7.1 Multiple-Choice Questions

1) What is the name given to organisms that can make their own food and thus sustain themselves without consuming organic molecules derived from other organisms?
   A) chemotrophs
   B) heterotrophs
   C) synthesizers
   D) autotrophs
   Answer:  D
   Topic:  7.1
   Skill:  Knowledge/Comprehension

2) Photoautotrophs
   A) make sugar by using organic raw materials.
   B) produce organic molecules from inorganic molecules.
   C) eat other organisms that use light energy to make food molecules.
   D) include only the green plants.
   Answer:  B
   Topic:  7.1
   Skill:  Knowledge/Comprehension

3) Which of the following is an example of a photoautotroph?
   A) cyanobacteria in freshwater and marine ecosystems
   B) grizzly bears in Alaska
   C) bacteria in our mouth
   D) mushrooms growing on the side of a dead tree
   Answer:  A
   Topic:  7.1
   Skill:  Application/Analysis

4) Autotrophs that utilize light as their energy source are
   A) chemosynthetic autotrophs.
   B) photoautotrophs.
   C) fungi.
   D) heterotrophs.
   Answer:  B
   Topic:  7.1
   Skill:  Knowledge/Comprehension
5) What is the likely origin of chloroplasts?
A) mitochondria that had a mutation for photosynthesis
B) photosynthetic prokaryotes that lived inside eukaryotic cells
C) prokaryotes with photosynthetic mitochondria
D) eukaryotes that engulfed photosynthetic fungi
Answer: B
Topic: 7.1
Skill: Knowledge/Comprehension

6) In most green plants, chloroplasts are
A) concentrated in a zone of leaf tissue called the mesophyll.
B) concentrated in a portion of the leaf called the stroma.
C) evenly distributed throughout the leaf tissue.
D) evenly distributed throughout the entire plant.
Answer: A
Topic: 7.2
Skill: Knowledge/Comprehension

7) ________ cells in leaves are specialized for photosynthesis.
A) Companion
B) Mesophyll
C) Sclerenchyma
D) Tracheid
Answer: B
Topic: 7.2
Skill: Knowledge/Comprehension

8) CO₂ enters and O₂ escapes from a leaf via
A) stomata.
B) thylakoids.
C) grana.
D) stroma.
Answer: A
Topic: 7.2
Skill: Knowledge/Comprehension

9) In the chloroplast, sugars are made in a compartment that is filled with a thick fluid called the
A) stomata.
B) thylakoid.
C) matrix.
D) stroma.
Answer: D
Topic: 7.2
Skill: Knowledge/Comprehension
10) Chloroplasts contain disklike membranous sacs arranged in stacks called
A) cristae.
B) thylakoids.
C) grana.
D) vacuoles.
Answer: C
Topic: 7.2
Skill: Knowledge/Comprehension

11) Where is chlorophyll found in a plant cell?
A) stroma
B) thylakoid membranes
C) cytoplasm
D) cristae
Answer: B
Topic: 7.2
Skill: Knowledge/Comprehension

12) The oxygen released into the air as a product of photosynthesis comes from
A) water.
B) glucose.
C) carbon dioxide.
D) chlorophyll.
Answer: A
Topic: 7.3
Skill: Knowledge/Comprehension

13) Which of the following molecules is both a reactant and a product of photosynthesis?
A) H$_2$O
B) glucose
C) O$_2$
D) chlorophyll
Answer: A
Topic: 7.3
Skill: Knowledge/Comprehension

14) If you expose a photosynthesizing plant to water that contains both radioactive H and radioactive O,
in which of the products of photosynthesis will the radioactive H and O show up?
A) H and O both in glucose
B) H in glucose; O in water
C) H in water; O in glucose
D) H in glucose and water; O in O$_2$
Answer: D
Topic: 7.3
Skill: Application/Analysis
15) A redox reaction involves the transfer of
A) oxygen.
B) water.
C) an electron.
D) carbon dioxide.
Answer: C
Topic: 7.4
Skill: Application/Analysis

