Name: _____

FirstSemester15

Matching

Match each item with the correct statement below.

a. organic chemistry
b. inorganic chemistry
c. biochemistry
d. analytical chemistry
e. physical chemistry

1. the study of the processes that take place in organisms
2. concerned with the mechanism, rate, and energy transfer that occurs when matter undergoes a change
3. the study of all chemicals containing carbon
4. the study of chemicals that, in general, do not contain carbon
5. the study of the composition of matter

Match each item with the correct statement below.

a. mixture
b. product
c. phase
d. reactant
e. heterogeneous mixture
f. vapor

6. gaseous state of substance that is a liquid or solid at room temperature
7. a physical blend of two or more components
8. part of a sample having uniform composition and properties
9. not uniform in composition
10. a substance formed in a chemical reaction
11. starting substance in a chemical reaction

Match each item with the correct statement below.

a. distillation
b. mass
c. chemical reaction
d. compound
e. element
f. homogeneous

12. amount of matter an object contains
13. describes mixture with a uniform composition

14. a process in which a liquid is boiled to produce a vapor that is condensed again into a liquid
15. substance that cannot be changed into simpler substances by chemical means
16. composed of two or more substances chemically combined in a fixed proportion
17. process in which substances are changed into different substances

Match each item with the correct statement below.

a. absolute zero
b. Kelvin temperature scale
c. Celsius temperature scale
d. weight
e. mass
f. significant figure
g. precision
h. accuracy

18. closeness to true value
19. narrowness of range of measurements
20. known or estimated in a measurement
21. the quantity of matter an object contains
22. the lowest point on the Kelvin scale
23. the SI scale for temperature
24. the force of gravity on an object
25. the non-SI scale for temperature

Match each item with the correct statement below.

a. proton
b. nucleus
c. atom
d. electron
e. neutron

26. the smallest particle of an element that retains the properties of that element
27. a positively charged subatomic particle
28. a negatively charged subatomic particle
29. a subatomic particle with no charge
30. the central part of an atom, containing protons and neutrons

Match each item with the correct statement below.

a. mass number
b. atomic mass unit
c. atomic number
d. atomic mass
e. isotope

31. atoms with the same number of protons, but different numbers of neutrons in the nucleus of an atom

32. the total number of protons and neutrons in the nucleus of an atom

33. the number of protons in the nucleus of an element

34. the weighted average of the masses of the isotopes of an element

35. one-twelfth the mass of a carbon atom having six protons and six neutrons

Match each item with the correct statement below.

a. atomic orbital
b. aufbau principle
c. electron configuration
d. ground state
e. Pauli exclusion principle
f. Heisenberg uncertainty principle

36. region of high probability of finding an electron

37. states the impossibility of knowing both velocity and position of a moving particle at the same time

38. lowest energy level

39. tendency of electrons to enter orbitals of lowest energy first

40. arrangement of electrons around atomic nucleus

41. each orbital has at most two electrons

Match each item with the correct statement below.

a. atomic emission spectrum
b. frequency
c. wavelength
d. photon
e. quantum
f. spectrum

42. discrete bundle of electromagnetic energy

43. energy needed to move an electron from one energy level to another

44. number of wave cycles passing a point per unit of time

45. distance between wave crests

46. separation of light into different wavelengths

47. frequencies of light emitted by an element

Match each item with the correct statement below.

a. electronegativity
b. ionization energy
c. atomic radius
d. metal
e. transition metal
f. periodic law
g. cation
h. period
i. group
j. electrons

48. horizontal row in the periodic table

49. vertical column in the periodic table

50. A repetition of properties occurs when elements are arranged in order of increasing atomic number.

51. type of element that is a good conductor of heat and electric current

52. type of element characterized by the presence of electrons in the *d* orbital

53. one-half the distance between the nuclei of two atoms when the atoms are joined

54. type of ion formed by Group 2A elements

55. subatomic particles that are transferred to form positive and negative ions

56. ability of an atom to attract electrons when the atom is in a compound

57. energy required to remove an electron from an atom

Match each item with the correct statement below.

a. halide ion
b. octet rule
c. ionic bond
d. electron dot structure
e. valence electron
f. coordination number
g. metallic bond

58. an electron in the highest occupied energy level of an atom

59. Atoms react so as to acquire the stable electron structure of a noble gas.

60. a depiction of valence electrons around the symbol of an element

61. an anion of chlorine or other halogen

62. the force of attraction binding oppositely charged ions together

63. the attraction of valence electrons for metal ions

64. the number of ions of opposite charge surrounding each ion in a crystal

Multiple Choice

Identify the choice that best completes the statement or answers the question.

65. Which field of science studies the composition and structure of matter?
a. physics
b. biology
c. chemistry
d. geology

66. Which of the following would a chemist be most likely to study?
a. a leaf floating on water
b. a leaf changing color in autumn
c. a leaf being blown by the wind
d. a leaf being eaten by insects

67. Which of the following best describes an example of pure chemistry?

a. testing the effects of lower concentrations of a drug on humans
b. studying chemicals containing carbon
c. developing a cure for osteoporosis
d. finding an antidote for a new strain of virus

68. Which of the following statements is false?
a. Knowledge of chemistry allows the public to make informed decisions.
b. Studying chemistry ensures that officials make correct choices in funding technology.
c. Knowledge of chemistry helps prepare people for careers in soil science.
d. Chemistry explains many aspects of nature.

