36) In plants, the molecular oxygen concentration of a leaf cell usually increases during the process of
A) photosynthesis  C) capillary action
B) transpiration  D) aerobic respiration

37) Which word equation represents the process of photosynthesis?
A) glucose + oxygen → carbon dioxide + water
B) malose + water → glucose + oxygen
C) glucose → alcohol + carbon dioxide
D) carbon dioxide + water → glucose + oxygen + water

38) The summary word equation shown below represents a set of reactions occurring in photosynthesis.
\[
\text{water} \xrightarrow{\text{chlorophyll}} \text{hydrogen} + \text{oxygen} \xrightarrow{\text{light}} \text{chlorophyll}
\]
These reactions are known as
A) carbon fixation reactions
B) fermentation reactions
C) photochemical reactions
D) dark reactions

39) Which statement correctly describes part of the photosynthetic process in plants?
A) Carbon dioxide is released in the dark reactions.
B) Alcohol is produced by the light reactions.
C) Oxygen is used in the dark reactions.
D) Water is split in the light reactions.

40) Which is the process in which light energy is absorbed and PGAL synthesized?
A) aerobic respiration
B) lactic acid fermentation
C) alcoholic fermentation
D) photosynthesis

41) Which reactions are involved in the process of photosynthesis?
A) both photochemical and carbon-fixation reactions
B) photochemical reactions, only
C) carbon-fixation reactions, only
D) neither photochemical nor carbon-fixation reactions

42) Bromthymol blue turns to bromthymol yellow in the presence of carbon dioxide. When the carbon dioxide is removed, the solution will return to a blue color. Two green water plants were placed in separate test tubes, each containing water and bromthymol yellow. Both test tubes were corked. One tube was placed in the light, the other in the dark. After several days, the liquid in the tube exposed to the light turned blue.

This demonstration illustrates that, during photosynthesis, green plants
A) need bromthymol blue
B) take in carbon dioxide
C) give off oxygen gas
D) form ATP molecules

43) Which compound is formed in the process of photosynthesis?
A) colchicine  C) ammonia
B) DNA  D) PGAL

44) An organic compound formed in the dark reactions of photosynthesis is
A) oxygen  C) PGAL
B) chlorophyll  D) H₂O

45) Which compound is a three-carbon sugar and a product of the dark reactions of photosynthesis?
A) DNA  C) ADP
B) PGAL  D) ATP

46) For the given statement, choose the process that is best described by the statement.
PGAL is synthesized.
A) anaerobic respiration
B) carbon-fixation reactions of photosynthesis
C) photochemical reactions of photosynthesis
D) aerobic respiration

47) The raw materials used by green plants for photosynthesis are
A) carbon dioxide and water
B) oxygen and water
C) carbon dioxide and glucose
D) oxygen and glucose

PGAL = high energy 3C compound formed during the dark reactions (light-independent)
Carbon-fixation reactions may result in the formation of the sugar compound represented by letter
A) A  B) B  C) C  D) D

49) For the given statement, select the reaction of photosynthesis that is best described by the statement.

PGAL is produced.
A) neither photochemical nor carbon-fixation reactions
B) both photochemical and carbon-fixation reactions
C) carbon-fixation reactions, only
D) photochemical reactions, only

50) An inorganic molecule required by green plants for the process of photosynthesis is
A) carbon dioxide  C) oxygen  D) starch
B) glucose

51) In the diagram of a young corn plant below, which letter indicates a structure that is adapted for carrying out the chemical reactions of photosynthesis?
A) A  B) B  C) C  D) D

52) For the following statement, choose the biochemical process that is best described by the statement.

Solar energy is converted to chemical energy in organic molecules.
A) fermentation  C) chemosynthesis
B) photosynthesis  D) replication

53) Which activity occurs in the process of photosynthesis?
A) Light energy is converted into the chemical energy of organic molecules.
B) Chemical energy from organic molecules is converted into light energy.
C) Organic molecules are converted into inorganic food molecules.
D) Organic molecules are obtained from the environment.

54) In most green plants, which wavelengths of light are most effective in the conversion of radiant energy into the chemical energy of organic compounds?
A) red and green  C) yellow and green
B) yellow and blue  D) red and blue

55) One bean plant is illuminated with green light and another bean plant of similar size and leaf area is illuminated with blue light. If all other conditions are identical, how will the photosynthetic rates of the plants most probably compare?
A) The plant under blue light will carry on photosynthesis at a greater rate than the one under green light.
B) Neither plant will carry on photosynthesis.
C) Photosynthesis will occur at the same rate in both plants.
D) The plant under green light will carry on photosynthesis at a greater rate than the one under blue light.
56) At optimum light intensity, which atmospheric gas most directly influences the rate of photosynthesis?
A) oxygen  C) carbon dioxide
B) hydrogen  D) nitrogen

57) For the given statement, choose the process that is best described by the statement.