16) Which of the following statements concerning the role of redox reactions in photosynthesis and cellular respiration is true?
A) Photosynthesis involves only reductions, while respiration involves only oxidations.
B) Photosynthesis involves only oxidations, while respiration involves only reductions.
C) In photosynthesis, carbon dioxide is oxidized to form sugar, while in respiration, sugar is reduced to form carbon dioxide.
D) In photosynthesis, carbon dioxide is reduced to form sugar, while in respiration, sugar is oxidized to form carbon dioxide.
Answer: D
Topic: 7.4
Skill: Knowledge/Comprehension

17) What is the source of energy that provides the boost for electrons during photosynthesis?
A) light
B) electromagnetism
C) cellular respiration
D) ATP
Answer: A
Topic: 7.4
Skill: Knowledge/Comprehension

18) Which of the following statements regarding photosynthesis is false?
A) ATP is not produced during photosynthesis, but only during cellular respiration.
B) Photosynthesis is ultimately powered by light energy and respiration by the chemical energy of fuel molecules.
C) Photosynthesis consumes CO2; respiration consumes O2.
D) Photosynthesis produces O2; respiration produces CO2.
Answer: A
Topic: 7.4, 7.5
Skill: Knowledge/Comprehension

19) The light reactions occur in the ________, while the Calvin cycle occurs in the ________.
A) stroma . . . thylakoid membranes
B) stroma . . . nucleus
C) cytoplasm . . . thylakoid membrane
D) thylakoid membranes . . . stroma
Answer: D
Topic: 7.5
Skill: Knowledge/Comprehension
20) Which of the following are produced during the light reactions of photosynthesis?
A) glucose, ADP, NADP+
B) glucose, ADP, NADP+, CO₂
C) ADP, NADP+, O₂
D) ATP, NADPH, O₂
Answer: D
Topic: 7.5
Skill: Knowledge/Comprehension

21) Which of the following is part of the light reaction?
A) carbon fixation
B) reduction of carbon
C) regeneration of NADP+
D) formation of waste products in the form of O₂
Answer: D
Topic: 7.5
Skill: Knowledge/Comprehension

22) Which of the following are produced during the Calvin cycle?
A) glucose, ADP, NADP+
B) glucose, ADP, NADP+, CO₂
C) ATP, NADPH, O₂
D) ATP, NADPH, CO₂
Answer: A
Topic: 7.5
Skill: Knowledge/Comprehension

23) Carbon fixation
A) occurs when carbon atoms from CO₂ are incorporated into an organic molecule.
B) supplies the cell with ATP.
C) occurs during the light reactions.
D) provides the cell with a supply of NADPH molecules.
Answer: A
Topic: 7.5
Skill: Knowledge/Comprehension

24) Sunlight is a type of ________ energy.
A) electromagnetic
B) potential
C) kinetic
D) nuclear
Answer: A
Topic: 7.6
Skill: Knowledge/Comprehension
25) The full range of electromagnetic energy is called the ________ spectrum.
A) visible
B) electromagnetic
C) energy
D) ultraviolet
Answer:  B
Topic:  7.6
Skill:  Knowledge/Comprehension

26) Why are most plants green?
A) Chlorophyll \(a\) reflects green light.
B) Chlorophyll \(a\) absorbs green light.
C) Chlorophyll \(b\) primarily uses green light as the source of energy for photosynthesis.
D) Green helps plants blend into their environment as a sort of camouflage.
Answer:  A
Topic:  7.6
Skill:  Knowledge/Comprehension

27) Which of the following colors contributes the \textit{least} energy to photosynthesis?
A) blue
B) red
C) orange
D) green
Answer:  D
Topic:  7.6
Skill:  Application/Analysis

28) Of the following wavelengths of light, which would you expect to be reflected or transmitted by chlorophyll \(a\)?
A) blue
B) green
C) yellow
D) red
Answer:  B
Topic:  7.6
Skill:  Knowledge/Comprehension

29) Chlorophyll \(b\)
A) is best at absorbing the energy of green light.
B) is best at absorbing the energy of blue-violet and red light, just like chlorophyll \(a\).
C) passes absorbed energy to chlorophyll \(a\).
D) catalyze the incorporation of carbon atoms into RuBP.
Answer:  C
Topic:  7.6
Skill:  Knowledge/Comprehension
30) Plant cells are protected from the harmful effects of reactive oxidative molecules by
A) mitochondria.
B) chlorophyll.
C) carotenoids.
D) ATP.
Answer: C
Topic: 7.6
Skill: Knowledge/Comprehension