69. Which of the following is NOT an example of chemistry research in the main area of energy?
a. producing hook-and-loop tape
b. determining the usefulness of oil from soybean plants
c. developing rechargeable batteries
d. studying the effects of insulation

70. One characteristic of a scientific theory is that _____.
a. it can never be proved
b. it can be proved
c. it cannot be modified
d. it summarizes a set of observations

71. Which step in the scientific method requires you to use your senses to obtain information?
a. revising a hypothesis
b. designing an experiment
c. making an observation
d. stating a theory

72. How do conceptual problems differ from numeric problems?
a. Solutions to conceptual problems involve analysis, while numeric solutions do not.
b. Logic is not usually involved in solving numeric problems.
c. A plan is necessary to solve numeric problems, but is not necessary for conceptual problems.
d. Solutions to conceptual problems normally do not involve calculations.

73. Which of the following is NOT an example of matter?
a. air
b. heat
c. smoke
d. water vapor

74. All of the following are physical properties of matter EXCEPT _____.
a. mass
b. color
c. melting point
d. ability to rust

75. Which of the following are considered physical properties of a substance?
a. color and odor
b. melting and boiling points
c. malleability and hardness
d. all of the above

76. A vapor is which state of matter?
a. solid
b. liquid
c. gas
d. all of the above

77. Which state of matter has a definite volume and takes the shape of its container?
a. solid
c. gas

b. liquid
d. both b and c

78. Which state of matter is characterized by having an indefinite shape, but a definite volume?
a. gas
b. liquid
c. solid
d. none of the above

79. Which state of matter is characterized by having a definite shape and a definite volume?
a. gas
b. liquid
c. solid
d. all of the above

80. Which state of matter expands when heated and is easy to compress?
a. gas
b. liquid
c. solid
d. all of the above

81. All of the following are physical properties of a substance in the liquid state EXCEPT ____.
a. indefinite volume
b. definite mass
c. not easily compressed
d. indefinite shape

82. Which of the following is a physical change?
a. corrosion
b. explosion
c. evaporation
d. rotting of food

83. Which of the following is a heterogeneous mixture?
a. air
b. salt water
c. steel
d. soil

84. Which of the following is true about homogeneous mixtures?
a. They are known as solutions.
b. They consist of two or more phases.
c. They have compositions that never vary.
d. They are always liquids.

85. An example of a homogeneous mixture is ____.
a. water
b. stainless steel
c. noodle soup
d. oxygen

86. Which of the following items is NOT a compound?
a. baking soda
b. salad dressing
c. sucrose
d. table salt

87. Which of the following is true about compounds?
a. They can be physically separated into their component elements.
b. They have compositions that vary.
c. They are substances.
d. They have properties similar to those of their component elements.

88. What distinguishes a substance from a mixture?
a. Substances are compounds, and mixtures are not.
b. Mixtures are groupings of elements, and compounds are not.
c. Samples of the same substance can have different intensive properties.
d. Mixtures can be separated physically, while compounds cannot.

89. The first figure in a properly written chemical symbol always is _____.
    a. boldfaced
    b. capitalized
    c. italicized
    d. underlined

90. Which of the following is used for chemical symbols today?
    a. drawings
    b. icons
    c. letters
    d. numbers

91. The chemical formula of a compound does NOT indicate the _____.
    a. identity of the elements in the compound
    b. how elements are joined in the compound
    c. the composition of the compound
    d. relative proportions of the elements in the compound

92. In the chemical reaction in which sucrose is heated and decomposes to form carbon dioxide and water, which of the following is a reactant?
    a. sucrose
    b. carbon dioxide
    c. water
    d. heat

93. What must occur for a change to be a chemical reaction?
    a. There must be a change in chemical properties.
    b. There must be a change in physical properties.
    c. The change must involve a change in mass.
    d. The change must involve a change in volume.

94. Which of the following does NOT involve a physical change?
    a. mixing
    b. melting
    c. grinding
    d. decomposing

95. Which of the following processes does NOT involve a change in chemical properties?
    a. rusting
    b. fermenting
    c. boiling
    d. burning

96. A chemical change occurs when a piece of wood _____.
    a. is split
    b. is painted
    c. decays
    d. is cut

97. What must be done to be certain that a chemical change has taken place?
    a. Check for the production of bubbles before and after the change.
    b. Demonstrate that a release of energy occurred after the change.
    c. Check the composition of the sample before and after the change.
    d. Demonstrate that energy was absorbed by the reactants after the change.

