PHOTOSYNTHESIS REVIEW ANSWERS

1. The light independent reactions occur in the stroma.
2. The light independent reactions are also known as the Calvin Cycle, Calvin-Benson Cycle & dark reactions.
3. Chlorophyll a
4. The light dependent reactions make oxygen, ATP, and NADPH.
5. The 2 reactants of photosynthesis are carbon dioxide & water.
6. Glucose is made during the light independent reactions (Calvin cycle).
7. CO_2 is used during the light independent reactions (Calvin cycle).
8. Green light is not absorbed or "used" by chlorophyll.
9. Water is converted into oxygen during the light dependent reactions (more specifically, during noncyclic photophosphorylation).
10. False, because the Calvin cycle (light independent reactions) can occur both in the presence as well as absence of light.
11. True. Photosynthesis converts light energy to chemical energy.
12. The two main stages of photosynthesis are the **a.** light dependent reactions and **b.** the light independent reactions (Calvin cycle works ok as an answer for b).
13. The mass of the individual molecules determines how fast they are carried by the solvent up the paper, and thus how quickly they are separated during chromatography.
14. True, the other plant pigments are able to capture and use wavelengths of light (like green) that chlorophyll is unable to use, thus making the plant more efficient at using the light that hits its leaves.
15. Xanthophyll
16. Light Independent reactions = Calvin cycle or Calvin-Benson Cycle (or dark reactions).
17. The 2 end products of photosynthesis are glucose ($C_6H_{12}O_6$) and oxygen (O_2).
18. The light dependent reactions occur in the grana, or more specifically, the thyllakoids.
19. Paper chromatography.
20. Oxygen is released into the air during the light dependent reactions (specifically, noncyclic photophosphorylation).
21. Red and violet or blue light are the 2 main wavelengths of light used by chlorophyll.
22. Photolysis refers to energy from light being used to split water into oxygen, electrons and hydrogen ions during the light dependent reactions.
23. NADPH carries both hydrogen and energy to the dark reactions.
24. ATP and NADPH carry energy from the light dependent reactions to the light independent reactions.
25. Carotene
26. Yellow
27. Chloroplast
28. Orange
29. Glucose
30. The light reactions can be divided into **A.** cyclic photophosphorylation and **B.** noncyclic photophosphorylation.
31. ATP stores energy within its phosphate bonds for short periods of time within all cells.
32. False. Yellow leaves would reflect and thus not use yellow light.
33. Photosynthesis (green plants) is the source of all oxygen in the earth's atmosphere.
34. All aerobic (oxygen using) organisms need glucose and oxygen from photosynthetic organisms.
35. Photosynthesis changes light energy to chemical energy.
36. When temperature is increased (and all other factors are left constant), the rate of photosynthesis first increases steadily, then reaches an optimum around 35-40˚ C, then decreases rapidly as the enzymes denature.
37. As light intensity increases (if all other factors are left constant), the rate of photosynthesis at first increases steadily but then begins to level off as all the enzymes are used. Also at high light intensities, oxygen out competes CO_2 for the active site on RUBP carboxylase, decreasing photosynthesis efficiency.
38. The light dependent reactions make ATP and NADPH which carry energy to the light independent reactions
39. Glucose is composed of 6 carbon atoms.

