

EARLY EXPERIMENTS ON PHOTOSYNTHESIS

- The oxygen evolved during photosynthesis came from water was demonstrated by using an isotope of
 - hydrogen in water
 - oxygen in water
 - oxygen in carbon dioxide
 - carbon in carbon dioxide.
- In which plant, Calvin experimented by radioactive isotopy to discover the stable product of C_3 cycle?
 - Chlorella*
 - Cycas*
 - Carrot
 - Tobacco
- Who among the following scientists was awarded the Nobel Prize in 1960 for tracing the path of carbon in photosynthesis?
 - Rubin
 - Hatch
 - Calvin
 - Huber
- Path of carbon in photosynthesis was found by using
 - centrifugation
 - radioisotopes
 - fractionation
 - chromatography.
- Calvin, used algae in his experiment, for tracing out the path of carbon, the algae used were
 - Chlorella* and *Chlamydomonas*
 - Chlorella* and *Scenedesmus*
 - Chlorococcum* and *Chlorella*
 - Chlorococcum* and *Scenedesmus*.
- Who demonstrated for the first time that in photosynthesis, oxygen is evolved from water?
 - Ruben and Kamen
 - Calvin
 - R. Hill
 - Govind ji
- A photosynthesising plant is releasing ^{18}O more than the normal. The plant must have been supplied with
 - O_3
 - H_2O with ^{18}O
 - CO_2 with ^{18}O
 - $C_6H_{12}O_6$ with ^{18}O .
- Who, after conducting experiments on purple and green sulphur bacteria, inferred that O_2 evolved during photosynthesis comes from H_2O not from CO_2 ?
 - Sachs
 - Engelmann
 - van Niel
 - Blackmann

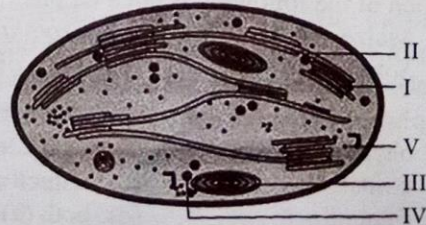
SITE OF PHOTOSYNTHESIS AND PHOTOSYNTHETIC PIGMENTS

- Which is a component of chlorophyll?
 - Mg
 - Mn
 - Fe
 - Zn
- Which part of leaf is meant for photosynthesis and gaseous exchange ?
 - Bundle sheath with chloroplasts
 - Bundle sheath extensions
 - Palisade parenchyma
 - Spongy parenchyma

- Photosynthetic unit is called as
 - sphaerosome
 - lysosome
 - quantaosome
 - dictyosome.
- The central atom in the porphyrin-like ring of chlorophyll is
 - iron
 - manganese
 - magnesium
 - molybdenum.
- Number of chlorophyll arranged per reaction centre in the light harvesting complex are
 - 100
 - 200
 - 300
 - 400.
- Cryptochrome is
 - yellow light absorbing pigment
 - pigment of cryptogams
 - red light absorbing pigment
 - blue light absorbing pigment.
- Photosynthesis is maximum in
 - blue light
 - green light
 - red light
 - ultraviolet light.
- Match the following columns and choose the correct combination from the given options.

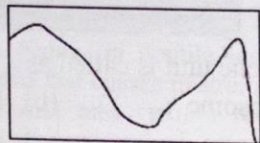
Column I	Column II
A. Visible light	1. 0.1 to 1 nm
B. Ultraviolet	2. 400 to 700 nm
C. X-rays	3. Longer than 740 nm
D. Infrared	4. 100 to 400 nm
	5. < 0.1 nm

 - A - 1, B - 3, C - 4, D - 5
 - A - 3, B - 2, C - 1, D - 5
 - A - 4, B - 3, C - 2, D - 1
 - A - 2, B - 4, C - 1, D - 3
- Which of the following represents the correct molecular formula of chlorophyll *b* ?
 - $C_{55}H_{72}O_6N_4Mg$
 - $C_{55}H_{72}O_5N_4Mg$
 - $C_{55}H_{72}O_4N_4Mg$
 - $C_{55}H_{70}O_6N_4Mg$
- Which chlorophyll molecule does not have a phytol tail?
 - chl *a*
 - chl *b*
 - chl *c*
 - chl *d*
- Refer to the given figure and find out the correct matching.



