is
(2007)

Options:

A. iron-sulphur protein

B. ferredoxin

C. quinone

D. cytochrome

Answer: C

Solution:

(c) : Type I photosystems use ferredoxin like iron-sulphur cluster proteins as terminal electron acceptors, while type II photosystems ultimately shuttle electrons to a quinone terminal electron acceptor. One has to note that both reaction centres types are present in chloroplasts of plants and cyanobacteria, working together to form an unique photosynthetic chain able to extract electrons from water, evolving oxygen as a byproduct.

Question53

During photorespiration, the oxygen consuming reaction(s) occur in (2006)

Options:

A. stroma of chloroplasts

B. stroma of chloroplasts and mitochondria

C. stroma of chloroplasts and peroxisomes

D. grana of chloroplasts and peroxisomes

Answer: C

Solution:

Solution:
(c) Photorespiration is the process which occurs in C_3 plants. In this process, peroxisomes, chloroplast and mitochondria take part. The oxygen consuming reactions occurs in peroxisomes and stroma of chloroplast while CO_2 releasing reaction occurs in mitochondria.

Question54

In photosystem I, the first electron acceptor is (2006)

Options:

A. an iron-sulphur protein

B. ferredoxin

C. cytochrome

D. plastocyanin

Answer: B

Solution:

Solution:
PSI passes electron to ferredoxin on stromal side of lumen. Ferredoxin (iron sulfur protein) receives electrons from PSI and reduces to NADP+ to form NADPH. This light reaction is catalyzed by the membrane-bound enzyme NADP reductase. Both A and B are correct answers.

In light reaction of photosynthesis two types of photosystems are involved. PS-I consists of plenty of chlorophyll-a and very less quantity of chlorophyll- b. These pigments absorb light energy and transfer it to the reaction centre - P-700. After absorbing adequate amount of light energy electron gets excited from P-700 molecule and moves to iron-sulphur protein complex, designated as A (Fe-S). It gets reduced after accepting electrons. It later gives these electron to ferredoxin and gets oxidized again.

Question55

As compared to a C_3 -plant, how many additional molecules of ATP are needed for net production of one molecule of hexose sugar by C_4 -plants?
(2006)

Options:

A. Two

B. Six

C. Twelve

D. Zero

Answer: C

Solution:

Solution:
(c) In C_4 plants every CO_2 molecule has to be fixed twice, so these plants are needed more energy for the synthesis of hexose sugar molecules than C_3 plants in which CO_2 has to be fixed only once. 18 ATP molecules are required by C_3 plants for the synthesis of one molecule of hexose sugar while 30 ATP molecules are needed by the C_4 plants for the same. Thus C_4 plants have a need of 12 ATP molecules extra than C_3 plants for the synthesis of one molecule of hexose sugar.

Question56

Photosynthetic Active Radiation (PAR) has the following range of

wavelengths.
(2006)

Options:

A. 340 − 450nm

B. 400 − 700nm

C. 500 − 600nm

D. 450 − 950nm

Answer: B

Solution:

Solution:
(b) : Wavelengths between 400 and 700nm which comprise the visible range of electromagnetic spectrum are capable of causing photosynthesis. These are called photosynthetically active radiations. Chlorophyll a and b absorb too much light in the blue and red region of spectrum of light. Carotenoids mostly absorb is the blue region of the spectrum.

Question57

Photosynthesis in C_4 plants is relatively less limited by atmospheric CO_2 levels because
(2005)

Options:

A. effective pumping of CO_2 into bundle sheath cells

B. RuBisCo in C_4 plants has higher affinity for CO_2

C. four carbon acids are the primary initial CO_2 fixation products

D. the primary fixation of CO_2 is mediated via PEP carboxylase

Answer: D

Solution:

Solution:
(d) In C_4 plants, initial fixation of carbon dioxide occurs in mesophyll cells. The primary acceptor of CO_2 is phosphoenol pyruvate or PEP. It combines with carbon dioxide in the presence of PEP carboxylase to form oxaloacetate.
C_4 plants are more efficient in picking up CO_2 even when it is found in low concentration because of the high affinity of PEP case.

Question58

In C_3 plants, the first stable product of photosynthesis during the dark reaction is
(2004)

Options:

A. malic acid

B. oxaloacetic acid

C. 3-phosphoglyceric acid

D. phosphoglyceraldehyde

Answer: C

Solution:

(c) : The Calvin cycle is also known as C_3 cycle because CO_2 reduction is cyclic process and first stable product in this cycle is a 3 - C compound (i.e., 3 -phosphoglyceric acid or 3 -PGA).
In this cycle, CO_2 acceptor molecule is RuBP or RuDP (i.e., Ribulose 1, 5-biphosphate or Ribulose 1, 5 -diphosphate).
There occurs covalent bonding of CO_2 to RuBP and the enzyme catalyzing this reaction is RuBP-carboxylase\/oxygenase (RuBisCO).