98. When paper turns yellow-brown upon exposure to sunlight, what type of change is likely taking place?
    a. a physical change
    b. a chemical change
    c. neither a physical change nor a chemical change
    d. both a physical change and a chemical change

99. Which of the following indicates that a chemical change has happened during cooking?
    a. The food darkens.
    b. Bubbles form in boiling water.
    c. Butter melts.
    d. Energy is transferred from the stove to a pan.

100. What happens to matter during a chemical reaction?
    a. Matter is neither destroyed or created.
    b. Some matter is destroyed.
    c. Some matter is created.
    d. Some matter is destroyed and some is created.

101. Which of the following is true for all chemical reactions?
    a. The total mass of the reactants increases.
    b. The total mass of the products is greater than the total mass of the reactants.
    c. The total mass of the products is less than the total mass of the reactants.
    d. The total mass of the reactants equals the total mass of the products.

102. What is the result of multiplying 2.5×10^{10} by 3.5×10^{-7} ?
    a. 8.75×10^{-3}
    b. 8.75×10^{17}
    c. 8.75×10^{3}
    d. 8.75×10^{-17}

103. Which of the following measurements contains two significant figures?
    a. 0.004 00 L
    b. 0.004 04 L
    c. 0.000 44 L
    d. 0.004 40 L

104. When a test instrument is calibrated, does its accuracy, precision, or reliability improve?
    a. precision
    b. accuracy
    c. reliability
    d. all of the above

105. Which group of measurements is the most precise? (Each group of measurements is for a different object.)
    a. 2 g, 3 g, 4 g
    b. 2.0 g, 3.0 g, 4.0 g
    c. 2 g, 2.5 g, 3 g
    d. 1 g, 3 g, 5 g

106. Which of the following measurements is expressed to three significant figures?
    a. 0.007 m
    b. 7077 mg
    c. 7.30×10^{-7} km
    d. 0.070 mm

107. How many significant figures are in the measurement 0.003 4 kg?
    a. two
    b. four
    c. five
    d. This cannot be determined.

108. How many significant figures are in the measurement 40,500 mg?
    a. two
    b. three
    c. four
    d. five

109. How many significant figures are in the measurement 811.40 grams?
   a. two
   b. three
   c. four
   d. five

110. Express the sum of 1111 km and 222 km using the correct number of significant digits.
   a. 1300 km
   b. 1330 km
   c. 1333 km
   d. 1333.0 km

111. Express the product of 2.2 mm and 5.00 mm using the correct number of significant digits.
   a. $10\ mm^2$
   b. $11\ mm^2$
   c. $11.0\ mm^2$
   d. $11.00\ mm^2$

112. What is the measurement 1042 L rounded off to two significant digits?
   a. 1.0×10^3 L
   b. 1040 L
   c. 1050 L
   d. 1.1×10^3 L

113. What is the metric system prefix for the quantity 0.000 001?
   a. *centi-*
   b. *deci-*
   c. *kilo-*
   d. *micro-*

114. Which of the following volumes is the smallest?
   a. one microliter
   b. one liter
   c. one milliliter
   d. one deciliter

115. What is the temperature of absolute zero measured in °C?
   a. –373°C
   b. –273°C
   c. –173°C
   d. –73°C

116. Which temperature scale has no negative temperatures?
   a. Celsius
   b. Fahrenheit
   c. Joule
   d. Kelvin

117. What is the boiling point of water in kelvins?
   a. 0 K
   b. 100 K
   c. 273 K
   d. 373 K

118. The weight of an object _____.
   a. is the same as its mass
   b. depends on its location
   c. is not affected by gravity
   d. is always the same

119. If the temperature changes by 100 K, by how much does it change in °C?
   a. 0°C
   b. 37°C
   c. 100°C
   d. 273°C

Commonly Used Metric Prefixes		
Prefix	**Meaning**	**Factor**

mega (M)	1 million times larger than the unit it precedes	10^6
kilo (k)	1000 times larger than the unit it precedes	10^3
deci (d)	10 times smaller than the unit it precedes	10^{-1}
centi (c)	100 times smaller than the unit it precedes	10^{-2}
milli (m)	1000 times smaller than the unit it precedes	10^{-3}
micro (μ)	1 million times smaller than the unit it precedes	10^{-6}
nano (n)	1000 million times smaller than the unit it precedes	10^{-9}
pico (p)	1 trillion times smaller than the unit it precedes	10^{-12}

120. What is the quantity 0.0075 meters expressed in centimeters? Use the table above to help you.
   a. 0.075 cm
   b. 0.75 cm
   c. 7.5 cm
   d. 70.5 cm

121. A train travels at a speed of 30 miles per hour. If 1 mile = 1.6 kilometers, how fast is the train traveling in kilometers per minute?
   a. 0.4 km/min
   b. 0.6 km/min
   c. 0.8 km/min
   d. 1.0 km/min

122. The density of mercury is 5,427 kg/(m^3). If the density of water is 1.0 g/mL, will mercury float or sink in water?
   a. Mercury will float because the density of mercury is 0.005427 g/mL, which is less than the 1.0 g/mL density of water.
   b. Mercury will float because the density of mercury is 0.05427 g/mL, which is less than the 1.0 g/mL density of water.
   c. Mercury will sink because the density of mercury is 5.427 g/mL, which is greater than the 1.0 g/mL density of water.
   d. Mercury will sink because the density of mercury is 5,427 g/mL, which is greater than the 1.0 g/mL density of water.