- (a) I-grana, II-stroma lamellae, III-starch granule, IV-lipid droplet, V-ribosomes
 (b) I-stroma lamellae, II-grana, III-ribosomes, IV-starch granule, V-lipid droplet
 (c) I-grana, II-stroma lamellae, III-lipid droplet, IV-ribosomes, V-starch granule
 (d) I-stroma lamellae, II-grana, III-starch granule, IV-ribosomes, V-lipid droplet

20. The following graph shows the



- (a) absorption spectrum of chlorophyll *a*
 (b) absorption spectrum of chlorophyll *b*
 (c) action spectrum of photosynthesis
 (d) both (a) and (b).
21. Photophosphorylation was discovered by
 (a) Arnon (b) Calvin
 (c) Hill (d) Ruben and Kamen.
22. Hill reaction was demonstrated
 (a) in the absence of water
 (b) in the absence of carbon dioxide
 (c) in the presence of carbon dioxide
 (d) in the absence of a suitable electron acceptor.

MECHANISM OF PHOTOSYNTHESIS

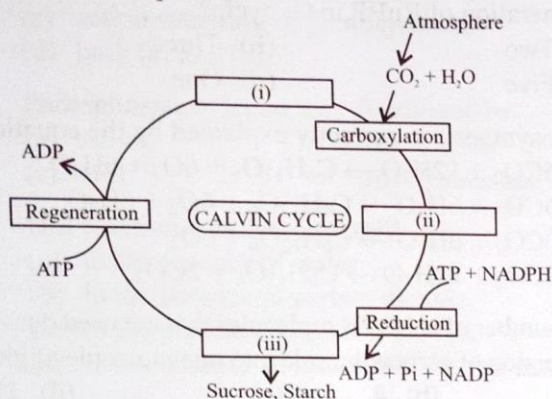
23. Which of the following pair is wrong?
 (a) C_3 – Maize
 (b) C_4 – Kranz anatomy
 (c) Calvin cycle – PGA
 (d) Hatch and Slack pathway – OAA
24. Dark reaction of photosynthesis is characterised by
 (a) water splitting and production of NADP
 (b) reduction of NADP to NADPH
 (c) cyclic and non-cyclic phosphorylation
 (d) enzyme mediated carbon fixation.
25. Which of the following inhibits O_2 release in light phase?
 (a) PMA (b) Zeatin
 (c) DCMU (d) None of these
26. Light reactions take place in
 (a) stroma (b) grana
 (c) cytoplasm (d) ER.
27. Substrate for photorespiration is
 (a) serine
 (b) glycolic acid or glycolate
 (c) IAA (d) malic acid.
28. Which of the following is not a C_4 plant?
 (a) Maize (b) *Crotolaria*
 (c) *Sorghum* (d) None of these
29. In photosynthesis, carbon dioxide is converted to carbohydrates. It is a _____ process.
 (a) oxidative (b) reductive
 (c) catabolic (d) both (a) and (b)

30. Oxygen evolved during photosynthesis comes from
 (a) carbohydrates (b) water
 (c) carbon dioxide (d) chlorophyll.
31. The first product of CO_2 fixation in C_4 plants is
 (a) PGA (b) oxaloacetic acid
 (c) malic acid (d) PEP.
32. The electron lost by P_{680} in the light reaction of photosynthesis is finally gained by
 (a) $NADP^+$ (b) NADPH
 (c) ATP (d) none of these.
33. First transitory chemical formed by reaction between CO_2 and RuBP is
 (a) PGAL/GAP
 (b) 2 carboxy, 3-keto, 1-5 biphosphoribotol
 (c) PGA
 (d) dihydroxy acetone phosphate.
34. Which of the following acts as an acceptor of CO_2 in C_3 plants?
 (a) Glycerate phosphate (b) Glucose diphosphate
 (c) Sedoheptulose (d) Ribulose biphosphate
35. Which of the following characteristics out of A, B and C are exhibited by C_4 plants?
 A. Kranz anatomy
 B. The first product of photosynthesis is oxaloacetic acid.
 C. Both PEP carboxylase and ribulose biphosphate carboxylase act as carboxylating enzymes.
 (a) Only A and B, but not C
 (b) Only B and C, but not A
 (c) Only A and C, but not B
 (d) All A, B and C
36. In C_4 plants synthesis of sugars/final CO_2 fixation occurs in
 (a) epidermis cells
 (b) spongy cells
 (c) undifferentiated mesophyll cells
 (d) bundle sheath cells.
37. Which of the following is a C_4 plant?
 (a) Potato (b) Mustard
 (c) Maize (d) Wheat
38. Respiration initiated in chloroplasts and occurring in light is called
 (a) aerobic respiration (b) anaerobic respiration
 (c) photorespiration (d) fermentation.
39. The carboxylating enzyme present in the bundle sheath cells of maize leaves is
 (a) PEP-carboxylase (b) RuBP carboxylase
 (c) carbonic anhydrase (d) hexokinase.
40. Which one of the following is not paired correctly?
 (a) Hill - Light reaction
 (b) Blackman - Dark reaction
 (c) Mitchell - Non-cyclic photophosphorylation
 (d) Dicker and Tio - Photorespiration
41. The seat of dark reaction of photosynthesis is
 (a) grana (b) thylakoids
 (c) stroma (d) intergranary fibres.