Question59

Plants adapted to low light intensity have
(2004)

Options:

A. larger photosynthetic unit size than the sun plants

B. higher rate of CO_2 fixation than the sun plants

C. more extended root system

D. leaves modified to spines

Answer: A

Solution:

Solution:
35. (a) : To absorb more sunlight (quantitatively), the plants growing in low light conditions have larger photosynthetic unit size. It means that they have more number of chlorophyll molecules per reaction center. to trap more light energy available to them.

Question60

Which fractions of the visible spectrum of solar radiations are primarily absorbed by carotenoids of the higher plants? (2003)

Options:

A. Blue and green

B. Green and red

C. Red and violet

D. Violet and blue

Answer: D

Solution:

Solution:
(d) : Carotenoids of higher plants are fat soluble compound that includes carotenes and xanthophylls. Most of them absorb light of violet and blue range. Green light is absorbed in less amount.

Question61

Which one of the following is wrong in relation to photorespiration? (2003)

Options:

A. It occurs in chloroplast

B. It occurs in day time only

C. It is a characteristic of C_4 plants

D. It is a characteristic of C_3 plants

Answer: C

Solution:

Solution:
(c) : Photorespiration is the light dependent process of oxygenation of ribulose biphosphate (RuBP) and release of carbon dioxide by the photosynthetic organs of a plant. It leads to oxidation of considerable amount of photosynthetic products to CO_2 and H_2O without the production of useful energy. Photorespiration occurs only in C_3 plants because at high temperature and high oxygen concentration RuBP carboxylase changes to RuBP oxygenase. Photorespiration is absent in C_4 plants. Peroxisome and mitochondria are required for completing the process.

Question62

In sugarcane plant $^{14}CO_2$ is fixed to malic acid, in which the enzyme that fixes CO_2 is
(2003)

Options:

A. ribulose biphosphate carboxylase

B. phosphoenol pyruvic acid carboxylase

C. ribulose phosphate kinase

D. fructose phosphatase

Answer: B

Solution:

Solution:
(b) : Sugarcane is a C_4 plant in which CO_2 is fixed in malic acid by the enzyme phosphoenol pyruvic acid carboxylase present in mesophyll cells.

Question63

Stomata of CAM plants
(2003)

Options:

A. are always open

B. open during the day and close at night

C. open during the night and close during the day

D. never open

Answer: C

Solution:

Solution:
(c) : Stomata of most plants open at sunrise and close in darkness to allow the entry of CO_2 needed for photosynthesis during the daytime. Certain succulents that are native to hot, dry conditions (e.g., cacti, Kalanchoe, and Bryophyllum) act in an opposite manner. They open their stomata at night, fix carbon dioxide into organic acids in the dark, and close their stomata during the day. This is an appropriate way to absorb CO_2 through open stomata at night, when transpiration stress is low, and conserve water during the heat of the day. These plants show Crassulacean Acid Metabolism (CAM).

Question64

Which element is located at the centre of the porphyrin ring in chlorophyll?
(2003)

Options:

A. Calcium

B. Magnesium

C. Potassium

D. Manganese

Answer: B

Solution:

Solution:
(b) : Chlorophyll is the green pigment present in plants and some photosynthetic bacteria. The empirical formula of chlorophyll-a molecule is $C_{55}H_{72}O_5N_4Mg$. It consist of a porphyrin head and a phytol tail. Porphyrin is a cyclic tetrapyrrole structure, having a magnesium atom in the centre. Tail consists of phytol alcohol and it is attached with one of the pyrrole rings.

Question65

Which one of the following concerns photophosphorylation ?
(2003)

Options:

A. $ADP + AMP \xrightarrow{\text{Light energy}} ATP$

B. $ADP + \text{Inorganic } PO_4 \xrightarrow{\text{Light energy}} ATP$

C. $ADP + \text{Inorganic } PO_4 \longrightarrow ATP$

D. $AMP + \text{Inorganic } PO_4 \xrightarrow{\text{Light energy}} ATP$

Answer: B

Solution:

Solution:
(b) : The light dependent production of ATP from ADP + Pi in the chloroplasts is called photophosphorylation.

Photophosphorylation is of 2 types_
Cyclic photophosphorylation - It involves only PS-I, water is not utilized and so no oxygen is evolved. Here two ATP molecules are produced.
Non-cyclic photophosphorylation - It involves both PS-I and PS-II, water is utilized and so oxygen is evolved. Here one ATP molecule and one $NADPH_2$ molecule are produced.

Question66

Which of the following absorb light energy for photosynthesis? (2002)

Options:

A. Chlorophyll

B. Water molecule

C. O_2

D. RuBP

Answer: A

Solution:

Solution:
(a) : Photosynthesis occurs in chloroplasts that contain photosynthetic pigments - chlorophylls, carotenoids etc. The light energy required for photosynthesis comes from sunlight. The sunlight travels in the form of small particles called photons. Each photon has a quantum of energy. This quantum of energy is absorbed by a single antenna chlorophyll and then migrates from one molecule to the other till it reaches the reaction center of photosystems. The reaction center is also P_{700} chlorophyll molecule that releases electron as a result of transferred energy. This electron is transferred between various acceptors and generates ATP and $NADPH_2$ in the light reaction of photosynthesis.