123. Which of the following equalities is NOT correct? Use the table above to help you.
   a. 100 cg = 1 g
   b. 1000 mm = 1 m
   c. 1 cm^3 = 1 mL
   d. 10 kg = 1 g

124. A cubic meter is about the same as the volume occupied by a _____.
   a. kilogram of water
   b. cup of milk
   c. washing machine
   d. basketball arena

125. What is the density of an object having a mass of 8.0 g and a volume of 25 cm^3 ?
   a. 0.32 g/cm^3
   b. 2.0 g/cm^3
   c. 3.1 g/cm^3
   d. 200 g/cm^3

126. What is the volume of 45.6 g of silver if the density of silver is 10.5 g/mL?

a. 0.23 mL
b. 4.34 mL
c. 479 mL
d. none of the above

127. If the temperature of a piece of steel decreases, what happens to its density?
a. The density decreases.
b. The density increases.
c. The density does not change.
d. The density first increases, then decreases.

128. Dalton's atomic theory included which idea?
a. All atoms of all elements are the same size.
b. Atoms of different elements always combine in one-to-one ratios.
c. Atoms of the same element are always identical.
d. Individual atoms can be seen with a microscope.

129. Which of the following is NOT a part of Dalton's atomic theory?
a. All elements are composed of atoms.
b. Atoms are always in motion.
c. Atoms of the same element are identical.
d. Atoms that combine do so in simple whole-number ratios.

130. Which of the following was originally a tenet of Dalton's atomic theory, but had to be revised about a century ago?
a. Atoms are tiny indivisible particles.
b. Atoms of the same element are identical.
c. Compounds are made by combining atoms.
d. Atoms of different elements can combine with one another in simple whole number ratios.

131. The comparison of the number of atoms in a copper coin the size of a penny with the number of people on Earth is made to illustrate which of the following?
a. that atoms are indivisible
b. that atoms are very small
c. that atoms are very large
d. that in a copper penny, there is one atom for every person on Earth

132. Dalton hypothesized that atoms are indivisible and that all atoms of an element are identical. It is now known that _____.
a. all of Dalton's hypotheses are correct
b. atoms of an element can have different numbers of protons
c. atoms are divisible
d. all atoms of an element are not identical but they must all have the same mass

133. Which of the following is true about subatomic particles?
a. Electrons are negatively charged and are the heaviest subatomic particle.
b. Protons are positively charged and the lightest subatomic particle.
c. Neutrons have no charge and are the lightest subatomic particle.
d. The mass of a neutron nearly equals the mass of a proton.

134. What is the relative mass of an electron?

a. 1/1840 the mass of a hydrogen atom
b. 1/1840 the mass of a neutron + proton
c. 1/1840 the mass of a C-12 atom
d. 1/1840 the mass of an alpha particle

135. Which of the following is correct concerning subatomic particles?
a. The electron was discovered by Goldstein in 1886.
b. The neutron was discovered by Chadwick in 1932.
c. The proton was discovered by Thomson in 1880.
d. Cathode rays were found to be made of protons.

136. As a consequence of the discovery of the nucleus by Rutherford, which model of the atom is thought to be true?
a. Protons, electrons, and neutrons are evenly distributed throughout the volume of the atom.
b. The nucleus is made of protons, electrons, and neutrons.
c. Electrons are distributed around the nucleus and occupy almost all the volume of the atom.
d. The nucleus is made of electrons and protons.

137. The atomic number of an element is the total number of which particles in the nucleus?
a. neutrons
b. protons
c. electrons
d. protons and electrons

138. In which of the following sets is the symbol of the element, the number of protons, and the number of electrons given correctly?
a. In, 49 protons, 49 electrons
b. Zn, 30 protons, 60 electrons
c. Cs, 55 protons, 132.9 electrons
d. F, 19 protons, 19 electrons

139. Using the periodic table, determine the number of neutrons in $^{16}_{}O$.
a. 4
b. 8
c. 16
d. 24

140. How many protons, electrons, and neutrons does an atom with atomic number 50 and mass number 125 contain?
a. 50 protons, 50 electrons, 75 neutrons
b. 75 electrons, 50 protons, 50 neutrons
c. 120 neutrons, 50 protons, 75 electrons
d. 70 neutrons, 75 protons, 50 electrons

141. If E is the symbol for an element, which two of the following symbols represent isotopes of the same element?
1. $^{20}_{10}E$ 2. $^{20}_{11}E$ 3. $^{21}_{9}E$ 4. $^{21}_{10}E$
a. 1 and 2
b. 3 and 4
c. 1 and 4
d. 2 and 3

142. Which of the following sets of symbols represents isotopes of the same element?
a. $^{91}_{42}J$ $^{92}_{42}J$ $^{93}_{40}J$
b. $^{50}_{19}L$ $^{50}_{20}L$ $^{50}_{21}L$
c. $^{84}_{38}M$ $^{86}_{38}M$ $^{87}_{38}M$
d. $^{138}_{59}Q$ $^{133}_{55}Q$ $^{133}_{54}Q$

143. How is the number of neutrons in the nucleus of an atom calculated?
   a. Add the number of electrons and protons together.
   b. Subtract the number of electrons from the number of protons.
   c. Subtract the number of protons from the mass number.
   d. Add the mass number to the number of electrons.