42. In the light reaction of photosynthesis, NADPH₂ and ATP are formed during
- non-cyclic photophosphorylation
 - cyclic photophosphorylation
 - both cyclic and non cyclic photophosphorylation
 - Calvin cycle.
43. In C₄ plants, CO₂ is accepted by
- pyruvate to form oxaloacetate
 - pyruvate to form malate
 - phosphoenol pyruvate to form oxaloacetate
 - oxaloacetate to form malate.
44. For each molecule of glucose formed in plants during photosynthesis, the number of molecules of ATP and NADPH₂ required respectively are
- 18 and 12
 - 24 and 16
 - 12 and 18
 - 12 and 24.
45. RuBisCO is an enzyme for
- CO₂ fixation in dark reaction
 - photorespiration
 - regeneration of RuBP
 - photolysis of water.
46. Which of the following plants keeps its stomata open during night and closed during the day ?
- Wheat
 - Orchid
 - Tea
 - Cactus
47. Non-cyclic photophosphorylation during photosynthesis produces
- NADPH
 - NADP
 - NADH
 - NAD.
48. _____ is a CAM plant.
- Maize
 - Pineapple
 - Onion
 - Pea
49. The radiation energy of light is converted to chemical energy and stored as
- AMP
 - ADP
 - ATP
 - GMP.
50. Enzymes of photorespiration are present in
- mitochondria
 - chloroplast
 - peroxisomes
 - mitochondria, chloroplast and peroxisomes.
51. First stable product of HSK path is
- malate
 - oxaloacetic acid
 - oxalosuccinic acid
 - succinic acid.
52. Photorespiration occurs in
- chloroplast, peroxisome and mitochondria
 - non-photosynthetic cell
 - both (a) and (b)
 - none of these.
53. In photosynthesis, splitting of water takes place during
- cyclic photophosphorylation
 - oxidative phosphorylation
 - non-cyclic photophosphorylation
 - Calvin cycle.
54. C₄ cycle takes place in
- rice
 - sugarcane
 - wheat
 - Allium cepa*.
55. The light dependent and O₂ independent production of ATP is called
- photorespiration
 - oxidative phosphorylation
 - photophosphorylation
 - photo-oxidation.
56. HSK pathway is also called as
- C₂ cycle
 - C₃ cycle
 - C₄ cycle
 - none of these.
57. In the photosynthetic process, PS II absorbs energy at or just below
- 680 nm
 - 860 nm
 - 880 nm
 - 780 nm.
58. How many molecules of ATP are required during regeneration of RuBP in C₃ cycle?
- Two
 - Three
 - Five
 - One
59. Photosynthesis is correctly explained by the equation
- $6\text{CO}_2 + 12\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + 6\text{H}_2\text{O}$
 - $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + 6\text{H}_2\text{O}$
 - $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
 - $2\text{CO}_2 + 12\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 2\text{CO}_2$.
60. The number of NADPH molecules that are used during the conversion of carbon dioxide into one molecule of glucose
- 1
 - 4
 - 6
 - 12.
61. Choose the correct statement.
- The C₄ plants do not have RuBisCO.
 - Carboxylation of RuBP leads to the formation of PGA and phosphoglycolate.
 - Carboxylation of phosphoenol pyruvate results in the formation of C₄ acids.
 - Decarboxylation of C₄ acids occurs in the mesophyll cells.
62. Match the following and choose the option with correct combination of elements.
- | Column I | Column II |
|------------------------|---------------------|
| A. Carboxylation | 1. Oxygen evolution |
| B. Phosphorylation | 2. Photorespiration |
| C. Photolysis of water | 3. RuBisCO |
| D. Phosphoglycolate | 4. Synthesis of ATP |
- A - 1, B - 2, C - 3, D - 4
 - A - 3, B - 4, C - 1, D - 2
 - A - 2, B - 3, C - 4, D - 1
 - A - 1, B - 3, C - 4, D - 2
63. The Calvin cycle proceeds in three stages.
- Reduction, during which carbohydrate is formed at the expense of the photochemically made ATP and NADPH.
 - Regeneration, during which the carbon dioxide acceptor ribulose-1, 5-biphosphate is formed.
 - Carboxylation, during which carbon dioxide combines with ribulose-1, 5-biphosphate.
- Identify the correct sequence.
- 3 → 1 → 2
 - 3 → 2 → 1
 - 1 → 2 → 3
 - 2 → 1 → 3