Question67

In photosynthesis energy from light reaction to dark reaction is transferred in the form of (2002)

Options:

A. ADP

B. ATP

C. RuDP

D. chlorophyll

Answer: B

Solution:

(b) : Photosynthesis consists of light dependent phase and light independent phase or dark reaction. Light dependent phase occurs in grana fraction of chloroplast. It involves cyclic and non-cyclic photophosphorylation where assimilatory powers (ATP and NADPH $_2$) are produced. In dark reaction, which occurs in stroma fraction of chloroplast, actual reduction of CO_2 to carbohydrates takes place using the assimilatory powers (ATP and NADPH $_2$ produced in the light dependent phase. It needs 18 ATP and 12 NADPH $_2$ molecules to produce one molecule of glucose.

Question68

Which pigment absorbs the red and far-red light? (2002)

Options:

A. Cytochrome

B. Phytochrome

C. Carotenoids

D. Chlorophyll

Answer: B

Solution:

Solution:
(b) : Phytochrome has a light absorbing or light detecting portion (the chromophore) attached to small protein of about 1,24,000 daltons. Phytochrome occurs in 2 forms, i.e. P_R and P_{FR} (i.e., red light and far red light absorbing forms) and these 2 forms are interconvertible. Cytochromes are electron transferring proteins. They contain iron porphyrin or copper porphyrin as prosthetic groups. Chlorophyll is the fundamental green pigment of photosynthesis. It is localized in the chloroplasts. Carotenoids are lipid compounds and they are yellow, orange, purple etc. in colour. These are found in higher plants red algae, green algae, fungi and photosynthetic bacteria.

Question69

What is true for photolithotrophs? (2001)

Options:

A. Obtain energy from radiations and hydrogen from organic compounds

B. Obtain energy from radiations and hydrogen from inorganic compounds

C. Obtain energy from organic compounds

D. Obtain energy from inorganic compounds

Answer: B

Solution:

(b) : Photolithotrophs are those plants that obtain energy from radiation and hydrogen from inorganic compounds.

Question70

Which pigment system is inactivated in red drop? (2001)

Options:

A. PS-I and PS-II

B. PS − I

C. PS-II

D. None of the above

Answer: C

Solution:

Solution:
(c) : Emerson and Lewis worked on Chlorella and calculated the quantum yield for different wavelengths. Emerson observed that rate of photosynthesis declines in the red region of the spectrum. This decline in photosynthesis is called "Red drop". It was observed that the quantum yield falls when the light of wavelengths more than 680 or 690 nm are supplied. As the PS-II P_{680} is driven by red light, so it remains inactive during red drop.

Question71

Which pair is wrong? (2001)

Options:

A. C_3 -maize

B. C_4 -kranz anatomy

C. Calvin cycle-PGA

D. Hatch and Slack cycle - OAA

Answer: A

Solution:

(a) : C_4 pathway was first reported in members of family Gramineae (grasses) like sugarcane, maize, sorghum, etc. In C_4 plants PEPCo (PEP carboxylase) is the key enzyme used to fix CO_2 in C_4 plants. Oxaloacetic acid is a 4 -C compound and is the first stable product so this pathway is known as C_4 cycle.

Question72

For assimilation of one CO_2 molecule, the energy required in form of ATP and NADPH $_2$ are
(2001)

Options:

A. 2 ATR and 2N ADPH $_2$

B. 5 ATP and 3N ADPH $_2$

C. 3 ATP and 2 NADPH $_2$

D. 18 ATP and 12 NADPH $_2$

Answer: C

Solution:

Solution:
(c) : Photosynthesis is actually oxidation reduction process in which water is oxidised and CO_2 is reduced to carbohydrates. The reduction of CO_2 to carbohydrates needs assimilatory powers, i.e., ATP and NADPH $_2$. The process of photosynthesis involves two steps-
(i) Light dependent phase or photochemical reaction.
(ii) Light independent phase or dark reaction.
In Calvin cycle, CO_2 acceptor molecule is $RuBP$ or RuBP. The enzyme catalyzing this reaction is RuBPcarboxylase\/oxygenase (RuBisCO). As Calvin cycle takes in only one carbon (as CO_2) at a time, so it takes six turns of the cycle to produce a net gain of six carbons (i.e., hexose or glucose). In this cycle, for formation of one mole of hexose sugar (Glucose), 18 ATP and 12 NADPH $_2$ are used. For 6 molecules of CO_2 it needs 18 ATP and 12 NADPH molecules so for assimilation of one molecule of CO_2 it needs 3 ATP and 2 NADPH $_2$ molecules.