31) A packet of light energy is called a
A) quantum.
B) pigment.
C) photon.
D) phaser.
Answer: C
Topic: 7.6
Skill: Knowledge/Comprehension

32) Which of the following statements about the absorption of photons by pigment molecules is true?
A) It takes several minutes for the pigment electrons to become excited.
B) Photons raise electrons in pigments to the ground state.
C) Excitation of the electrons is a very stable state.
D) The release of energy by the excited electron can be as heat, light, or fluorescence.
Answer: D
Topic: 7.7
Skill: Knowledge/Comprehension

33) Which of the following photosynthetic pigments can be found at the photosystem reaction center?
A) chlorophyll $b$
B) chlorophyll $a$
C) a carotenoid
D) phycocyanin
Answer: B
Topic: 7.7
Skill: Knowledge/Comprehension

34) Which of the following is a normal process of photosynthesis that could not occur if all reaction centers were inactivated by a toxin?
A) donation of excited electrons by chlorophyll $a$ to a primary electron acceptor
B) donation of excited electrons by chlorophyll $b$ to a primary electron acceptor
C) absorption of photons by chlorophyll $b$
D) absorption of photons by carotenoids
Answer: A
Topic: 7.7
Skill: Knowledge/Comprehension
35) How do the reaction centers of photosystem I and II differ?
A) Chlorophyll \( a \) is found in photosystem I and chlorophyll \( b \) in photosystem II.
B) Each preferentially absorbs slightly different wavelengths of light.
C) Photosystem I functions first in the sequence of steps that make up the light reactions.
D) Photosystem II does not transfer electrons from photons.
Answer: B
Topic: 7.7
Skill: Knowledge/Comprehension

36) Clusters of light-gathering pigments in a photosystem
A) pass energy to the reaction center.
B) are found in the roots of plants.
C) absorb electrons.
D) break down \( \text{H}_2\text{O} \).
Answer: A
Topic: 7.7
Skill: Knowledge/Comprehension

37) In a photosystem, clusters of chlorophyll \( a \), chlorophyll \( b \), and carotenoid pigments function most like
A) an antenna.
B) a propeller on a motorboat.
C) a windmill.
D) a spring.
Answer: A
Topic: 7.7
Skill: Application/Analysis

38) The energy that excites P680 and P700 is supplied by
A) electrons passing down the electron transport chain.
B) ATP.
C) photons.
D) NADPH.
Answer: C
Topic: 7.8
Skill: Knowledge/Comprehension

39) The electron transport chains of the light reactions
A) are located in the stroma.
B) shuttle electrons along in a series of redox reactions.
C) provide energy for the citric acid cycle.
D) are found on the plasma membrane of mesophyll cells.
Answer: B
Topic: 7.8
Skill: Knowledge/Comprehension
40) As a result of the cascade of electrons down the electron transport chains of the light reactions,
A) NADPH is reduced to NADP⁺.
B) NADPH is oxidized to NADP⁺.
C) NADP⁺ is reduced to NADPH.
D) NADP⁺ is oxidized to NADPH.
Answer:  C  
Topic:  7.8  
Skill:  Knowledge/Comprehension

41) The electrons lost from the reaction center of photosystem I are replaced by electrons from
A) CO₂.
B) H₂O.
C) the top of the electron transport chain.
D) the bottom of the electron transport chain.
Answer:  D  
Topic:  7.8  
Skill:  Knowledge/Comprehension

42) The electrons lost from the reaction center of photosystem II are replaced by electrons from
A) CO₂.
B) ATP.
C) H₂O.
D) photosystem I.
Answer:  C  
Topic:  7.8  
Skill:  Knowledge/Comprehension

43) Photosystem II
A) has P700 at its reaction center.
B) passes electrons to photosystem I.
C) does not have a reaction center.
D) releases CO₂ as a by-product.
Answer:  B  
Topic:  7.8  
Skill:  Knowledge/Comprehension

