EXERCISE – I (Conceptual Question) **Build Up your Understanding**

PHOTOSYNTHESIS INTRODUCTION AND EARLY EXPERIMENTS

1. Oxygen which is liberated during photosynthesis comes from-
(1) Carbon dioxide (2) Water (3) Chlorophyll (4) Phosphoglyceric acid

2. In which of the following process, the light energy is converted into chemical energy?
(1) Digestive action (2) Respiration (3) Photosynthesis (4) Fermentation

3. During photosynthesis the oxygen in glucose comes from
(1) Water (2) Carbon di oxide
(3) O_2 in air (4) Both from water and CO_2

4. The law of limiting factor for photosynthesis was given by:
(1) R. Hill (2) Krebs (3) Calvin (4) Blackman

5. The percentage of light energy utilized by higher plants, in the process of photosynthesis is
(1) 100% (2) 10% (3) 50% (4) 1-2%

6. If the CO_2 content of the atmosphere is as high as 300 parts per million -
(1) All plants would be killed
(2) The plants would not grow properly
(3) Plants would grow for some time and then die
(4) The plants would thrive well

7. The isotope of carbon used extensively for studies in photosynthesis :-
(1) C^{13} (2) C^{14} (3) C^{15} (4) C^{16}

8. Which is the evidence to show that oxygen released in photosynthesis comes from water ?
(1) Isotopic oxygen (O^{18}) supplied as Hp appears in the O_2 released in photosynthesis.
(2) Activated chloroplast in water released O_2 if supplied potassium ferrocyanide or some other oxidising agent in the absence of CO_2.
(3) Photosynthetic bacteria use H_2S and CO_2 to make carbohydrates, H_2O and sulphur.
(4) All of the above.

9. The path of CO_2 in the dark reactions of photosynthesis was successfully traced by the use of the following :-
(1) or (2) $C^{14}O_2$ (3) p^{32} (4) X - rays

10. Discovery of Emerson effect has already shown the existence of:-
(1) Two distinct photosystems (2) Light and dark reactions of photosynthesis
(3) Photophosphorylation (4) Photorespiration

11. Name the scientist, who first pointed out that plants purify foul air by bell jar experiment?
(1) Willstatter (2) Robert Hooke (3) Priestley (4) Jean Senebier

12. Of the total amount of water absotbed by the plant, its actual percentage used during photosynthesis is :-
(1) 50% (2) 90% (3) 1% (4) 25%

13. Moll's half leaf experiment explains that
(1) Carbon dioxide is essential for photosynthesis
(2) Chlorophyll and water are necessary for photosynthesis
(3) Light and water are essential for photosynthesis
(4) All the above are correct

14. Oxygen during photosynthesis comes from water was proved with the help of 0 18 experiment by:
(1) Ruben and Kamen (2) Hill
(3) Warburg (4) Blackman

15. Name of the scientist who pointed out the importance of different wavelengths of light using a green algae and aerobic bacteria :-
(1) Priestley (2) Ingen-Housz (3) K.V. Thimann (4) Englemann

16. Photosynthesis in C_4 plants is relatively less limited by atmospheric CO_2 levels because :
(1) Four carbon acids are the primary initial CO_2 fixation products
(2) The primary fixation of CO_2 is mediated via PEP carboxylase
(3) Effective pumping of CO_2 into bundlesheath cells
(4) Rubisco in C_4 plants has higher affinity for CO_2

17. Photosynthesis is
(l) Oxidative, exergonic, catabolic (2) Redox-reaction, ehdergonic, anabolic
(3) Reductive, exergonic, anabolic (4) Reductive, endergonic, catabolic

18. The significance of light & chlorophyll in photosynthesis was discovered by
(1) Priestley (2) Ingenuous (3) Englemann (4) Blackman

19. Wavelength of light responsible for Emerson's enhancement effect :
(1) only 680 nm ↑ (2) only 680 ↓
(3) infra red wavelength (4) Both, 680 nm ↑ and 680 nm ↓

PHOTOSYNTHETIC APPARATUS, PIGMENTS & PIGMENT SYSTEMS

20. The process of photo-phosphorylation take place in:
(1) Chloroplast (2) Ribosome's (3) Mitochondria (4) Cell-wall

21. PS Ioccurs in:
(1) Appressed part of granal thylakoids
(2) Appressed and non appressed part of grana thylakoids
(3) Stroma
(4) Stroma thylakoids and non-appressed part of grcma thylakoids.