Question73

For the synthesis of one glucose molecule the Calvin cycle operates for
(2001)

Options:

A. 2 times

B. 4 times

C. 6 times

D. 8 times

Answer: C

Solution:

(c) : Photosynthesis is actually oxidation reduction process in which water is oxidised and CO_2 is reduced to carbohydrates. The reduction of CO_2 to carbohydrates needs assimilatory powers, i.e., ATP and NADPH $_2$. The process of photosynthesis involves two steps-
(i) Light dependent phase or photochemical reaction.
(ii) Light independent phase or dark reaction.
In Calvin cycle, CO_2 acceptor molecule is $RuBP$ or RuBP. The enzyme catalyzing this reaction is RuBPcarboxylase\/oxygenase (RuBisCO). As Calvin cycle takes in only one carbon (as CO_2) at a time, so it takes six turns of the cycle to produce a net gain of six carbons (i.e., hexose or glucose). In this cycle, for formation of one mole of hexose sugar (Glucose), 18 ATP and 12 NADPH $_2$ are used. For 6 molecules of CO_2 it needs 18 ATP and 12 NADPH molecules so for assimilation of one molecule of CO_2 it needs 3 ATP and 2 NADPH $_2$ molecules.

Question74

The first step for initiation of photosynthesis will be (2001)

Options:

A. photolysis of water

B. excitement of chlorophyll molecules due to absorption of light

C. ATP formation

D. glucose formation

Answer: B

Solution:

Solution:
(b) : The process of photosynthesis involves two steps-
(i) Light dependent phase or photochemical reaction.
(ii) Light independent these or dark reaction. Light reaction occurs in grana fraction of chloroplast and in this reaction are included those activities, which are dependent on light. The grana of chloroplasts contains many collaborating molecules of pigment. A quantum of light is absorbed by a single antenna chlorophyll, then it migrates from one molecule to the other till it reaches the reaction center. This quantum of light is used for generating ATP and NADPH, which is later consumed in dark reactions produce sugars by fixing CO_2, molecules.

Question75

Which is the first CO_2 acceptor enzyme in C_4 plants?

(2000)

Options:

A. RuDP carboxylase

B. Phosphoric acid

C. RuBisCO

D. PEP- carboxylase

Answer: D

Solution:

Solution:
(d) : C_4 pathway was first reported in members of family Gramineae (grasses) like sugarcane, maize, sorghum, etc. In C_4 plants PEPCo (PEP carboxylase) is the key enzyme used to fix CO_2 in C_4 plants. Oxaloacetic acid is a 4 -C compound and is the first stable product so this pathway is known as C_4 cycle.

Question76

Carbon dioxide acceptor in C_3 -plants is (1999)

Options:

A. PGA

B. PEP

C. RuDP

D. none of these

Answer: C

Solution:

(c) : An enzyme ribulose biphosphate carboxylase catalyses the dark reaction, pertaining to the addition of CO_2 to Ribulose- $1-5$ -diphosphate. It is found in abundance in leaves and it is believed that it is the single most abundant protein on earth. It is clear that the first acceptor of CO_2 is Ribulose $1-5$ diphosphate and the first product formed after fixation of CO_2 is 3 -phosphoglyceric acid.

Question77

The rate of photosynthesis is higher in (1999)

Options:

A. very high light

B. continuous light

C. red light

D. green light

Answer: C

Solution:

Solution:
(c) : Plants can use a small portion of light which falls upon them. Chlorophyll-a and chlorophyll- b absorb too much light in the blue and red region. Carotenoids absorb light mostly in the blue region of spectrum of light. In monochromatic lights, maximum photosynthesis occurs in red light, followed by blue light and poor photosynthesis in green light. Under very high light intensity solarization phenomenon occurs. It involves photooxidation of different cellular components including chlorophyll.

Question78

Chlorophyll a molecule at its carbon atom 3 of the pyrrole ring II has one of the following
(1997)

Options:

A. carboxylic group

B. magnesium

C. aldehyde group

D. methyl group

Answer: D

Solution:

Solution:
(d) : The empirical formula of chlorophyll a molecule is $C_{55}H_{72}O_5N_4Mg$. It has tadpole like configuration. It consists of a porphyrin head and a phytol tail. Porphyrin is a cyclic tetrapyrol structure, having a magnesium atom in the centre. In chlorophyll a, a methyl group (CH_3) is attached to the third carbon in the porphyrin head.

Question79

The core metal of chlorophyll is (1997)

Options:

A. Ni

B. Cu

C. F e

D. Mg

Answer: D

Solution:

Solution:
(d) : The empirical formula of chlorophyll a molecule is $C_{55}H_{72}O_5N_4Mg$. It has tadpole like configuration. It consists of a porphyrin head and a phytol tail. Porphyrin is a cyclic tetrapyrol structure, having a magnesium atom in the centre. In chlorophyll a, a methyl group (CH_3) is attached to the third carbon in the porphyrin head.