64. Which of the following statements is true with regard to the light reaction of photosynthetic mechanism in plants?
- Chlorophyll *a* occurs with peak absorption at 680 nm in photosystem I and at 700 nm in photosystem II.
 - Magnesium and sodium ions are associated with photolysis of water molecules.
 - O₂ is evolved during cyclic photophosphorylation.
 - Photosystems I and II are both involved in non-cyclic photophosphorylation.
65. The primary CO₂ acceptor in plants having C₄ pathway is
- phosphoglyceric acid
 - glyceraldehyde phosphate
 - phosphoenol pyruvate
 - oxaloacetic acid.

66. Refer the given diagram showing Calvin cycle, and select the correct option.



- (i) RuBP (ii) Triose phosphate (iii) PGA
- (i) PGA (ii) RuBP (iii) Triose phosphate
- (i) PGA (ii) Triose phosphate (iii) RuBP
- (i) RuBP (ii) PGA (iii) Triose phosphate

67. Photolysis of each water molecule in light reaction will yield
- 2 electrons and 4 protons
 - 4 electrons and 4 protons
 - 4 electrons and 3 protons
 - 2 electrons and 2 protons.

68. Consider the following statements

- The portion of the spectrum between 500 nm and 800 nm is also referred to as photosynthetically active radiation (PAR).
- Magnesium, calcium and chloride ions play prominent roles in the photolysis of water.
- In cyclic photophosphorylation, oxygen is not released (as there is no photolysis of water) and NADPH is also not produced.

Of these statements given above

- A is true; but B and C are false
- A and B are false; but C is true
- B is true; but A and C are false
- A and B are true; but C is false.

69. Which of the following statements with regard to photosynthesis is/are correct ?

- In C₄ plants, the primary CO₂ acceptor is PEP.
- In the photosynthetic process, PS II absorbs energy at or just below 680 nm.
- The pigment that is present in the pigment system I is P₆₈₃.

- B and C only
- A only
- C only
- A and B only

70. Consider the following statements regarding photosynthesis.

- ATP formation during photosynthesis is termed as photophosphorylation.
- Kranz anatomy pertains to leaf.
- Reduction of NADP⁺ to NADPH occurs during Calvin cycle.
- In a chlorophyll molecule, magnesium is present in phytol tail.

Of the above statements

- A and B are correct
- C and D are correct
- A and C are correct
- A and D are correct.

71. In C₃ plants, the first stable compound formed after CO₂ fixation is

- phosphoglyceraldehyde
- malic acid
- oxaloacetic acid
- 3-phosphoglycerate.

72. Which one of the following is not true about the light reactions of photosynthesis?

- Light energy provides energy for the photolysis of water through excitation of the reaction centre of PS II.
- The flow of electrons from water to NADP in non-cyclic electron transport produces one ATP.
- Reactions of the two photosystems are needed for the reduction of NADP.
- P₆₈₀ and P₇₀₀ are the reaction centres of PS I and PS II respectively.

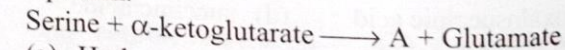
73. The minerals involved in the photolysis of water are

- Manganese
 - Calcium
 - Magnesium
 - Chloride
- A and B only
 - A, B and D only
 - A, B and C only
 - C and D only.

