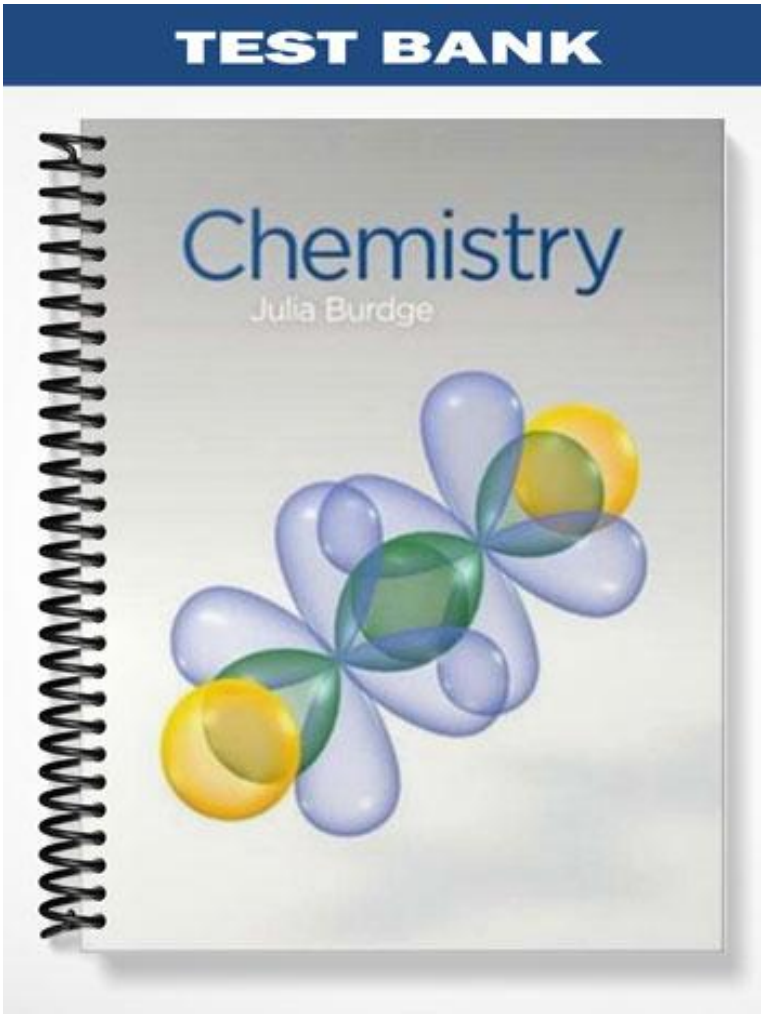
TEST BANK



Chapter 2 Atoms, Molecules, and Ions

Student: _____

1. The scientist who determined the magnitude of the electric charge of the electron was:
   A. John Dalton
   B. Robert Millikan
   C. J. J. Thomson
   D. Henry Moseley
   E. J. Burdge

2. When J. J. Thomson discovered the electron, what physical property of the electron did he measure?
   A. its charge, e
   B. its charge-to-mass ratio, e/m
   C. its temperature, T
   D. its mass, m
   E. its atomic number, Z

3. Which of the following is a type of radioactive radiation which has no charge and is unaffected by external electric or magnetic fields?
   A. α rays
   B. β rays
   C. γ rays
   D. δ rays
   E. ε rays

4. Which of the following is a type of radioactive radiation that consists of positively charged particles and is deflected away from the positively charged plate?
   A. α rays
   B. β rays
   C. γ rays
   D. δ rays
   E. ε rays

5. Which of the following is a type of radioactive radiation that consists of electrons and is deflected away from the negatively charged plate?
   A. α rays
   B. β rays
   C. γ rays
   D. δ rays
   E. ε rays

6. Which of these scientists developed the nuclear model of the atom?
   A. John Dalton
   B. Robert Millikan
   C. J. J. Thomson
   D. Henry Moseley
   E. Ernest Rutherford

7. Rutherford's experiment with alpha particle scattering by gold foil established that
   A. protons are not evenly distributed throughout an atom.
   B. electrons have a negative charge.
   C. electrons have a positive charge.
   D. atoms are made of protons, neutrons, and electrons.
   E. protons are 1840 times heavier than electrons.