22. Which one of the following pigment does not occur in thci chloroplast?

(1) Carotene (2) Xanthophylls (3) Chlorophyll 'b' (4) Anthocyanin

23. Chlorophyll contains :
(1) Fe (2) Mg (3) K (4) Mn

24. Which pigment is water soluble?
(1) Chlorophyll (2) Carotene (3) Anthocyanin (4) Xanthophylls

25. The site for dark reaction of photosynthesis is:
(1) Stroma (2) Grana (3) Intergrana (4) Mitochondria

26. Chlorophyll is present :-
(1) In the grana of chloroplasts (2) On the surface of chloroplasts
(3) Dispersed through out the chloroplasts (4) In the stroma of chloroplasts

27. Which colour of light gives maximum absorption peak by chlorophyll 'a' ?
(1) Blue light (2) Green light (3) Violet light (4) Red light

28. Presence of carotenes in chloroplast helps in
(1) ATP synthesis
(2) Transferring radiant energy into chemical energy
(3) Protecting chlorophyll molecules from photo oxidation
(4) Absorption of longer wavelength of light

29. The formula of chlorophyll'a' is
(1) $C_{35}H_{72}O_5N_4$ Mg (2) $C_{55}H_{70}O_3N_4$ Mg
(3) $C_{55}H_{72}O_5N_4$ Mg (4) $C_{51}H_{70}O_6N_4$ Mg

30. The number of pigment molecules in quanta some is:
(1) 250 - 400 (2) 300 - 900 (3) 500 - 600 (4) 50 -100

31. The main difference between chlorophyll 'a' and 'b' is:
(1) Chlorophyll 'a' is a linear chain compound and 'b' is branched chain
(2) Chlorophyll 'a' has no Mg^+ ion in center of molecule
(3) In chlorophyll 'a' there is $–GH_3$ group whereas in 'b' it is –CHO group
(4) All of the above

32. Chlorophyll 'a' is found in
(1) All O_2 releasing photosynthetic forms (2) Only higher plants
(3) Higher plants that photosynthesize (4) All photosynthetic eukaryotes.

33. In pigment system-I, reaction centre is :
(1) P-600 (2) P-680 (3) P-700 (4) P-720

34. Basic structure of all chlorophyll comprises of:
(1) Cytochrome system (2) Flavoproteins

(3) Porphyrin system (4) Plastocyanin

35. What is the by product of bacterial photosynthesis?
(1) O_2 (2) CO_2 (3) S (4) H_2S

36. In chlorophyll molecule "Mg" is situated in
(1) Centre of porphyrin ring (2) Corner of porphyrin
(3) In phytol tail (4) In isocyclic ring

37. The photosynthetic pigment "chlorophylls" are soluble in
(1) Water (2) Inorganic solvent (3) Organic solvent (4) Water & organic solvent

38. Which of the following chlorophyll is lack of phytoltail?
(1) Chl 'a' (2) Chl. 'b' (3) Chl. 'c' (4) Chl. 'e'

39. Which of the following protein is most abundant on the earth?
(1) Catalase (2) Rubisco (3) Amylase (4) None of these

40. Universal photosynthetic chlorophyll is
(1) Chl - 'a' (2) Chi 'b' (3) Chi - 'c' (4) Chi- 'e'

41. Which of the following is the site of photolysis of water?
(1) Stroma of chloroplast (2) Cristae of chloroplast
(3) Ribosome of chloroplast (4) Lumen surface of thylakoid membrane

42. Which one of the following is precursor of protochlorophyll?
(1) Acetyl COA (2) Succinyl COA (3) Oxlaoacetic acid (4) a-ketoglutarate

LIGHT REACTIONS OR PHOTOPHOSPHORYLATION

43. The first step in photosynthesis is
(1) Joining of three carbon atoms to from glucose
(2) Formation of ATP
(3) Ionization of water
(4) Excitement of an electron of chlorophyll by a photon of light