Light energy is absorbed by organic pigment molecules.
A) anaerobic respiration
B) aerobic respiration
C) photochemical reactions of photosynthesis
D) carbon-fixation reactions of photosynthesis

58) In the diagram below, the plant was exposed to several different colors of light. If all the light intensities were the same, under which color of light would oxygen be produced at the slowest rate?
A) white  C) red
B) green  D) blue

59) For the following statement, select the phrase which is most closely associated with the statement.

Light energy is absorbed by chlorophyll.
A) neither the photochemical nor carbon-fixation reactions
B) carbon-fixation reactions, only
C) both the photochemical and carbon-fixation reactions
D) photochemical reactions, only

60) For the given statement, select the reaction of photosynthesis that is best described by the statement.

Water molecules are split.
A) neither photochemical nor carbon-fixation reactions
B) carbon-fixation reactions, only
C) photochemical reactions, only
D) both photochemical and carbon-fixation reactions

61) For the following statement, choose the biochemical process that is best described by the statement.

Some bacteria obtain energy for food production by oxidizing compounds of sulfur or iron.
A) fermentation  C) replication
B) photosynthesis  D) chemosynthesis

62) The diagram below represents a leaf cross-section.

Which letter indicates the principal region of food manufacture?
A) D  B) E  C) B  D) C

63) Enzymes for both photochemical and carbon-fixation reactions are found within organelles known as
A) ribosomes  C) chloroplasts
B) lysosomes  D) Golgi complexes

64) The process represented by the equation below occurs within cells of which organism?

\[ 12\text{H}_2\text{O} + 6\text{CO}_2 \xrightarrow{\text{energy, enzymes}} \text{C}_{6}\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O} + 6\text{O}_2 \]
A) a mushroom  B) a grasshopper
C) a human  D) a bean plant

65) Cells are adapted for carrying on the light reactions of photosynthesis because they contain
A) atoms of carbon-14
B) photolytic enzymes and pigments
C) nitrogen-fixing enzymes
D) molecules of hemoglobin
66) An organism was added to a test tube containing water, which was then sealed and placed in sunlight. The graph below shows an increase in the oxygen content of the test tube over a period of time. Which type of organism was most probably added to the test tube?

A) fresh-water animal  C) virus  
B) ameba  D) green alga

Questions 67 through 69 refer to the following:

One hundred samples of living plant tissues were placed in each of four sealed containers of equal volume. The amount of CO₂ present in each of the containers was 250 cubic centimeters. The data table below shows the color of light and the temperature that each container was exposed to. The amount of CO₂ remaining in each container at the end of 2 days is also shown in the table below. Assume that any experimental conditions not listed are identical in all four containers.

<table>
<thead>
<tr>
<th>Container</th>
<th>Plant</th>
<th>Plant Part</th>
<th>Light Color</th>
<th>Temperature (°C)</th>
<th>CO₂ Present After 2 Days (cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>myrtle</td>
<td>leaf</td>
<td>red</td>
<td>15</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>myrtle</td>
<td>leaf</td>
<td>red</td>
<td>27</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>oak</td>
<td>root</td>
<td>blue</td>
<td>27</td>
<td>300</td>
</tr>
<tr>
<td>4</td>
<td>oak</td>
<td>leaf</td>
<td>orange</td>
<td>27</td>
<td>150</td>
</tr>
</tbody>
</table>

67) In which container was photosynthesis most likely taking place at the fastest rate?
A) 1  B) 2  C) 3  D) 4

68) Which two containers should be used in order to compare the average amount of CO₂ used per day at two different temperatures?
A) 3 and 4  C) 1 and 3  
B) 1 and 2  D) 2 and 3

69) In which container was photosynthesis most likely not occurring?
A) 1  B) 2  C) 3  D) 4

70) In an investigation of the cycling of environmental gases, a student placed water and bromthymol blue in each of four test tubes as shown in the diagrams below. No additional items were placed in tube 1, a snail was placed in tube 2, an aquatic plant (elodea) was placed in tube 3, and both a snail and an elodea were placed in tube 4. The tubes were then stopped and placed in bright light for 24 hours.