8. J. J. Thomson studied cathode ray particles (electrons) and was able to measure the mass/charge ratio. His results showed that
   A. the mass/charge ratio varied as the cathode material was changed.
   B. the charge was always a whole-number multiple of some minimum charge.
   C. matter included particles much smaller than the atom.
   D. atoms contained dense areas of positive charge.
   E. atoms are largely empty space.

9. Who is credited with measuring the mass/charge ratio of the electron?
   A. Dalton
   B. Gay-Lussac
   C. Thomson
   D. Millikan
   E. Rutherford

10. Who is credited with first measuring the charge of the electron?
   A. Dalton
   B. Gay-Lussac
   C. Thomson
   D. Millikan
   E. Rutherford

11. Millikan's oil-drop experiment
   A. established the charge on an electron.
   B. showed that all oil drops carried the same charge.
   C. provided support for the nuclear model of the atom.
   D. suggested that some oil drops carried fractional numbers of electrons.
   E. suggested the presence of a neutral particle in the atom.

12. Who is credited with discovering the atomic nucleus?
    A. Dalton
    B. Gay-Lussac
    C. Thomson
    D. Millikan
    E. Rutherford

13. Rutherford bombarded gold foil with alpha (α) particles and found that a small percentage of the particles were deflected. Which of the following was not accounted for by the model he proposed for the structure of atoms?
    A. the small size of the nucleus
    B. the charge on the nucleus
    C. the total mass of the atom
    D. the existence of protons
    E. the presence of electrons outside the nucleus

14. Which one of the following statements about atoms and subatomic particles is correct?
    A. Rutherford discovered the atomic nucleus by bombarding gold foil with electrons.
    B. The proton and the neutron have identical masses.
    C. The neutron's mass is equal to that of a proton plus an electron.
    D. A neutral atom contains equal numbers of protons and electrons.
    E. An atomic nucleus contains equal numbers of protons and neutrons.

15. Bromine is the only nonmetal that is a liquid at room temperature. Consider the isotope bromine-81, $^{81}_{35}\mathrm{Br}$. Select the combination which lists the correct atomic number, neutron number, and mass number, respectively.
    A. 35, 46, 81
    B. 35, 81, 46
    C. 81, 46, 35
    D. 46, 81, 35
    E. 35, 81, 116

16. Atoms X, Y, Z, and R have the following nuclear compositions:
    $^{410}_{186}\mathrm{X}$ $^{410}_{183}\mathrm{Y}$ $^{412}_{186}\mathrm{Z}$ $^{412}_{185}\mathrm{R}$

    Which two are isotopes?
    A. X and Y
    B. X and R
    C. Y and R
    D. Z and R
    E. X and Z

17. Atoms of the same element with different mass numbers are called
    A. ions.
    B. neutrons.
    C. allotropes.
    D. chemical families.
    E. isotopes.

18. How many neutrons are there in an atom of lead whose mass number is 208?
    A. 82
    B. 126
    C. 208
    D. 290
    E. None of the answers is correct.

19. An atom of the isotope sulfur-31 consists of how many protons, neutrons, and electrons? (p = proton, n = neutron, e = electron)
    A. 15 p, 16 n, 15 e
    B. 16 p, 15 n, 16 e
    C. 16 p, 31 n, 16 e
    D. 32 p, 31 n, 32 e
    E. 16 p, 16 n, 15 e

20. Give the number of protons (p), electrons (e), and neutrons (n) in one atom of chlorine-37.
    A. 37 p, 37 e, 17 n
    B. 17 p, 17 e, 37 n
    C. 17 p, 17 e, 20 n
    D. 37 p, 17 e, 20 n
    E. 17 p, 37 e, 17 n

21. Two isotopes of an element differ only in their
    A. symbol.
    B. atomic number.
    C. atomic mass.
    D. number of protons.
    E. number of electrons.