Question80

$NADPH_2$ is generated through (1997)

Options:

A. photosystem II

B. anaerobic respiration

C. glycolysis

D. photosystem I

Answer: D

Solution:

Solution:
(d) : Non-cyclic photophosphorylation involves both PS-I and PS-II. Here electrons are not cycled back and are used in the reduction of NADP to $NADPH_2$. The electrons generated by PSII are passed over a series of electron carriers in a downhill journey and handed over to reaction centre of PSI. PSI again passes the electrons to $NADP^+$ which combines with H^+ ions to form NADPH.

Question81

'The law of limiting factors' was proposed by (1996)

Options:

A. Leibig

B. Hatch and Slack

C. Blackman

D. Arnon

Answer: C

Solution:

Solution:
(c) : Blackman (1905) gave the law of limiting factors which states that when a process is conditioned as to its rapidity by a number of separate factors, the rate of the process is limited by the pace of the slowest process. It is the factor which is present in minimum amount.

Question82

What will be the number of Calvin cycles to generate one molecule of hexose? (1996)

Options:

A. 8

B. 9

C. 4

D. 6

Answer: D

Solution:

Solution:
(c) : Photosynthesis is actually oxidation reduction process in which water is oxidised and CO_2 is reduced to carbohydrates. The reduction of CO_2 to carbohydrates needs assimilatory powers, i.e., ATP and NADPH $_2$. The process of photosynthesis involves two steps-
(i) Light dependent phase or photochemical reaction.
(ii) Light independent phase or dark reaction. In Calvin cycle, CO_2 acceptor molecule is RuBP or RuBP. The enzyme catalyzing this reaction is RuBPcarboxylase\/oxygenase (RuBisCO). As Calvin cycle takes in only one carbon (as CO_2) at a time, so it takes six turns of the cycle to produce a net gain of six carbons ($\mathrm{i.e.}$, hexose or glucose). In this cycle, for formation of one mole of hexose sugar (Glucose), 18 ATP and 12 NADPH $_2$ are used. For 6 molecules of CO_2 it needs 18 ATP and 12 NADPH molecules so for assimilation of one molecule of CO_2 it needs 3 ATP and 2 NADPH $_2$ molecules.

Question83

Photorespiration is favoured by (1996)

Options:

A. high temperature and low O_2

B. high humidity and temperature

C. high O_2 and low CO_2

D. high CO_2 and low O_2

Answer: C

Solution:

Solution:
(c) : Photorespiration is the light dependent process of oxygenation of ribulose biphosphate (RuBP) and release of carbon dioxide by the photosynthetic organs of a plant. It leads to oxidation of considerable amount of photosynthetic products to CO_2 and H_2O without the production of useful energy. Photorespiration occurs only in C_3 plants because at high temperature and high oxygen concentration RuBP carboxylase changes to RuBP oxygenise. Photorespiration is absent in C_4 plants. Peroxisome and mitochondria are required for completing the process.

Question84

In C_4 plants, CO_2 combines with (1996)

Options:

A. phosphoenol pyruvate

B. phosphoglyceraldehyde

C. phosphoglyceric acid

D. ribulose diphosphate.

Answer: A

Solution:

(a) : C_4 pathway was first reported in members of family Gramineae (grasses) like sugarcane, maize, sorghum, etc. In C_4 plants PE PCo (PEP carboxylase) is the key enzyme used to fix CO_2 in C_4 plants. Oxaloacetic acid is a 4-C compound and is the first stable product so this pathway is known as C_4 cycle.

Question85

In C_4 plants, CO_2 fixation is done by (1996)

Options:

A. sclerenchyma

B. chlorenchyma and hypodermis

C. mesophyll cells

D. guard cells

Answer: C

Solution:

Solution:
(c) : The C_4 plants have a characteristic leaf anatomy called kranz anatomy. Here two types of chloroplasts are present - bundle sheath chloroplasts and mesophyll chloroplasts. In C_4 plants, there are two carboxylation reactions which occur first in mesophyll chloroplasts and then in bundle sheath chloroplasts. CO_2 acceptor molecule in mesophyll chloroplasts is PEP (Phospho-enol pyruvate) and not Ribulose 1 , 5-biphosphate. Further it has enzyme PEPcarboxylase for initial CO_2 fixation. RuBP carboxylase is absent in mesophyll chloroplasts but is present in bundle sheath chloroplasts. The first product formed is oxaloacetic acid and hence it is known as C_4 cycle. Bundle sheath cells fix CO_2 through C_3 cycle.

Question86

The primary acceptor, during CO_2. fixation in C_3 plants, is (1995)

Options:

A. phosphoenolpyruvate (PEP)

B. ribulose 1,5 -diphosphate (RuDP)

C. phosphoglyceric acid (PGA)

D. ribulose monophosphate (RMP)

Answer: B

Solution:

(b) : The Calvin cycle is also known as C_3 cycle because CO_2 reduction is cyclic process and first stable product in this

cycle is a 3 -C compound (i.e., 3 -phosphoglyceric acid or 3 -PGA). In this cycle, CO_2 acceptor molecule is RuBP or RuDP (i.e., Ribulose 1, 5-biphosphate or Ribulose 1, 5 -diphosphate). There occurs covalent bonding of CO_2 to RuBP and the enzyme catalyzing this reaction is RuBP-carboxylase\/oxygenase (RuBisCO).