44) Photophosphorylation during photosynthesis differs from oxidative phosphorylation during cellular respiration in that
A) it involves an electron transport chain.
B) energy is stored in the form of a proton concentration difference.
C) regeneration of ATP is driven by a flow of protons through an ATP synthase.
D) the final electron acceptor is NADP⁺ and not oxygen.
Answer:  D  
Topic:  7.9  
Skill:  Knowledge/Comprehension
45) In photophosphorylation, energy from electron flow is used to transport ________ from the ________ to the thylakoid compartment, generating a concentration gradient of ________.
A) electrons . . . grana . . . H⁺
B) H⁺ . . . grana . . . electrons
C) H⁺ . . . stroma . . . H⁺
D) H⁺ . . . stroma . . . ATP
Answer: C
Topic: 7.9
Skill: Knowledge/Comprehension

46) The chloroplast ATP synthase
A) is a nucleic acid complex.
B) couples the flow of H⁺ to the phosphorylation of ADP.
C) is found in the stroma.
D) helps transport H⁺ against the concentration gradient.
Answer: B
Topic: 7.9
Skill: Knowledge/Comprehension

47) In photosynthesis, the chemiosmotic production of ATP
A) requires oxygen.
B) is analogous to the production of ATP in mitochondria.
C) is done by the Calvin cycle.
D) is a result of the oxidation of glucose.
Answer: B
Topic: 7.9
Skill: Knowledge/Comprehension

48) Mitochondria transfer ________ energy from ________ to ATP; chloroplasts transform ________ energy into the chemical energy of ATP.
A) chemical . . . food . . . light
B) food . . . light . . . chemical
C) light . . . food . . . kinetic
D) food . . . light . . . nuclear
Answer: A
Topic: 7.9
Skill: Knowledge/Comprehension

49) Photosynthetic organisms derive their carbon from
A) carbon monoxide.
B) carbon dioxide.
C) hydrocarbons.
D) methane.
Answer: B
Topic: 7.10
Skill: Knowledge/Comprehension
50) ATP and NADPH
A) power sugar synthesis during the Calvin cycle.
B) are products of the Calvin cycle.
C) provide energy to Photosystem I and Photosystem II.
D) are used in the electron transport chain to pump H+ into the thylakoid space.
Answer: A
Topic: 7.10
Skill: Knowledge/Comprehension

51) To produce one glucose, the Calvin cycle needs to be run through ________ time(s).
A) two
B) four
C) six
D) eight
Answer: C
Topic: 7.10
Skill: Knowledge/Comprehension

52) The Calvin cycle constructs __________, an energy-rich molecule that a plant cell can then use to make glucose or other organic molecules.
A) G3P
B) ATP
C) NADH
D) carbon dioxide
Answer: A
Topic: 7.10
Skill: Knowledge/Comprehension

53) The addition of oxygen instead of carbon dioxide to RuBP results in
A) cellular respiration.
B) photorespiration.
C) photophosphorylation.
D) aerobic respiration.
Answer: B
Topic: 7.11
Skill: Knowledge/Comprehension

54) Photorespiration
A) may be an evolutionary relic from when atmospheric O2 levels were low.
B) is of benefit to the plant since it breaks down rubisco.
C) is attributable to high CO2 levels.
D) produces glucose.
Answer: A
Topic: 7.11
Skill: Knowledge/Comprehension
55) What is the main adaptive advantage of the C₄ and CAM photosynthesis strategies over the C₃ strategy?
A) They help the plant conserve water and synthesize glucose efficiently under hot, dry conditions.
B) They allow the plant to fix carbon more efficiently under conditions of low atmospheric CO₂.
C) They allow the plant to fix carbon more efficiently in dim or cool conditions.
D) They make it possible for the plant to use the Calvin cycle at night.
Answer: A
Topic: 7.11
Skill: Knowledge/Comprehension

56) The ultimate source of all the food we eat and the oxygen we breathe is
A) cellular respiration.
B) photosynthesis.
C) glycolysis.
D) anaerobic metabolism.
Answer: B
Topic: 7.12
Skill: Knowledge/Comprehension

57) Plants use sugars as
A) a fuel for photosynthesis.
B) a starting material for the Calvin cycle.
C) a source of electrons for chemiosmosis.
D) a fuel for cellular respiration and a starting material for making other organic molecules.
Answer: D
Topic: 7.12
Skill: Application/Analysis