22. A magnesium ion, Mg^{2+}, has:
    A. 12 protons and 13 electrons
    B. 24 protons and 26 electrons
    C. 12 protons and 10 electrons
    D. 24 protons and 22 electrons
    E. 12 protons and 14 electrons

23. An aluminum ion, Al^{3+}, has:
    A. 13 protons and 13 electrons
    B. 27 protons and 24 electrons
    C. 16 protons and 13 electrons
    D. 13 protons and 10 electrons
    E. 10 protons and 13 electrons

24. An oxide ion, O^{2-}, has:
    A. 8 protons and 10 electrons
    B. 10 protons and 8 electrons
    C. 8 protons and 9 electrons
    D. 8 protons and 7 electrons
    E. 10 protons and 7 electrons

25. A sulfide ion, S^{2-}, has:
    A. 16 protons and 16 electrons
    B. 32 protons and 16 electrons
    C. 16 protons and 14 electrons
    D. 16 protons and 18 electrons
    E. 32 protons and 18 electrons

26. How many protons and electrons are present in one Br^- ion?
    A. 35 p, 35 e
    B. 80 p, 81 e
    C. 35 p, 34 e
    D. 35 p, 36 e
    E. 80 p, 34 e

27. The elements in a column of the periodic table are known as
    A. metalloids.
    B. a period.
    C. noble gases.
    D. a group.
    E. nonmetals.

28. Which of these materials are usually poor conductors of heat and electricity?
    A. metals
    B. metalloids
    C. nonmetals
    D. alkaline earth metals
    E. alkali metals

29. Which of these elements is most likely to be a good conductor of electricity?
    A. N
    B. S
    C. He
    D. Cl
    E. Fe

30. Which of the following elements are the least reactive?
    A. alkali metals
    B. noble gases
    C. halogens
    D. alkaline earth metals
    E. metalloids

31. Which of the following is a non-metal?
    A. lithium, Li, Z = 3
    B. bromine, Br, Z = 35
    C. mercury, Hg, Z = 80
    D. bismuth, Bi, Z = 83
    E. sodium, Na, Z = 11

32. Which of the following is a metal?
    A. nitrogen, N, Z = 7
    B. phosphorus, P, Z = 15
    C. arsenic, Z = 33
    D. thallium, Tl, Z = 81
    E. silicon, Si, Z = 14

33. Which of the following is a metalloid?
    A. carbon, C, Z = 6
    B. sulfur, S, Z = 16
    C. germanium, Ge, Z = 32
    D. iridium, Z = 77
    E. bromine, Br, Z = 35

34. A row of the periodic table is called a:
    A. group
    B. period
    C. isotopic mixture
    D. family
    E. subshell

35. Silicon, which makes up about 25% of Earth's crust by mass, is used widely in the modern electronics industry. It has three naturally occurring isotopes, ^{28}Si, ^{29}Si, and ^{30}Si. Calculate the atomic mass of silicon.

Isotope	Isotopic Mass (amu)	Abundance %
^{28}Si	27.976927	92.23
^{29}Si	28.976495	4.67
^{30}Si	29.973770	3.10

A. 29.2252 amu
B. 28.9757 amu
C. 28.7260 amu
D. 28.0855 amu
E. 27.9801 amu

36. Lithium forms compounds which are used in dry cells and storage batteries and in high-temperature lubricants. It has two naturally occurring isotopes, ^{6}Li (isotopic mass = 6.015121 amu) and ^{7}Li (isotopic mass = 7.016003 amu). Lithium has an atomic mass of 6.9409 amu. What is the percent abundance of lithium-6?
A. 92.50%
B. 86.66%
C. 46.16%
D. 7.503%
E. 6.080%

37. Which of the following cannot exist as a homonuclear diatomic molecule?
A. hydrogen
B. phosphorus
C. fluorine
D. nitrogen
E. oxygen

38. Which of the following are allotropes?
A. diamond and graphite
B. hydrogen and deuterium
C. bromine and chlorine
D. hydrogen and oxygen
E. None of the answers is correct.