144. In which of the following is the number of neutrons correctly represented?
   a. $^{19}_{9}F$ has 0 neutrons.
   b. $^{75}_{33}As$ has 108 neutrons.
   c. $^{24}_{12}Mg$ has 24 neutrons.
   d. $^{238}_{92}U$ has 146 neutrons.

145. How do the isotopes hydrogen-1 and hydrogen-2 differ?
   a. Hydrogen-2 has one more electron than hydrogen-1.
   b. Hydrogen-2 has one neutron; hydrogen-1 has none.
   c. Hydrogen-2 has two protons; hydrogen-1 has one.
   d. Hydrogen-2 has one proton; hydrogen-1 has none.

146. What unit is used to measure weighted average atomic mass?
   a. amu
   b. gram
   c. angstrom
   d. nanogram

147. Which of the following equals one atomic mass unit?
   a. the mass of one electron
   b. the mass of one helium-4 atom
   c. the mass of one carbon-12 atom
   d. one-twelfth the mass of one carbon-12 atom

148. Which of the following statements is NOT true?
   a. Protons have a positive charge.
   b. Electrons are negatively charged and have a mass of 1 amu.
   c. The nucleus of an atom is positively charged.
   d. Neutrons are located in the nucleus of an atom.

149. Why do chemists use relative masses of atoms compared to a reference isotope rather than the actual masses of the atoms?
   a. The actual mass of an electron is very large compared to the actual mass of a proton.
   b. The actual masses of atoms are very small and difficult to work with.
   c. The number of subatomic particles in atoms of different elements varies.
   d. The actual masses of protons, electrons, and neutrons are not known.

150. Which of the following is necessary to calculate the atomic mass of an element?
   a. the atomic mass of carbon-12
   b. the atomic number of the element
   c. the relative masses of the element's protons and neutrons
   d. the masses of each isotope of the element

151. In Bohr's model of the atom, where are the electrons and protons located?
   a. The electrons move around the protons, which are at the center of the atom.
   b. The electrons and protons move throughout the atom.

c. The electrons occupy fixed positions around the protons, which are at the center of the atom.
d. The electrons and protons are located throughout the atom, but they are not free to move.

152. How does the energy of an electron change when the electron moves closer to the nucleus?
a. It decreases.
b. It increases.
c. It stays the same.
d. It doubles.

153. What is the shape of the 3*p* atomic orbital?
a. sphere
b. dumbbell
c. bar
d. two perpendicular dumbbells

154. What is the maximum number of *f* orbitals in any single energy level in an atom?
a. 1
b. 3
c. 5
d. 7

155. What is the maximum number of *d* orbitals in a principal energy level?
a. 1
b. 2
c. 3
d. 5

156. What is the maximum number of electrons in the second principal energy level?
a. 2
b. 8
c. 18
d. 32

157. When an electron moves from a lower to a higher energy level, the electron ____.
a. always doubles its energy
b. absorbs a continuously variable amount of energy
c. absorbs a quantum of energy
d. moves closer to the nucleus

158. If the spin of one electron in an orbital is clockwise, what is the spin of the other electron in that orbital?
a. zero
b. clockwise
c. counterclockwise
d. both clockwise and counterclockwise

159. What is the next atomic orbital in the series 1*s*, 2*s*, 2*p*, 3*s*, 3*p*?
a. 2*d*
b. 3*d*
c. 3*f*
d. 4*s*

160. What is the electron configuration of potassium?
a. $1s^2 2s^2 2p^2 3s^2 3p^2 4s^1$
b. $1s^2 2s^2 2p^{10} 3s^2 3p^3$
c. $1s^2 2s^2 3s^2 3p^6 3d^1$
d. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

161. If three electrons are available to fill three empty 2*p* atomic orbitals, how will the electrons be distributed in the three orbitals?
a. one electron in each orbital
b. two electrons in one orbital, one in another, none in the third
c. three in one orbital, none in the other two
d. Three electrons cannot fill three empty 2*p* atomic orbitals.

162. How many unpaired electrons are in a sulfur atom (atomic number 16)?
   a. 0
   b. 1
   c. 2
   d. 3

163. How many half-filled orbitals are in a bromine atom?
   a. 1
   b. 2
   c. 3
   d. 4

164. Stable electron configurations are likely to contain ____.
   a. filled energy sublevels
   b. fewer electrons than unstable configurations
   c. unfilled *s* orbitals
   d. electrons with a clockwise spin

165. What is the basis for exceptions to the aufbau diagram?
   a. Filled and half-filled energy sublevels are more stable than partially-filled energy sublevels.
   b. Electron configurations are only probable.
   c. Electron spins are more important than energy levels in determining electron configuration.
   d. Some elements have unusual atomic orbitals.