40. $C_6H_{12}O_6$
41. PGAL has 3 carbon atoms.
42. Carbon dioxide and water are the main 2 reactants of photosynthesis.
43. Glucose and oxygen are the two main products of photosynthesis.
44. Plants utilize light energy between the approximate wavelengths of 400-740 nm.
45. Light energy energizes or excites the electrons within chlorophyll so that they are boosted to outer energy levels in the atoms.
46. Plants have other plant pigments (accessory pigments) besides the chlorophylls so that the plant can capture and thus use other wavelengths of light that the chlorophylls can't absorb.
47. ATP contains more energy.
48. ATP contains more high energy phosphate bonds than does either ADP or AMP.
49. ATP = Adenosine TriPhosphate
50. $6CO_2 + 6H_2O$ ----- Light----→ $C_6H_{12}O_6 + 6O_2$
51. $C_6H_{12}O_6 + 6O_2$ ----------→ $6CO_2 + 6H_2O$
52. The products of photosynthesis are the reactants of aerobic respiration and viceaversa.
53. Photolysis
54. Photophosphorylation (Photo = light & phosphorylation = act of making ATP)
55. Accessory pigments are helper pigments
56. Reduction reactions involve: a) gain of electrons, b) gain of energy, c) gain of hydrogen, d) or loss of oxygen.
57. Oxidation reactions involve: a) loss of electrons, b) loss of energy, c) loss of hydrogen, d) or gain of oxygen.
58. Light energy is converted to chemical energy in glucose during photosynthesis.
59. RuBP Carboxylase or Rubisco
60. Chemiosmosis
61. When the CO_2 concentration is increased (while all other factors are kept constant), the rate of photosynthesis increases steadily at first, but then levels off as all the enzymes for the reactions that make up photosynthesis are busy.
62. During cyclic photophosphorylation, light strikes pigments within photosystem I, energizing an electron which is given to a cycle of electron acceptors. The energy in this electron is then given to make 1 ATP. The deenergized electron returns to the same photosystem to complete the cycle.
63. Photophosphorylation refers to the use of light to energize electrons which in turn can power the prodution of ATP during the light dependent reactions.
64. Chemiosmosis occurs during the reactions of Photosystem II.
65. During noncyclick photophosphorylation, water is split to make electrons, protons (H+) and oxygen. The electrons are given to electron acceptors that pump the H+ across the membrane. As the protons diffuse back across the membrane (chemiosmosis), they pass ATP synthase which makes 2 ATP. A second excitation of the electron at the next photosystem provides energy to combine NADP+ with the electron and left over H+ from chemiosmosis, creating NADPH.
66. ATP synthase
67. Clusters of chlorphylls and the accessory pigments on the thyllakoid membranes are known as photosystems.
68. Thyllakoid
69. Granum (singular) or grana (plural)
70. Photolysis means the splitting of water.
71. Stroma
72. Photolysis provides oxygen (for respiration), electrons (to replace those that have left the photosystem for the electron acceptors), and hydrogen ions (H+) which are used to make ATP during chemiosmosis and which eventually will be carried by NADPH to the light dependent reactions where it is added to CO_2 to make glucose.
73. 5 carbon RuBP picks up CO_2 as the 1st step of the Calvin Cycle.
74. Energy in the form of energized electrons and protons (H^+) are added from ATP and NADPH to convert PGA to PGAL during the Calvin Cycle.
75. Rubisco or RUBP carboxylase adds CO_2 to RuBP to begin the reduction of CO_2 into glucose.
76. Grana (pl) or granum (singular) are the stacks of thyllakoids in the chloroplast.
77. Noncyclic photophosphorylation makes 2 ATP.

78. Cyclic photophosphorylation makes 1 ATP per cycle.
79. 6 carbon dioxide + 6 water in the presence of light yield glucose + 6 oxygen
    or $CO_2 + 6H_2O$ ------ Light----> $C_6H_{12}O_6 + 6O_2$
80. Photosystem II uses the light wavelength of 680 nm to power its reaction center.
81. Photosystem I uses the light wavelength of 700 nm to power its reaction center.
82. NADP+ & ADP are products of the light independent reactions which must diffuse back to the light dependent reactions to help keep them going.
83. ATP and NADPH both carry energy from the light dependent to the light independent reactions.
84. **Carbon fixation** is the addition of inorganic CO2 to organic RuBP.
85. Because having many different photosynthetic pigments working together helps the chloroplast collect many wavelengths of light that ordinarily chlorophyll a would not be able to collect.
86. The H+ used for chemiosmosis during noncyclic photophosphorylation comes from photolysis, the splitting of water.
87. As chlorophyll molecules lose excited electrons to the electron acceptors, they need a source of new electrons. These electrons come from the splitting of water during photolysis.
88. Chemiosmosis occurs during noncyclic photophosphorylation. energized electrons from photosystem II pass through electron acceptors which actively transport H+ into the thyllakoid. At high concentration, the H+ diffuse back out of the thyllakoid, passing ATP synthase which in turn makes 2 ATP.
89. 6 complete turns of the Calvin Cycle (LIR) are needed to make one glucose molecule.
90. ATP is needed in the steps between PGAL and RuBP during the Calvin Cycle to energize the PGAL so it will reconfigure itself from a 3-carbon to a 5-carbon molecule.
91. Noncyclic & Cyclic Photophosphorylation are the 2 main sets of reactions of the Light Dependent Reactions of Photosynthesis
92. The LIR needs the ATP and NADPH produced by the LDR in order to fix carbon dioxide into glucose.
93. CO_2 is reduced to glucose by the addition of energy, electrons and hydrogen during the Calvin Cycle (LDR).
94. ATP stores and carries energy from the light-dependent reactions to the light-independent reactions where the energy is added during the synthesis of glucose.
95. NADPH carries energy (the energized electrons) and hydrogen from the light-dependent reactions to the stroma where the light-independent reactions occur.
96. The oxygen atoms in glucose come from the carbon dioxide that enters the light independent reactions from the air. (The hydrogens in glucose come from the water that was split by photolysis at the beginning of the LDR.)