39. Which of these elements is chemically similar to magnesium?
A. sulfur
B. calcium
C. iron
D. nickel
E. potassium

40. Which of these elements is chemically similar to oxygen?
    A. sulfur
    B. calcium
    C. iron
    D. nickel
    E. potassium

41. Which of these elements is chemically similar to potassium?
    A. calcium
    B. arsenic
    C. phosphorus
    D. cerium
    E. cesium

42. Which, if any, of the following elements do not occur in the major classes of organic compounds?
    A. H
    B. C
    C. N
    D. O
    E. All of these elements occur in the major classes of organic compounds.

43. Which of the following is the empirical formula for hexane, C_6H_{14}?
    A. $C_{12}H_{28}$
    B. C_6H_{14}
    C. C_3H_7
    D. $CH_{2.3}$
    E. $C_{0.43}H$

44. What is the name of PCl_3?
    A. phosphorus chloride
    B. phosphoric chloride
    C. phosphorus trichlorate
    D. trichlorophosphide
    E. phosphorus trichloride

45. The compound, P_4S_{10}, is used in the manufacture of safety matches. What is its name?
    A. phosphorus sulfide
    B. phosphoric sulfide
    C. phosphorus decasulfide
    D. tetraphosphorus decasulfide
    E. phosphorus sulfide

46. Diiodine pentaoxide is used as an oxidizing agent that converts carbon monoxide to carbon dioxide. What is its chemical formula?
    A. I_2O_5
    B. IO_5
    C. $2IO_5$
    D. I_5O_2
    E. $(IO_5)_2$

47. What is the name of P_4Se_3?
    A. phosphorus selenide
    B. phosphorus triselenide
    C. tetraphosphorus selenide
    D. phosphoric selenide
    E. tetraphosphorus triselenide

48. Tetrasulfur dinitride decomposes explosively when heated. What is its formula?
    A. S_2N_4
    B. S_4N_2
    C. $4SN_2$
    D. S_4N
    E. S_2N

49. An anion is defined as
    A. a charged atom or group of atoms with a net negative charge.
    B. a stable atom.
    C. a group of stable atoms.
    D. an atom or group of atoms with a net positive charge.
    E. neutral.

50. Which one of these species is an ion?
    A. B^{3+}
    B. NaCl
    C. He
    D. ^{14}C
    E. None of the answers is correct.

51. Which of these pairs of elements would be most likely to form an ionic compound?
    A. P and Br
    B. Cu and K
    C. C and O
    D. O and Zn
    E. Al and Rb

52. Which pair of elements would be most likely to form an ionic compound?
    A. P and Br
    B. Zn and K
    C. F and Al
    D. C and S
    E. Al and Rb

53. What is the formula for the ionic compound formed by calcium ions and nitrate ions?
    A. Ca_3N_2
    B. $Ca(NO_3)_2$
    C. Ca_2NO_3
    D. Ca_2NO_2
    E. $CaNO_3$

54. What is the formula for the ionic compound formed by calcium and selenium?
    A. CaSe
    B. Ca_2Se
    C. $CaSe_2$
    D. Ca_3Se
    E. $CaSe_3$

55. Which is the correct formula for copper (II) phosphate?
    A. Cu_2PO_4
    B. $Cu_3(PO_4)_2$
    C. Cu_2PO_3
    D. $Cu(PO_4)_2$
    E. $Cu(PO_3)_2$

56. The chemical name for ClO^{3-} is "chlorate ion." What is the common name for $HClO_3$?
    A. hydrochloric acid
    B. chloroform
    C. hydrogen trioxychloride
    D. chlorous acid
    E. chloric acid

57. The formula for magnesium sulfate is:
    A. MnS
    B. MgS
    C. $MnSO_3$
    D. $MgSO_4$
    E. $MnSO_3$

58. The formula for sodium sulfide is:
    A. NaS
    B. K_2S
    C. NaS_2
    D. Na_2S
    E. SeS

59. The chemical formula for iron (II) nitrate is:
    A. $Fe_2(NO_3)_3$
    B. $Ir(NO_2)_2$
    C. Fe_2N_3
    D. $Fe(NO_3)_2$
    E. $Fe(NO_2)_2$