166. Which electron configuration of the 4*f* energy sublevel is the most stable?
   a. $4f^{7}$
   b. $4f$
   c. $4f^{13}$
   d. $4f^{14}$

167. Which of the following electron configurations of outer sublevels is the most stable?
   a. $4d^{5}5s^{1}$
   b. $4d^{4}5s^{2}$
   c. $4d^{3}5s^{3}$
   d. $4d^{2}5s^{4}$

168. How does the speed of visible light compare with the speed of gamma rays, when both speeds are measured in a vacuum?
   a. The speed of visible light is greater.
   b. The speed of gamma rays is greater.
   c. The speeds are the same.
   d. No answer can be determined from the information given.

169. Which of the following electromagnetic waves have the highest frequencies?
   a. ultraviolet light waves
   b. X-rays
   c. microwaves
   d. gamma rays

170. How are the frequency and wavelength of light related?
   a. They are inversely proportional to each other.
   b. Frequency equals wavelength divided by the speed of light.
   c. Wavelength is determined by dividing frequency by the speed of light.
   d. They are directly proportional to each other.

171. What is the wavelength of an electromagnetic wave that travels at 3×10^{8} m/s and has a frequency of 60 MHz? (1 MHz = 1,000,000 Hz)

a. $\frac{60{,}000{,}000\ \text{Hz}}{300{,}000{,}000\ \text{m/s}}$

b. 60 MHz × 300,000,000 m/s

c. $\frac{300{,}000{,}000\ \text{m/s}}{60{,}000{,}000\ \text{Hz}}$

d. No answer can be determined from the information given.

172. Emission of light from an atom occurs when an electron _____.

a. drops from a higher to a lower energy level
b. jumps from a lower to a higher energy level
c. moves within its atomic orbital
d. falls into the nucleus

173. What is the approximate energy of a photon having a frequency of 4×10^{7} Hz? ($h = 6.6 \times 10^{-34}$ J·s)

a. 3×10^{-26} J
b. 3×10^{-27} J
c. 2×10^{-41} J
d. 3×10^{42} J

174. What is the approximate frequency of a photon having an energy 5×10^{-24} J? ($h = 6.6 \times 10^{-34}$ J·s)

a. 8×10^{9} Hz
b. 3×10^{-57} Hz
c. 3×10^{-58} Hz
d. 1×10^{-10} Hz

175. Which of the following quantum leaps would be associated with the greatest energy of emitted light?

a. n = 5 to n = 1
b. n = 4 to n = 5
c. n = 2 to n = 5
d. n = 5 to n = 4

176. How do the energy differences between the higher energy levels of an atom compare with the energy differences between the lower energy levels of the atom?

a. They are greater in magnitude than those between lower energy levels.
b. They are smaller in magnitude than those between lower energy levels.
c. There is no significant difference in the magnitudes of these differences.
d. No answer can be determined from the information given.

177. Bohr's model could only explain the spectra of which type of atoms?

a. single atoms with one electron
b. bonded atoms with one electron
c. single atoms with more than one electron
d. bonded atoms with more than one electron

178. Who predicted that all matter can behave as waves as well as particles?

a. Albert Einstein
c. Max Planck

b. Erwin Schrodinger
d. Louis de Broglie

179. According to the Heisenberg uncertainty principle, if the position of a moving particle is known, what other quantity CANNOT be known?
a. mass
b. charge
c. spin
d. velocity

180. How can the position of a particle be determined?
a. by analyzing its interactions with another particle
b. by measuring its velocity
c. by measuring its mass
d. by determining its charge

181. The wavelike properties of electrons are useful in ____.
a. defining photons
b. writing electron configurations
c. magnifying objects
d. determining the velocity and position of a particle

182. In an *s* orbital, the probability of finding an electron a particular distance from the nucleus does NOT depend on ____.
a. a quantum mechanical model
b. direction with respect to the nucleus
c. the Schrodinger equation
d. the electron energy sublevel

183. What is another name for the representative elements?
a. Group A elements
b. Group B elements
c. Group C elements
d. transition elements

184. What is another name for the transition metals?
a. noble gases
b. Group A elements
c. Group B elements
d. Group C elements

185. Who arranged the elements according to atomic mass and used the arrangement to predict the properties of missing elements?
a. Henry Moseley
b. Antoine Lavoisier
c. John Dalton
d. Dmitri Mendeleev

186. Which of the following categories includes the majority of the elements?
a. metalloids
b. liquids
c. metals
d. nonmetals

187. Of the elements Pt, V, Li, and Kr, which is a nonmetal?
a. Pt
b. V
c. Li
d. Kr

188. In which of the following sets is the symbol of the element, the number of protons, and the number of electrons given correctly?
a. In, 49 protons, 49 electrons
b. Zn, 30 protons, 60 electrons
c. Cs, 55 protons, 132.9 electrons
d. F, 19 protons, 19 electrons

189. What element has the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^2$?
   a. nitrogen
   b. selenium
   c. silicon
   d. silver

190. Which of the following is true about the electron configurations of the noble gases?
   a. The highest occupied *s* and *p* sublevels are completely filled.
   b. The highest occupied *s* and *p* sublevels are partially filled.
   c. The electrons with the highest energy are in a *d* sublevel.
   d. The electrons with the highest energy are in an *f* sublevel.