44. The gain of light reaction is :-
(1) ATP & NADPH (H^+) (2) NADPH (H^+) & glucose
(3) Only ATP (4) O_2 & glucose

45. Algae and other submerged plants bount in water during day time and sink at night, because
(1) They come up to receive O_2
(2) They lose weight at night
(3) They become buoyant due to accumulation of O_2 as a result of photosynthesis
(4) They become light due to food material accumulation

46. Which one of the following concerns with photophosphorylation :
(1) ADP +AMP $\xrightarrow{\text{Light energy}}$ ATP
(2) ADP + Inorganic PO_4 $\xrightarrow{\text{Light energy}}$ ATP

(3) ADP + Inorganic PO_4 $\longrightarrow$ ATP
(4) AMP + Inorganic PO_4 $\longrightarrow$ ATP

47. The function of ATP in photosynthesis is the transfer of energy from the
(1) Dark reaction to the light reaction (2) Light reaction to the dark reaction
(3) Chloroplasts to mitochondria (4) Mitochondria to chloroplasts

48. In photosynthesis, hydrogen is transferred from the light reactions to dark reactions by :-
(1) DPN (2) DNA (3) ATP (4) NADP

49. During photochemical reaction of photosynthesis
(1) liberation of O_2 takes place
(2) Formation of ATP and $NADPH_2$ take place
(3) Liberation of O_2, formation of ATP, and $NADPH_2$ takes place
(4) Assimilation of CO_2 takes place

50. ADP + iP = ATP in grana is called :
(1) Phosphorylation (2) Oxidative phosphorylation
(3) Photophosphorylation (4) Photolysis

51. Which of the following is excited molecule during photosynthesis :
(1) Chlorophyll (2) Oxygen (3) Carbon dioxide (4) Water

52. $NADPH(H^+)$ is also called
(1) Real power (2) Oxidising agent
(3) Power house of energy (4) Reducing power

53. During splitting of H_20, H^+ is ultimately captured by
(1) Chlorophyll (2) NADP
(3) O_2 (4) Cytochrome

54. At the time of splitting of H_2O, which initially captures the electron
(1) Chlorophyll (2) NADP (3) OH^- (4) Cytochrome

55. In cyclic photophosphorylation which one of the following is formed
(1) NADP & ATP (2) ATP
(3) NADH + H^+ and O_2 (4) NADPH + H^+ ATP and O_2

56. Fixation of 1 CO_2 requires :-
(1) 6NADPH(H^+) & 3ATP (2) 2NADPH(H^+) & 3ATP
(3) 4NADPH(H^+) & 3ATP (4) 5NADPH(H^+) & 3ATP

57. Photooxidation of water in photosynthesis is in association of
(1) Cytochrome b_6 (2) Pigment system – I
(3) Pigment system (4) Plastocyanin

58. During ATP synthesis electron pass through
(1) Water (2) Cytochromes (3) O_2 (4) CO_2

59. Which pigment system immediately donates e^- for the reduction of NADP.
(1) PS II (2) PS I (3) CO_2 (4) Plastoquinone

60. Photosynthesis is an oxidation reduction process, the materials that is oxidised is
(1) CO_2 (2) NADP (3) H_2O (4) PGA

61. Photo-oxidation of chlorophyll is called
(1) Intensification (2) Chlorosis (3) Solarization (4) Defoliation

62. The electron ejected by P_{680} in light reaction is initially accepted by
(1) Plastoquinone (2) ATP (3) Ferredoxin (4) P-700

63. Which element are presents in OEC (Oxygen evolving complex)
(1) Mn^{++} (2) Cl^- (3) Ca^{++} (4) All

64. Which one is Cu^{++} containing protein complex :-
(1) Ferridoxin (2) Plastocyanin (3) Plastoquione (4) Cytochrome

65. Only pigment system-I is concerned with
(1) Photolysis of H_2O (2) Cyclic photophosphorylation
(3) Non-cyclic photophosphorylation (4) Oxidative phosphorylation

66. The first electron carrier molecule for e^- excited from P_{700} is
(1) Cytochrome (2) Cu protein/Plastocyanin
(3) FeS protein/Ferredoxin (4) Fe-Mg protein