60. Which one of the following formulas of ionic compounds is the least likely to be correct?
    A. NH_4Cl
    B. $Ba(OH)_2$
    C. Na_2SO_4
    D. Ca_2NO_3
    E. $Cu(CN)_2$

61. What is the formula for lead (II) oxide?
    A. PbO
    B. PbO_2
    C. Pb_2O
    D. PbO_4
    E. Pb_2O_3

62. Potassium permanganate is a strong oxidizer that reacts explosively with easily oxidized materials. What is its formula?
    A. $KMnO_3$
    B. $KMnO_4$
    C. K_2MnO_4
    D. $K(MnO_4)_2$
    E. $K_2Mn_2O_7$

63. Ferric oxide is used as a pigment in metal polishing. Which of the following is its formula?
    A. FeO
    B. Fe_2O
    C. FeO_3
    D. Fe_2O_5
    E. Fe_2O_3

64. What is the name of $Mn(CO_3)_2$?
    A. manganese carbide
    B. magnesium (IV) carbonate
    C. manganese (II) carbonate
    D. magnesium (II) carbonate
    E. manganese (IV) carbonate

65. Iron (III) chloride hexahydrate is used as a coagulant for sewage and industrial wastes. What is its formula?
    A. $Fe(Cl \cdot 6H_2O)_3$
    B. $Fe_3Cl \cdot 6H_2O$
    C. $FeCl_3(H_2O)_6$
    D. $Fe_3Cl(H_2O)_6$
    E. $FeCl_3 \cdot 6H_2O$

66. The mass of a neutron is equal to the mass of a proton plus the mass of an electron.
    True False

67. All neutral atoms of tin have 50 protons and 50 electrons.
    True False

68. Copper (Cu) is a transition metal.
    True False

69. Lead (Pb) is a main-group element.
    True False

70. Ionic compounds may carry a net positive or negative charge.
    True False

71. When an alkali metal combines with a non-metal, a covalent bond is normally formed.
    True False

72. The empirical formula of C_6H_6 is CH.
    True False

73. Almost all the mass of an atom is concentrated in the nucleus.
    True False

74. When a beam of alpha particles passes between two electrically charged plates, the beam is deflected toward the positive plate.
    True False

75. J. J. Thomson suggested the name "radioactivity" to describe the spontaneous emission of particles and/or radiation.
    True False

76. _____ is the emission and transmission of energy through space in the form of waves.
_____

77. _____ is the negatively charged plate connected to a high-voltage source.
_____

78. _____ coined the term "radioactivity" to describe the spontaneous emission of particles and/or radiation.
_____

79. _____ are electrons that are deflected away from negatively charged plates.
_____

80. _____ are atoms that have the same atomic number (Z) but different mass numbers (A).
_____

81. _____ have properties that are intermediate between those of metals and nonmetals.
_____

82. _____ is the name given for the elements in Group VIIIA.
_____

83. _____ is defined as a mass exactly equal to one-twelfth the mass of one carbon-12 atom.
_____

84. _____ are one of two or more distinct forms of an element.
_____

85. What is the law that describes different samples of a given compound that always contain the same elements in the same mass ratio?

86. How many neutrons are in ^{13}C?

87. What is the name of Cu_2O?

88. What is the formula for sodium dichromate?

89. What is the name given for the elements in Group 1A in the periodic table?

90. What is the name given for the elements in Group 7A in the periodic table?

91. Which group is given the name chalcogens?

92. What is the law of conservation of mass?

93. What are the three types of radiation produced by the decay of substances like uranium?

94. Define ion.

95. Fill in the blank spaces and write out all the symbols in the left hand column in full, in the form ${}^{A}_{Z}\mathrm{X}$ (i.e., include the appropriate values of Z and A as well as the correct symbol X).