191. Which of the following electron configurations is most likely to result in an element that is relatively inactive?
   a. a half-filled energy sublevel
   b. a filled energy sublevel
   c. one empty and one filled energy sublevel
   d. a filled highest occupied principal energy level

192. Which subatomic particle plays the greatest part in determining the properties of an element?
   a. proton
   b. electron
   c. neutron
   d. none of the above

193. Which of the following elements is a transition metal?
   a. cesium
   b. copper
   c. tellurium
   d. tin

194. Which of the following groupings contains only representative elements?
   a. Cu, Co, Cd
   b. Ni, Fe, Zn
   c. Al, Mg, Li
   d. Hg, Cr, Ag

195. Which of the following is true about the electron configurations of the representative elements?
   a. The highest occupied *s* and *p* sublevels are completely filled.
   b. The highest occupied *s* and *p* sublevels are partially filled.
   c. The electrons with the highest energy are in a *d* sublevel.
   d. The electrons with the highest energy are in an *f* sublevel.

196. What are the Group 1A and Group 7A elements examples of?
   a. representative elements
   b. transition elements
   c. noble gases
   d. nonmetallic elements

197. Of the elements Fe, Hg, U, and Te, which is a representative element?
   a. Fe
   b. Hg
   c. U
   d. Te

198. How does atomic radius change from top to bottom in a group in the periodic table?
   a. It tends to decrease.
   b. It tends to increase.
   c. It first increases, then decreases.
   d. It first decreases, then increases.

199. What causes the shielding effect to remain constant across a period?
   a. Electrons are added to the same principal energy level.
   b. Electrons are added to different principal energy levels.

c. The charge on the nucleus is constant.
d. The atomic radius increases.

200. What element in the second period has the largest atomic radius?
a. carbon
b. lithium
c. potassium
d. neon

201. Which of the following elements has the smallest atomic radius?
a. sulfur
b. chlorine
c. selenium
d. bromine

202. Which of the following statements is true about ions?
a. Cations form when an atom gains electrons.
b. Cations form when an atom loses electrons.
c. Anions form when an atom gains protons.
d. Anions form when an atom loses protons.

203. The metals in Groups 1A, 2A, and 3A ____.
a. gain electrons when they form ions
b. all form ions with a negative charge
c. all have ions with a 1^+ charge
d. lose electrons when they form ions

204. Which of the following statements is NOT true about ions?
a. Cations are positively charged ions.
b. Anions are common among nonmetals.
c. Charges for ions are written as numbers followed by a plus or minus sign.
d. When a cation forms, more electrons are transferred to it.

205. Why is the second ionization energy greater than the first ionization energy?
a. It is more difficult to remove a second electron from an atom.
b. The size of atoms increases down a group.
c. The size of anions decreases across a period.
d. The nuclear attraction from protons in the nucleus decreases.

206. In which of the following sets are the charges given correctly for all the ions?
a. Na^+, Mg^+, Al^+
b. K^+, Sr^{2+}, O^{2-}
c. Rb^-, Ba^{2-}, P^{3+}
d. N^-, O^{2-}, F^{3-}

207. In which of the following groups of ions are the charges all shown correctly?
a. Li^-, O^{2-}, S^{2+}
b. Ca^{2+}, Al^{3+}, Br^-
c. K^{2-}, F^-, Mg^{2+}
d. Na^+, I^-, Rb^-

208. What is the element with the lowest electronegativity value?
a. cesium
b. helium
c. calcium
d. fluorine

209. What is the element with the highest electronegativity value?
a. cesium
b. helium
c. calcium
d. fluorine

210. Which of the following elements has the smallest ionic radius?
   a. Li
   b. K
   c. O
   d. S

211. What is the energy required to remove an electron from an atom in the gaseous state called?
   a. nuclear energy
   b. ionization energy
   c. shielding energy
   d. electronegative energy

212. For Group 2A metals, which electron is the most difficult to remove?
   a. the first
   b. the second
   c. the third
   d. All the electrons are equally difficult to remove.

213. Which of the following factors contributes to the decrease in ionization energy within a group in the periodic table as the atomic number increases?
   a. increase in atomic size
   b. increase in size of the nucleus
   c. increase in number of protons
   d. fewer electrons in the highest occupied energy level

214. Which of the following elements has the lowest electronegativity?
   a. lithium
   b. carbon
   c. bromine
   d. fluorine

215. Which statement is true about electronegativity?
   a. Electronegativity is the ability of an anion to attract another anion.
   b. Electronegativity generally increases as you move from top to bottom within a group.
   c. Electronegativity generally is higher for metals than for nonmetals.
   d. Electronegativity generally increases from left to right across a period.