74. The enzyme responsible for primary carboxylation in C₃ plants is

- hexokinase
- succinic dehydrogenase
- pyruvate carboxylase
- RuBP carboxylase oxygenase.

75. Select the option which correctly completes the given equation.



- Hydroxypyruvate
- Phosphoglycerate
- Glycolate
- Xylulose-5-phosphate

76. Photorespiration is favoured by
- high temperature and low O₂
 - high humidity and temperature
 - high O₂ and low CO₂
 - high CO₂ and low O₂.

77. What will be the number of Calvin cycles to generate one molecule of hexose?

- 8
- 9
- 4
- 6

78. NADPH₂ is generated through

- photosystem II
- anaerobic respiration
- glycolysis
- non-cyclic photophosphorylation.

79. Which of the following correctly distinguish between C_3 and C_4 cycle?

	C_3 cycle	C_4 cycle
(a)	It occurs in mesophyll and bundle sheath cell.	It occurs in mesophyll cell only.
(b)	Chloroplasts are dimorphic.	Chloroplasts are monomorphic.
(c)	The CO_2 acceptor is PEP.	The CO_2 acceptor is RuBP.
(d)	Less energy consuming process.	High energy consuming process.

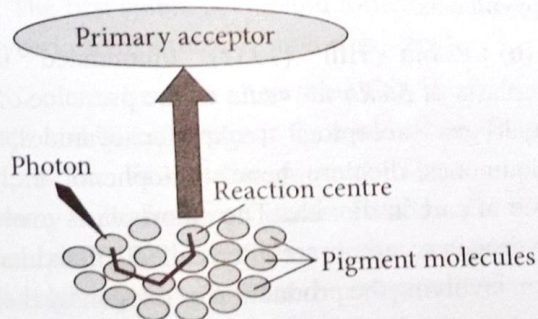
80. The first step for initiation of photosynthesis will be
 (a) photolysis of water
 (b) excitement of chlorophyll molecules due to absorption of light
 (c) ATP formation (d) glucose formation.

81. Which is the first CO_2 acceptor enzyme in C_4 plants?
 (a) RuDP carboxylase (b) Phosphoric acid
 (c) RuBisCO (d) PEP-carboxylase

82. Assimilatory powers produced during photosynthesis are
 (a) RuDP and RuMP (b) ATP and $NADPH_2$
 (c) $C_6H_{12}O_6$ and PGAL (d) H_2O and O_2 .

83. The first intermediate formed during dark reaction of photosynthesis is
 (a) ribulose 5-phosphate (b) fructose 1, 6 diphosphate
 (c) phosphoglyceraldehyde (d) ribulose 1, 5 biphosphate.

84. The given figure is indicating the



(a) non-cyclic phosphorylation
 (b) cyclic phosphorylation
 (c) light harvesting complex
 (d) Z-scheme of light reaction.

85. Dichlorophenyl dimethyl urea (DCMU)
 (a) inhibits O_2 evolution and non-cyclic photo-phosphorylation

(b) promotes O_2 evolution and non-cyclic photo-phosphorylation
 (c) none of these
 (d) both (a) and (b).

FACTORS AFFECTING PHOTOSYNTHESIS

86. Warburg effect refers to
 (a) decreased photosynthetic rate at very high O_2 concentration
 (b) increased photosynthetic rate at very high O_2 concentration
 (c) decreased photosynthetic rate at very low O_2 concentration
 (d) increased photosynthetic rate at very low O_2 concentration.

87. 'The law of limiting factors' was proposed by
 (a) Leibig (b) Hatch and Slack
 (c) Blackman (d) Arnon.

88. Photosynthesis in C_4 plants is relatively less limited by atmospheric CO_2 levels because
 (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.

89. The factor which is not limiting in normal conditions for photosynthesis is
 (a) water (b) chlorophyll
 (c) light (d) carbon dioxide.

90. Given table shows the CO_2 compensation point and optimum CO_2 concentration for photosynthesis for C_3 and C_4 plants.

Parameters	C_3 Plants	C_4 Plants
CO_2 compensation point	50-150 ppm	A
Optimum CO_2 concentration	B	360 ppm

Select the correct values for A and B.

A	B
(a) 0-50 ppm	300 ppm
(b) 0-10 ppm	450 ppm
(c) 100-150 ppm	250 ppm
(d) 100-110 ppm	290 ppm