67. Pigment system-II occurs in
(1) Grana (2) Stroma (3) Matrix (4) Oxysomes

68. During photosynthesis
(1) Water is reduced & CO_2 is oxidized (2) CO_2 is reduced & water is oxidized
(3) Both CO_2 & water is reduced (4) Both CO_2 & water is oxidized

69. Connecting link between light phase and dark phase of photosynthesis.
(1) Only ATP (2) Only NADPH (H^+)
(3) Only NADH + H^+ (4) ATP & NADPH (H^+)

70. Which photosynthetic pigment converts nascent oxygen to molecular oxygen :-
(1) Chlorophyll-a (2) Carotenoids (3) Phycobilins (4) Chlorophyll-b

71. Hill reaction occurs in :
(1) High altitude plants (2) Total darkness
(3) Presence of ferricyanide (4) Absence of water

DARK REACTIONS (C_3-PLANTS, C_4-PLANTS, CAM-PLANTS)

72. In photosynthesis CO_2 combines with
(1) RUBP (2) ATP (3) ADP (4) PGA

73. During the dark reaction of photosynthesis :-
(1) Water splits
(2) CO_2 is reduced to organic compounds
(3) Chlorophyll is activated
(4) Stable C_6-sugar is broken into three carbon sugars

74. Carbohydrates, the most abundant biomolecules on earth, are produced by :
(1) all bacteria, fungi and algae
(2) fungi, algae and green plant cells
(3) some bacteria, algae and green plants cells
(4) viruses, fungi and bacteria

75. The enzyme that fixes atmospheric CO_2 in C_4 plants is :-
(1) PEP carboxylase (2) Hexokinase (3) RUBP oxygenase (4) Hydrogenase

76. During photosynthesis when PGA is changed into phosphoglyceraldehyde which of the following reaction occur :-
(1) Oxidation (2) Reduction (3) Electrolysis (4) Hydrolysis

77. Carbon refixation in C_4 plants occurs in chloroplasts of :-
(1) Palisade tissue (2) Spongy mesophyll
(3) Bundle sheath cells (4) Guard cells

78. Tropical plants like sugarcane show high efficiency of CO_2 fixation because of :-
(1) Calvin cycle (2) Hatch-Slack cycle
(3) Cyclic photophosphorylation (4) TCA Cycle

79. "Krabz" type of Anatomy is found in :-
(1) C_4 plant (2) C_3 plant (3) Succulent plants (4) None of the above

80. Ribulosediphosphate carboxylase enzyme, catalyse the carboxylation reaction between
(1) CO_2 and ribulose-1, 5-diphosphate
(2) Oxaloacetic acid and acetyl Co-A
(3) PGA and dihydroxyacetone phosphate
(4) Ribulosediphosphate and phosphate glyceraldehydes

81. Which of the following is C-4 plants
(1) Maize (2) A triplex (3) Sugarcane (4) All of the above

82. C_4 plants are adapted to
(1) Hot and dry climate (2) Temperate climate
(3) Cold and dry climate (4) Hot and Humid climate

83. C_4 plants are found among
(1) Only gramineae (2) Only monocot
(3) Only dicot (4) Monocots as well as dicots

84. In case of C_4 pathway, the first step is :-
(1) CO_2 combines with RUDP (2) CO_2 combines with PGA
(3) CO_2 combines with PEP (4) CO_2 combines with RMP

85. In dark reaction, first reaction is the
(1) Carboxylation (2) Decarboxylation (3) Dehydrogenation (4) Deamination

86. Number of ATP molecules required for regeneration phase of RUBP during synthesis of 1 glucose molecule.
(1) 6 (2) 12 (3) 18 (4) 30

87. Isotopes employed to study the process of photosynthesis reaction.
(1) S^{35} and P^{32} (2) C^{14} and O^{18} (3) N^{14} and Co^{60} (4) N^{14} and O^{18}

88. Chloroplast is present in bundle sheath cells of
(1) C_3-plants (2) C_4 plants (3) CAM plants (4) Photo respiring plants

89. CO_2 is accepted by RUBP in C_4 plants in
(1) Mesophyll cells (2) Bundle sheath cells
(3) Stomatal gaurd cells (4) Epidermal cells

90. Bundle sheath chloroplast of C_4 plant are :-
(1) Large & agranal (2) Large & granal (3) Small & agranal (4) Small & granal