Question87

The CO_2 fixation during C_4 pathway occurs in the chloroplast of (1995)

Options:

A. guard eells

B. bundle sheath cells

C. mesophyll cells

D. spongy parenchyma.

Answer: C

Solution:

Solution:
(c) : The C_4 plants have a characteristic leaf anatomy called kranz anatomy. Here two types of chloroplasts are present - bundle sheath chloroplasts and mesophyll chloroplasts. In C_4 plants, there are two carboxylation reactions which occur first in mesophyll chloroplasts and then in bundle sheath chloroplasts. CO_2 acceptor molecule in mesophyll chloroplasts is PEP (Phospho-enol pyruvate) and not Ribulose 1 , 5-biphosphate. Further it has enzyme PEPcarboxylase for initial CO_2 fixation. RuBP carboxylase is absent in mesophyll chloroplasts but is present in bundle sheath chloroplasts. The first product formed is oxaloacetic acid and hence it is known as C_4 cycle. Bundle sheath cells fix CO_2 through C_3 cycle.

Question88

Which of the following pigments acts as a reaction-centre during photosynthesis? (1994)

Options:

A. Carotene

B. Phytochrome

C. P_{700}

D. Cytochrome

Answer: C

Solution:

(c) : During photosynthesis a portion of light energy absorbed by chlorophyll and carotenoids is eventually stored as chemical energy via the formation of chemical bonds. This conversion of energy from one form to another is a complex process that depends on cooperation between many pigment molecules and a group of electron transfer proteins. The majority of pigments serve as an antenna complex, collecting light and transfusing energy to the reaction center complex. There are two photochemical complexes, known as photosystem I and II. PSII absorbs far red light of wavelengths greater than 680 nm and PSI absorbs red light of wavelengths greater than 700 nm. Both these complexes are involved in light reactions of photosynthesis.

Question89

During light reaction of photosynthesis, which of the following phenomenon is observed during cyclic phosphorylation as well as non-cyclic phosphorylation?
(1994)

Options:

A. Release of O_2

B. Formation of ATP

C. Formation of NADPH

D. Involvement of PS I and PS II pigment systems

Answer: B

Solution:

(b) : The light dependent production of ATP from ADP + Pi in the chloroplasts is called photophosphorylation. Photophosphorylation is of 2 types_
Cyclic photophosphorylation - It involves only PS-I, water is not utilized and so no oxygen is evolved. Here two ATP molecules are produced.
Non-cyclic photophosphorylation - It involves both PS-I and PS-II, water is utilized and so oxygen is evolved. Here one ATP molecule and one NADPH $_2$ molecule are produced.

Question90

A photosynthesising plant is releasing ^{18}O more than the normal. The plant must have been supplied with
(1993)

Options:

A. O_3

B. H_2O with ^{18}O

C. CO_2 with ^{18}O

D. $C_6H_{12}O_6$ with ^{18}O

Answer: B

Solution:

Solution:
(b) : Water molecule breaks up into hydrogen and oxygen in the illuminated chloroplasts. This is called photolysis of water. If a photosynthesising plant is releasing ^{18}O more than the normal, the plant must have been supplied with H_2O with ^{18}O.

Question91

Maximum solar energy is trapped by (1993)

Options:

A. planting trees

B. cultivating crops

C. growing algae in tanks

D. growing grasses

Answer: C

Solution:

Solution:
(c) : Maximum solar energy is trapped by growing algae in tanks. The light spectrum of red and blue light are most effective in performing photosynthesis for growing algae.

Question92

The carbon dioxide acceptor in Calvin cycle/ C_3 -plants is (1993)

Options:

A. phosphoenol pyruvate (PEP)

B. ribulose 1,5 -diphosphate (RuDP)

C. phosphoglyceric acid (PGA)

D. ribulose monophosphate (RMP)

Answer: B

Solution:

(b) : In Calvin cycle, CO_2 is accepted by Ribulose -1,5 - diphosphate (RuDP) already present in the cells and a 6 -carbon addition compound is formed which is unstable. It soon gets converted into 2 molecules of 3 -phosphoglyceric acid due to hydrolysis and dismutation. Phosphoenol pyruvate (PEP) and Phosphoglyceric acid (PGA) are formed in glycolysis.