How would the solution in tube 3 change after 24 hours?
A) It would contain more oxygen.  
B) It would change from yellow to blue.  
C) It would contain less nitrogen.  
D) It would change from blue to brick red.
71) In a maple tree, the enzymatic hydrolysis of starches, lipids, and proteins occurs
   A) both extracellularly and intracellularly
   B) intracellularly, only
   C) neither extracellularly nor intracellularly
   D) extracellularly, only

72) Although the life function of digestion is characteristic of most organisms, studies of thousands of different kinds of green plants have failed to reveal any specialized organ systems for digestion in these plants. Based on these observations and your knowledge of biology, you would conclude that green plants
   A) secrete hormones which hydrolyze foods outside of the plant
   B) cannot digest carbohydrates
   C) receive all their organic nutrients from the air
   D) carry on intracellular digestion

73) Twelve bean plants were used to study the effect of nutrients on the rate of plant growth. All the plants used in this investigation were initially the same height. Starting on day 1, six of the bean plants (Group A) were given 30 milliliters of distilled water every day for seven consecutive days. Starting on the same day, the other six bean plants (Group B) were given 30 milliliters of distilled water containing 0.1 gram of fertilizer every day for seven consecutive days. The average daily change in the height of the plants in each group is shown in the data table below.

<table>
<thead>
<tr>
<th>Day</th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

Based on the data in the table, if all the bean plants were 70 millimeters tall on day 1, the average height of the bean plants in group B on day 7 would be
   A) 95 mm
   B) 75 mm
   C) 81 mm
   D) 100 mm

74) Name and define the process that produces the gas found in the greatest quantity in area A.

75) Using one or more complete sentences, state what effect a decrease in light intensity would have on the process observed during this investigation.

76) The sugar maple has many structural adaptations that enable it to survive very well in many areas of New York State.

Write a complete sentence explaining the function of a cuticle and how it contributes to the survival of the tree.
Students in a biology class placed equal numbers of corn seeds on wet paper towels in glass petri dishes as shown in the diagram below. Half of the seeds were placed in a sunny location to germinate, and the other half of the seeds were placed in a dark location to germinate. All of the corn seeds were produced by plants that were heterozygous (Cc) for chlorophyll production. Corn plants that do not have the genetic ability to produce chlorophyll are known as albinos (cc). Throughout the investigation, temperature and moisture were kept constant.

Table I indicates the class data for the number of green plants and the number of white plants produced by the germinated seeds.

<table>
<thead>
<tr>
<th>Seeds Germinated in the Dark</th>
<th>Seeds Germinated in the Light</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 green plants</td>
<td>150 white plants</td>
</tr>
<tr>
<td>109 green plants</td>
<td>38 white plants</td>
</tr>
</tbody>
</table>

All petri dishes were then placed in a sunny location. Table II indicates the class data for the number of green plants and the number of white plants observed one week later.

<table>
<thead>
<tr>
<th>Seeds Moved from Dark to Light</th>
<th>Seedlings Remaining in Light</th>
</tr>
</thead>
<tbody>
<tr>
<td>116 green plants</td>
<td>34 white plants</td>
</tr>
<tr>
<td>109 green plants</td>
<td>38 white plants</td>
</tr>
</tbody>
</table>

Explain why all of the white (albino) plants indicated in Table II will die within a few weeks after germination, even though maintained under the same conditions as the green plants. [Use a complete sentence.]

78) Which process is best illustrated by the diagram?

- A) transpiration
- B) photosynthesis
- C) respiration
- D) hydrolysis

79) Green plants usually do not exercise large amounts of CO₂ because they use CO₂ in the process of

- A) transpiration
- B) hydrolysis
- C) photosynthesis
- D) anaerobic respiration

80) Which summary word equation best describes a process that directly requires light energy?

- A) glucose + glucose → maltose + water
- B) glucose → alcohol + carbon dioxide + ATP
- C) glucose + oxygen → carbon dioxide + water + ATP
- D) water + carbon dioxide → glucose + oxygen + water

81) Hydrogen atoms and carbon dioxide molecules participate in a series of chemical changes that produce a three-carbon sugar in photosynthesis. These chemical changes are part of

- A) the carbon-fixation reactions, only
- B) both the photochemical and the carbon-fixation reactions
- C) neither the photochemical nor the carbon-fixation reactions
- D) the photochemical reactions, only
82) The diagram below represents some of the events that take place in a plant cell.