58) Plant cells
A) lack mitochondria and chloroplasts.
B) lack mitochondria but have chloroplasts.
C) have mitochondria but do not have chloroplasts.
D) have mitochondria and chloroplasts.
Answer: D
Topic: 7.12
Skill: Knowledge/Comprehension

59) Global warming due to the greenhouse effect may be
A) moderated by photosynthesis, which removes carbon dioxide from the atmosphere.
B) made worse by photosynthesis, which adds carbon dioxide to the atmosphere.
C) reduced by the burning of fossil fuels, which removes oxygen from the atmosphere.
D) of little concern, since it is part of the normal cycle for the planet.
Answer: A
Topic: 7.13
Skill: Knowledge/Comprehension
60) Which of the following statements about the greenhouse effect is true?
A) The greenhouse effect is reduced by deforestation.
B) The greenhouse effect is exacerbated by the use of fossil fuels.
C) The greenhouse effect will decrease the average temperature of the planet.
D) The greenhouse effect has no direct relationship with the Industrial Revolution of the 1800s.
Answer: B
Topic: 7.13
Skill: Knowledge/Comprehension

61) It has been argued that cutting old-growth forests and replacing them with plantations of young trees would help to alleviate the threat of global greenhouse warming. What important fact does this argument ignore?
A) Forests play too minor a role in global CO2 dynamics, which are affected far more by marine algae.
B) Young trees fix carbon at a lower rate per unit mass than old trees.
C) Most of the biomass of the cut trees would be added to the atmosphere as CO2 within a few years.
D) Most of the young trees would die within a few years.
Answer: C
Topic: 7.13
Skill: Application/Analysis

62) Ozone
A) formation is promoted by CFCs.
B) is broken down by carbon dioxide.
C) is a source of oxygen for cellular respiration.
D) protects Earth from UV radiation.
Answer: D
Topic: 7.14
Skill: Knowledge/Comprehension

63) Ozone consists of _______ oxygen atom(s).
A) one
B) two
C) three
D) four
Answer: C
Topic: 7.14
Skill: Knowledge/Comprehension

64) Which of the following has been a major source of ozone destruction over the past 50 years?
A) chlorofluorocarbons
B) ethylene glycol
C) carbon dioxide
D) chemiosmosis
Answer: A
Topic: 7.14
Skill: Knowledge/Comprehension
7.2 Art Questions

1) In this drawing of a chloroplast, which structure represents the thylakoid membrane?

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

Answer: C

Topic: 7.2
Skill: Knowledge/Comprehension
2) According to this figure, how do $H^+$ ions make their way from the stroma to the thylakoid interior?

A) through photosystem I  
B) through an electron transport chain molecule  
C) through the ATP synthase  
D) directly through the phospholipids of the thylakoid membrane

Answer: B  
Topic: 7.9  
Skill: Application/Analysis
7.3 Scenario Questions

*After reading the paragraph, answer the question(s) that follow.*

You're conducting an experiment to determine the effect of different wavelengths of light on the absorption of carbon dioxide as an indicator of the rate of photosynthesis in aquatic ecosystems. If the rate of photosynthesis increases, the amount of carbon dioxide in the environment will decrease and vice versa. You've added an indicator to each solution. When the carbon dioxide concentration decreases, the color of the indicator solution also changes.

Small aquatic plants are placed into three containers of water mixed with carbon dioxide and indicator solution. Container A is placed under normal sunlight, B under green light, and C under red light. The containers are observed for a 24-hour period.

1) Based on your knowledge of the process of photosynthesis, the plant in the container placed under red light would probably
   A) absorb no CO$_2$.
   B) absorb the same amount of CO$_2$ as the plants under both the green light and normal sunlight.
   C) absorb less CO$_2$ than the plants under green light.
   D) absorb more CO$_2$ than the plants under the green light.

   Answer: D
   Topic: 7.6
   Skill: Application/Analysis

2) Carbon dioxide absorption is an appropriate indicator of photosynthesis because
   A) CO$_2$ is needed to produce sugars in the Calvin cycle.
   B) CO$_2$ is needed to complete the light reactions.
   C) plants produce oxygen gas by splitting CO$_2$.
   D) the energy in CO$_2$ is used to produce ATP and NADPH.

   Answer: A
   Topic: 7.3-7.5, 7.12
   Skill: Knowledge/Comprehension