91. Most efficient photosynthesis & presence of bundle sheath chloroplast are characteristics of
(1) C_3-plants (2) C_2 plants (3) C_4 plants (4) CAM plants

92. In C_4 pathway the fixation of CO_2 (by PEP Case) occurs in
(1) Palisade tissue (2) Mesophyll (3) Bundle sheath (4) Guard cell

93. Synthesis of fructose in C_4 pathway occurs in the chloroplast of
(1) Spongy mesophyll (2) Bundle sheath cells
(3) Guard cells (4) Palisade tissue

94. In addition to the 12 molecules of NADPH(H^+) the energy required for the synthesis of one mole of hexose by c3 and c4 pathway is
(1) 18 molecules of ATP (2) 30 molecules of ATP
(3) 18 & 30 molecules of ATP respectively (4) 30 & 18 molecules of ATP respectively

95. How many molecules of water are needed by a green plant to produce one molecule of hexose/reduce 6 molecules of CO_2

(1) 6 (2) 12 (3) 24 (4) only one

96. How many calvin cycles would generate one molecules of glucose/hexose
(1) One cycle (2) Three cycles (3) Six cycles (4) Twelve cycles

97. CAM – plants are mainly
(1) Succulent xerophyte (2) Hydrophytes
(3) Epiphytes (4) None of the above

98. The first stable product of Calvin cycle and HSK cycle are
(1) 4-C and 3-C compounds (2) 4-C and 6-C compounds
(3) 3-C and 4-C compounds (4) 5-C and 4-C compounds

99. Which of the following was used during discovery of Calvin cycle :
(1) Spirogyra (2) Volvox (3) Chlamydomonas (4) Chlorella

100. In sugarcane plant $^{14}CO_2$ is fixed in malice acid, in which the enzyme that fixes CO_2 is
(1) Ribulose, biphosphate carboxylase
(2) Phosphoenolpyruvic acid carboxylase (PEP-case)
(3) Ribulose phosphate kinase
(4) Fructose phosphatase

101. The rate of photosynthesis does not depend upon
(1) Light duration (2) Light intensity
(3) Light quality (colour) (4) Temperature

102. Which one of the following have high CO_2 compensation point:
(1) C_2 plants (2) C_3 plants (3) C_4 plants (4) Alpine herbs

103. Solarisation is a process in which :
(1) Sugar are formed with the help of solar energy
(2) Chlorophyll is formed
(3) Destruction of chlorophyll
(4) Mobilization of light energy.

104. Accumulation of food in assimilatory cells results in
(1) Increase in the rate of photosynthesis (2) Decrease in the rate of photosynthesis
(3) No effect (4) May increase or decrease

105. 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:
(1) two (2) six (3) zero (4) twelve

106. First stable product of Photorespiration is :-
(1) PGAL (2) Glycerate (3) Glycine (4) Phosphoglycolate

107. Etiolated plants are formed due to lack of
(1) Light (2) Hg (3) Fe (4) Mg

108. During day light hours, the rate of photosynthesis is higher than that of respiration and the ratio of oxygen produced to that of consumed is
(1) 10 : 1 (2) 5 : 1 (3) 1 : 1 (4) 50 : 1

109. Generally atmospheric CO_2 is not limiting for hydrophytes
(1) Mesophytes plants fix H_2S in their photosynthesis
(2) These plants obtain CO_2 from water in the form of HCD-3
(3) Glucose is not required for their respiration
(4) All the above

110. Photorespiration is favoured by
(1) Low light intensity (2) Low O_2 and high CO_2
(3) Low temperature (4) High O_2 and Low CO_2

111. What is C_2 - Cycle
(1) Glycolate cycle (2) Calvin cycle (3) Kreb's cycle (4) TCA - cycle

112. Compensation point means
(1) When the rate of photosynthesis is equal to rate of respiration
(2) When there is neither photosynthesis nor respiration
(3) When the entire food manufactured in photosynthesis remains unutilized
(4) When availability of water equalise with necessity of water:

113. At the compensation point there will not be
(1) Photosynthesis
(2) Net gaseous exchange between the plant and its environment
(3) Respiration in plants
(4) Loss in weight of the plant in dark