Question93

Which one is a C_4 -plant?
(1993)

Options:

A. Papaya

B. Pea

C. Potato

D. Maize/corn

Answer: D

Solution:

Plants exhibiting characteristic kranz anatomy are C_4 plants. Spatial separation of carbon dioxide fixation and RUBISCO activity in mesophyll and bundle sheath cells of C_4 plants respectively avoids photorespiration by concentrating CO_2 in bundle sheath cells to scale down the oxygenase activity of RUBISCO and increase the RUBISCO efficiency. Maize is C_4 plant while papaya, peas, potato are C_3 plants. So, the correct answer is option D

Question94

Chlorophyll a occurs in
(1992)

Options:

A. all photosynthetic autotrophs

B. in all higher plants

C. all oxygen liberating autotrophs

D. all plants except fungi.

Answer: C

Solution:

(c) : Chlorophyll-a occur in all photosynthesizing plants except bacteria. Chlorophyll- a is the only one common to all organisms that possess chlorophyll (the only one in blue green algae) and is believed to be specifically required. In a few photosynthetic bacteria other kinds of chlorophyll, bacteriochlorophylls, occur.

Question95

Photosystem II occurs in (1992)

Options:

A. stroma

B. cytochrome

C. grana

D. mitochondrial surface.

Answer: C

Solution:

Solution:
71. (c) : Photosystem II has almost equal number of chlorophyll a and chlorophyll b molecules. It is dark green in colour and located mostly in the appressed parts of grana thylakoids towards the inner surface of membranes.

Question96

The enzyme that catalyses carbon dioxide fixation in C_4 plants is (1992)

Options:

A. RuBP carboxylase

B. PEP carboxylase

C. carbonic anhydrase

D. carboxydismutase.

Answer: B

Solution:

Solution:
(b) : C_4 pathway was first reported in members of family Gramineae (grasses) like sugarcane, maize, sorghum, etc. In C_4 plants PE PCo (PEP carboxylase) is the key enzyme used to fix CO_2 in C_4 plants. Oxaloacetic acid is a 4-C compound and is the first stable product so this pathway is known as C_4 cycle.

Question97

The first carbon dioxide acceptor in C_4 -plants is (1992, 1990)

Options:

A. phosphoenol-pyruvate

B. ribulose 1,5 -diphosphate

C. oxaloacetic acid

D. phosphoglyceric acid.

Answer: A

Solution:

Solution:
(a) : The primary acceptor of CO_2, is a 3 carbon compound phosphoenol pyruvic acid. Addition of CO_2 to any compound is called carboxylation. In C_4 cycle, CO_2 combines with phosphoenol pyruvic acid to form oxaloacetic acid, with the help of enzyme phosphoenol pyruvate carboxylase (PEPCo). The oxaloacetic acid breaks up into pyruvic acid and CO_2 which combines with RuBP to form PGA as in Calvin cycle.

Question98

Ferredoxin is a constituent of (1991)

Options:

A. PSI

B. PS II

C. Hill reaction

D. P_{680}

Answer: A

Solution:

Solution:
(a) : In photosystem-I, the ejected electron is trapped by FRS (ferrodoxin reducing substance) which is an unknown oxidation - reduction system. The electron is now transferred to a non-heme iron protein called ferrodoxin (Fd) from which electron is transferred to $NADP^+$ intermediate protein electron carrier ferrodoxin-NADP reductase. So that $NADP^+$ is reduced to $NADPH + H^+$

Question99

During monsoon, the rice crop of eastern states of India shows lesser yield due to limiting factor of
(1991)

Options:

A. CO_2

B. light

C. temperature

D. water.

Answer: B

Solution:

Solution:
(b) : Rate of yield is dependent of light as photosynthesis is dependent on light. Maximum rate of photosynthesis occur when light is brightest (high light intensity). But during monsoon, the light is dim (low light intensity) and so this reduces rate of photosynthesis and hence yield.

Question100

Which technique has helped in investigation of Calvin cycle?
(1991)

Options:

A. X-ray crystallography

B. X-ray technique

C. Radioactive isotope technique

D. Intermittent light

Answer: C

Solution:

(c) : By employing ^{14}C labelled carbon dioxide $^{14}CO_2$ in photosynthesis and observing the appearance of characteristic radiations in different reaction intermediates and product in different experiments. Calvin and his co-workers were able to formulate the complete metabolic path of carbon assimilation in the form of cycle which is called as Calvin cycle.

Question101

Dark reactions of photosynthesis occur in (1991)

Options:

A. granal thylakoid membranes

B. stromal lamella membranes

C. stroma outside photosynthetic lamellae

D. periplastidial space.

Answer: C

Solution:

Solution:
(c) : The dark reactions of photosynthesis is purely enzymatic and slower than the primary photochemical reaction. It takes place in stroma portion of the chloroplast and is independent of light i.e., it can occur either in presence or in absence of light provided that assimilatory power is available.

Question102

Photosynthetic pigments found in the chloroplasts occur in (1991)

Options:

A. thylakoid membranes

B. plastoglobules

C. matrix

D. chloroplast envelope.

Answer: A

Solution:

(a) : Photosynthetic pigments are found in the thylakoid membrane of chloroplasts. The grana lamellae are paired to form sac like structures and form thylakoids. Chlorophylls and other photosynthetic pigments are confined to grana.