216. Which of the following statements correctly compares the relative size of an ion to its neutral atom?
   a. The radius of an anion is greater than the radius of its neutral atom.
   b. The radius of an anion is identical to the radius of its neutral atom.
   c. The radius of a cation is greater than the radius of its neutral atom.
   d. The radius of a cation is identical to the radius of its neutral atom.

217. As you move from left to right across the second period of the periodic table ____.
   a. ionization energy increases
   b. atomic radii increase
   c. electronegativity decreases
   d. atomic mass decreases

218. Of the following elements, which one has the smallest first ionization energy?
   a. boron
   b. carbon
   c. aluminum
   d. silicon

219. How many valence electrons are in an atom of phosphorus?
   a. 2
   b. 3
   c. 4
   d. 5

220. How many valence electrons does a helium atom have?
a. 2
b. 3
c. 4
d. 5

221. What is the name given to the electrons in the highest occupied energy level of an atom?
a. orbital electrons
b. valence electrons
c. anions
d. cations

222. What is the electron configuration of the calcium ion?
a. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$
b. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4\ 4s^2$
c. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5\ 4s^1$
d. $1s^2\ 2s^2\ 2p^6\ 3s^2$

223. What is the electron configuration of the gallium ion?
a. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$
b. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5\ 4s^1$
c. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 4p^6$
d. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}$

224. What is the charge on the strontium ion?
a. 2–
b. 1–
c. 1+
d. 2+

225. How many electrons does silver have to give up in order to achieve a pseudo-noble-gas electron configuration?
a. 1
b. 2
c. 3
d. 4

226. What is the formula of the ion formed when potassium achieves noble-gas electron configuration?
a. K^{2+}
b. K^{+}
c. K^{1-}
d. K^{2-}

227. Which of the following ions has a pseudo-noble-gas electron configuration?
a. Fe^{2+}
b. Mn^{2+}
c. Cu^{+}
d. Ni^{+}

228. Which of the following elements does NOT form an ion with a charge of 1+?
a. fluorine
b. hydrogen
c. potassium
d. sodium

229. What is the formula of the ion formed when cadmium achieves a pseudo-noble-gas electron configuration?
a. Cd^{3+}
c. Cd^{+}

b. Cd^{2+} d. Cd^{2-}

230. What is the formula of the ion formed when phosphorus achieves a noble-gas electron configuration?

a. P^{3+} c. P^{2-}

b. P^{2+} d. P^{3-}

231. How does oxygen obey the octet rule when reacting to form compounds?

a. It gains electrons.
b. It gives up electrons.
c. It does not change its number of electrons.
d. Oxygen does not obey the octet rule.

232. Which of the following occurs in an ionic bond?

a. Oppositely charged ions attract.
b. Two atoms share two electrons.
c. Two atoms share more than two electrons.
d. Like-charged ions attract.

233. What is the net charge of the ionic compound calcium fluoride?

a. 2– c. 0

b. 1– d. 1+

234. How many valence electrons are transferred from the nitrogen atom to potassium in the formation of the compound potassium nitride?

a. 0 c. 2

b. 1 d. 3

235. How many valence electrons are transferred from the calcium atom to iodine in the formation of the compound calcium iodide?

a. 0 c. 2

b. 1 d. 3

236. What is the formula unit of aluminum oxide?

a. AlO c. AlO_3

b. Al_3O d. Al_2O_3

237. What is the formula for sodium sulfate?

a. $NaSO_4$ c. $Na(SO_4)_2$

b. Na_2SO_4 d. $Na_2(SO_4)_2$

238. Alloys are commonly used in manufacturing. Which of the following is NOT a reason to use an alloy instead of a pure metal?

a. Bronze is tougher than pure copper. c. Brass is more malleable than pure copper.
b. Sterling silver is stronger than pure silver. d. Cast iron is more brittle than pure iron.

239. Which of the following compounds has the formula KNO_3?

a. potassium nitrate
b. potassium nitride
c. potassium nitrite
d. potassium nitrogen oxide

240. Which of the following pairs of elements is most likely to form an ionic compound?

a. magnesium and fluorine
b. nitrogen and sulfur
c. oxygen and chlorine
d. sodium and aluminum

241. Which of the following particles are free to drift in metals?

a. protons
b. electrons
c. neutrons
d. cations

242. What is the basis of a metallic bond?

a. the attraction of metal ions to mobile electrons
b. the attraction between neutral metal atoms
c. the neutralization of protons by electrons
d. the attraction of oppositely charged ions

243. What characteristic of metals makes them good electrical conductors?

a. They have mobile valence electrons.
b. They have mobile protons.
c. They have mobile cations.
d. Their crystal structures can be rearranged easily.

244. Which metallic crystal structure has a coordination number of 8?

a. body-centered cubic
b. face-centered cubic
c. hexagonal close-packing
d. tetragonal

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