114. What does not occur in photorespiration
(1) Utilization of O_2 (2) Production of CO_2
(3) Synthesis of ATP (4) All the above

115. DCMU is an inhibitor of
(1) PS-I (2) PS-II (3) Calvin cycle (4) Kred's cycle

116. Main factor which limits the rate of photosynthesis on a clear day is
(1) Chlorophyll (2) Light (3) CO_2 (4) Water

117. Photosynthetic bacteria differ from green plants in
(1) Nature of their photosynthetic pigments
(2) Type of electron donors
(3) Photosynthetic process being non oxygenic
(4) All of the above

118. Which one of the following is wrorig in relation to photorespiration :

(1) It occurs in chloroplasts (2) It occurs in daytime only
(3) It is a characterisitic of C_4 plants (4) It is a characteristic of C_3 plants

119. Photosynthetically active radiation (PAR) represents. the following range of wavelength :
(1) 400-700 nm (2) 500-600 nm (3) 450-950 nm (4) 340-450 nm

120. In C_3 plants, the first stable product of photosynthesis during the dark reaction is :
(1) Phosphoglycereldehyde (2) Malic acid
(3) Oxaloacetic acid (4) 3-phosphoglyceric acid

121. Plants adapted to low light intensity have :
(1) Leaves modified to spines
(2) Large photosynthetic unit size than the sun plants
(3) Higher rate of CO2 fixation than the sun plants
(4) More extended root system

122. In chloroplasts, chlorophyll is present in the:-
(1) Stroma (2) Outer membrane (3) Inner membrane (4) Thylakoids

123. Which one of the following categories of organisms do not evolve oxygen during photosynthesis :
(1) Red algae (2) Photosynthetic bacteria
(3) Crplants with Kranz anatomy (4) Blue green algae

124. Which pair is wrong :
(1) C_3 plant-maize (2) Calvin cycle-PGA
(3) Hatch and Slack cycle - Maize (4) C4-plant- Kranz Anatomy

ANSWER KEY

EXERCISE-I (Conceptual Question)

1.	(2)	**2.**	(3)	**3.**	(2)	**4.**	(4)	**5.**	(4)	**6.**	(4)	**7.**	(2)
8.	(4)	**9.**	(2)	**10.**	(1)	**11.**	(3)	**12.**	(3)	**13.**	(1)	**14.**	(1)
15.	(4)	**16.**	(3)	**17.**	(2)	**18.**	(2)	**19.**	(4)	**20.**	(1)	**21.**	(4)
22.	(4)	**23.**	(2)	**24.**	(3)	**25.**	(1)	**26.**	(1)	**27.**	(1)	**28.**	(3)
29.	(3)	**30.**	(1)	**31.**	(3)	**32.**	(1)	**33.**	(3)	**34.**	(3)	**35.**	(3)
36.	(1)	**37.**	(3)	**38.**	(3)	**39.**	(2)	**40.**	(1)	**41.**	(4)	**42.**	(2)
43.	(4)	**44.**	(1)	**45.**	(3)	**46.**	(2)	**47.**	(2)	**48.**	(4)	**49.**	(3)
50.	(3)	**51.**	(1)	**52.**	(4)	**53.**	(2)	**54.**	(1)	**55.**	(2)	**56.**	(2)
57.	(3)	**58.**	(2)	**59.**	(2)	**60.**	(3)	**61.**	(3)	**62.**	(1)	**63.**	(4)
64.	(2)	**65.**	(2)	**66.**	(3)	**67.**	(1)	**68.**	(2)	**69.**	(4)	**70.**	(2)
71.	(3)	**72.**	(1)	**73.**	(2)	**74.**	(3)	**75.**	(1)	**76.**	(2)	**77.**	(3)
78.	(2)	**79.**	(1)	**80.**	(1)	**81.**	(4)	**82.**	(1)	**83.**	(4)	**84.**	(3)
85.	(1)	**86.**	(1)	**87.**	(2)	**88.**	(2)	**89.**	(2)	**90.**	(1)	**91.**	(3)
92.	(2)	**93.**	(2)	**94.**	(3)	**95.**	(2)	**96.**	(3)	**97.**	(1)	**98.**	(3)