Question103

Kranz anatomy is typical of
(1990)

Options:

A. C_4 plants

B. C_3 plants

C. C_2 plants

D. CAM plants

Answer: A

Solution:

Solution:
(a) : The C_4 plants have a characteristic leaf anatomy called kranz anatomy. Here two types of chloroplasts are present - bundle sheath chloroplasts and mesophyll chloroplasts. In C_4 plants, there are two carboxylation reactions which occur first in mesophyll chloroplasts and then in bundle sheath chloroplasts. CO_2 acceptor molecule in mesophyll chloroplasts is PEP (Phospho-enol pyruvate) and not Ribulose 1 , 5-biphosphate. Further it has enzyme PEPcarboxylase for initial CO_2 fixation. RuBP carboxylase is absent in mesophyll chloroplasts but is present in bundle sheath chloroplasts. The first product formed is oxaloacetic acid and hence it is known as C_4 cycle. Bundle sheath cells fix CO_2 through C_3 cycle.

Question104

A very efficient converter of solar energy with net productivity of 204kg / m^2 or more is the crop
(1989)

Options:

A. wheat

B. sugarcane

C. rice

D. bajra

Answer: B

Solution:

(b) : A very efficient converter of solar energy with net productivity of $2-4 \mathrm{kg} / \mathrm{m}^2$ or more is sugarcane, maize which are C_4 plants. Others are C_3 plants.

Question105

In C_4 plants, Calvin cycle operates in (1989)

Options:

A. stroma of bundle sheath chloroplasts

B. grana of bundle sheath chloroplasts

C. grana of mesophyll chloroplasts

D. stroma of mesophyll chloroplasts

Answer: A

Solution:

Solution:
(a) : The C_4 plants have a characteristic leaf anatomy called kranz anatomy. Here two types of chloroplasts are present - bundle sheath chloroplasts and mesophyll chloroplasts. In C_4 plants, there are two carboxylation reactions which occur first in mesophyll chloroplasts and then in bundle sheath chloroplasts. CO_2 acceptor molecule in mesophyll chloroplasts is PEP (Phospho-enol pyruvate) and not Ribulose 1 , 5-biphosphate. Further it has enzyme PEPcarboxylase for initial CO_2 fixation. RuBP carboxylase is absent in mesophyll chloroplasts but is present in bundle sheath chloroplasts. The first product formed is oxaloacetic acid and hence it is known as C_4 cycle. Bundle sheath cells fix CO_2 through C_3 cycle.

Question106

The substrate for photorespiration is (1989)

Options:

A. phosphoglyceric acid

B. glycolate

C. serine

D. glycine

Answer: B

Solution:

(b) Light dependent uptake of O_2 and release of CO_2 in C_3 photosynthetic cell is called photorespiration. Glycolate (glycolic acid) is the chief metabolite of photorespiration and also its substrate. Other important metabolities are the amino acids glycine and serine. But phosphoglyceric acid (PGA) is a lipid and is not substrate of photorespiration.

Question107

The size of chlorophyll molecule is (1989)

Options:

A. head 15 × 15 Å, tail 25 Å

B. head 20 × 20 Å, tail 25 Å

C. head 15 × 15 Å, tail 20 Å

D. head 10 × 12 Å, tail 25 Å.

Answer: C

Solution:

Solution:
(c) : Chlorophyll are the magnesium porphyrin (head, 15 × 15 Å) compounds. The porphyrin ring consists of four pyrrole rings joined together by CH bridges. Along chain of C atoms called as phytol (tail; 20 Å chain is attached to porphyrin ring.

Question108

NADP is reduced to NADPH in (1988)

Options:

A. PS I

B. PS II

C. Calvin cycle

D. noncyclic photophosphorylation

Answer: D

Solution:

(d) : Non-cyclic photophosphorylation involves both PS-I and PS-II. Here electrons are not cycled back and are used in the reduction of NADP to NADPH $_2$. The electrons generated by PSII are passed over a series of electron carriers in a downhill journey and handed over to reaction centre of PSI. PSI again passes the electrons to NADP $^+$ which combines with H^+ ions to form NADPH.

Question109

Carbon dioxide joins the photosynthetic pathway in (1988)

Options:

A. PS I

B. PS II

C. light reaction

D. dark reaction.

Answer: D

Solution:

(d) : The dark reactions or Blackman's reactions or biosynthetic phase involves three steps: (i) Fixation of CO_2 , (ii) Reduction of CO_2 and (iii) Synthesis of other compound from glucose. It is independent of light. Pigment System I is relatively very weakly fluorescent while pigment system II is strongly fluorescent. Light energy absorbed by pigment in the two systems is ultimately trapped by the P_{700} and P_{680} Light reaction is associated with the grana of the chloroplasts. It takes place in the presence of light only.