![Green Plant Cell Diagram]

The letters X, Y, and Z most likely represent:
A) light, O₂, and methane
B) CO₂, light, and H₂O
C) N₂, O₂, and H₂O
D) light, ammonia, and H₂O

83) I. water + chlorophyll light → oxygen + hydrogen
II. CO₂ + hydrogen + ATP → X + H₂O

Which process is represented by equation I?
A) synthesis
B) carbon fixation
C) photolysis
D) the dark reaction

84) Plants may use FGAL (phosphoglyceraldehyde) for the
A) transport of auxins
B) splitting of water molecules
C) synthesis of sugar
D) production of oxygen gas

85) The diagram below represents some metabolic activities in a chloroplast.

![Metabolic Activities Diagram]

Which substance diffuses in the direction of arrow 1 after it is formed in the structure represented in area A?
A) glucose
B) starch
C) carbon dioxide
D) oxygen

86) A small piece of black paper was folded in half and used to cover part of the top and bottom portions of a leaf on a living geranium plant. After the plant was kept in sunlight for several days, the paper was removed. The leaf was then boiled in alcohol to remove the chlorophyll and placed in Lugol's iodine solution. Only the part of the leaf that had not been covered turned blue black.

This investigation was most likely testing the hypothesis that
A) light is necessary for photosynthesis to occur
B) plants use alcohol in the production of chlorophyll
C) green plants use carbon dioxide in photosynthesis
D) alcohol plus chlorophyll forms Lugol's solution

87) A wet-mount slide of photosynthetic protists was prepared and then exposed to light that had been broken up into a spectrum. When viewing this preparation through the microscope, a student would most likely observe that most of the protists had clustered in the regions of
A) green and yellow light
B) yellow and blue light
C) orange and green light
D) red and blue light

Questions 88 and 89 refer to the following:

![Microscope Preparation Diagram]

88) The gas bubbles produced in this investigation most likely contained molecules of
A) ammonia
B) sulfur dioxide
C) oxygen
D) uric acid

89) Which wavelengths of light would be most effective for the conversion of radiant energy into the chemical energy of organic compounds in the elodea?
A) red and green
B) red and blue
C) yellow and blue
D) yellow and green
90) Four plants of the same size and type were grown for 24 hours under identical conditions except for the color of the light source. The chart below identifies the color of the light each plant was exposed to during the experiment.

<table>
<thead>
<tr>
<th>Plant</th>
<th>Light Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Red</td>
</tr>
<tr>
<td>B</td>
<td>Green</td>
</tr>
<tr>
<td>C</td>
<td>Blue</td>
</tr>
<tr>
<td>D</td>
<td>White</td>
</tr>
</tbody>
</table>

After 24 hours, the leaves of each plant were tested for sugar. Which plant most likely contained the smallest amount of sugar?

A) A  B) B  C) C  D) D

91) Two black paper disks were clipped together; one on each side of a healthy geranium leaf, as shown in the diagram below. The plant containing the leaf was then kept in constant light for a period of one week. At the end of the week, the leaf was removed from the plant, and the disks were discarded. The leaf was boiled in water and then in alcohol to remove the pigments. Next, it was treated with an iodine solution.

What would most likely be the appearance of the leaf after the iodine treatment?

A) The area that had been covered by the paper disks would be brown, but the rest of the leaf would be blue black.
B) The area that had been covered by the paper disks would be blue black, but the rest of the leaf would be yellow.
C) The entire leaf would be brown.
D) The entire leaf would be brick red.

92) The illustration of a micrograph below shows part of a cell containing a portion of a chloroplast.

The highest concentration of chlorophyll exists in the region indicated by letter

A) A  B) B  C) C  D) D

93) The diagram below represents a cross section of a leaf.

Which structure is indicated by letter X?

A) palisade layer  B) cuticle  C) guard cell  D) spongy cell

Questions 94 and 95 refer to the following:

A student conducting an experiment placed five geranium plants of equal size in environmental chambers. Growing conditions were the same for each plant except that each chamber was illuminated by a different color of light of the same intensity. At the end of 20 days, plant growth was measured.

94) Using one or more complete sentences, state a possible hypothesis for this experiment.

95) Using one or more complete sentences, state the control that should be used in this experiment.
SAMPLE ANSWER: Photosynthesis is the process that produces the gas found in the greatest quantity in area A. Photosynthesis is the process by which green plants make their own nutritive materials in the sunlight.

SAMPLE ANSWER: A decrease in light intensity would decrease the rate at which the gas is produced. Light is the source of energy for the process of photosynthesis.

Answers vary.

SAMPLE ANSWER: Chlorophyll is a green pigment necessary for photosynthesis. White plants do not make chlorophyll and therefore cannot carry out photosynthesis.

SAMPLE ANSWER: The color of light affects plant growth.

SAMPLE ANSWER: The control should be a geranium plant grown in a chamber with white light or sunlight.