Symbol	# protons	# neutrons	# electrons
…	17	18	…
Au	…	118	…
…	…	20	20

96. Briefly explain the relationship between hypothesis and experiment in the scientific method.

97. The table below describes four atoms.

	Atom A	Atom B	Atom C	Atom D
Number of protons	79	80	80	79
Number of neutrons	118	120	118	120
Number of electrons	79	80	80	79

Which atoms represent the same element?

98. In the early 1900s, Ernest Rutherford performed an experiment with gold foil, targets and alpha particles to probe the structure of the atoms. He observed that most of these alpha particles penetrated the foil undeflected. Realizing that atoms are electrically neutral (that is, they have equal numbers of protons and electrons) and that the mass of a proton is significantly greater than the mass of an electron, use Rutherford's data to propose a structural model of an atom.

99. Describe the contributions of Marie Curie.

100. State the two important experimental results (and the names of the responsible scientists) which enabled the mass of the electron to be determined.

101. Name the three important "laws" that were accounted for by Dalton's atomic theory.

102. Dalton's atomic theory has required some modifications in the light of subsequent discoveries. For any three appropriate postulates of Dalton's atomic theory: state the postulate in its original form and in one sentence, describe why the postulate has needed modification.

103. Describe the difference between an empirical formula and a molecular formula.

104. Determine the average atomic mass of boron is the natural abundance of ^{10}B weighing exactly 10.0129 amu is 19.9% and the natural abundance of ^{11}B weighing exactly 11.0093 amu is 80.1%? Show all your work.

105. Explain what is meant by an ionizable hydrogen atom.

106. Describe what is meant by the term "functional group" in organic chemistry.

Chapter 2 Atoms, Molecules, and Ions Key

1. B
2. B
3. C
4. A
5. B
6. E
7. A
8. B
9. C
10. D
11. A
12. E
13. C
14. D
15. A
16. E
17. E
18. B
19. B
20. C
21. C
22. C
23. D
24. A
25. D
26. D
27. D
28. C
29. E

30. B
31. B
32. D
33. C
34. B
35. D
36. D
37. B
38. A
39. B
40. A
41. E
42. E
43. C
44. E
45. D
46. A
47. E
48. B
49. A
50. A
51. D
52. C
53. B
54. A
55. B
56. E
57. D
58. D
59. D
60. D

61. A
62. B
63. E
64. E
65. E
66. FALSE
67. TRUE
68. TRUE
69. TRUE
70. FALSE
71. FALSE
72. TRUE
73. TRUE
74. FALSE
75. FALSE
76. radiation
77. cathode
78. Marie Curie
79. β particles
80. isotopes
81. metalloids
82. noble gases
83. one atomic mass unit
84. allotropes
85. law of definite proportions
86. 7
87. Copper (I) oxide
88. $Na_2Cr_2O_7$
89. Alkali metals
90. Halogens
91. Group 6A

92. Matter can be neither created nor destroyed.

93. Alpha, beta, and gamma radiation

94. An ion is an atom or group of atoms that has a net positive or negative charge.

95.

Symbol	# protons	# neutrons	# electrons
Cl	17	18	17
Au	79	118	79
Ca	20	20	20

96. A hypothesis should be capable of leading to a prediction which is testable by experiment. If the experimental result differs from the prediction, the hypothesis should be modified.

97. Atoms A and D represent the same element. Atoms B and C represent the same element.

98. Atoms are mostly empty space. The mass is concentrated mostly at the center of the atom.

99. Marie Curie discovered two new elements, and is one of three people to win two Nobel Prizes. She also suggested the term "radioactivity" to describe the spontaneous emission of particles and/or radiation.

100. Thomson measured m/e, the mass-to-charge ratio. Millikan measured e, the charge. Thus, the mass m could be calculated.

101. Laws of conservation of mass; definite composition; multiple proportions

102. Matter consists of atoms which are indivisible, cannot be created or destroyed. But, atoms are divisible, as the existence of subatomic particles shows. Atoms of one element cannot be converted into atoms of another element. They can be converted in various nuclear reactions, including radioactive decay. Atoms of an element are identical in mass and other properties. Isotopes of an element differ in their masses and other properties.

103. An empirical formula is the simplest chemical formula that has the smallest possible whole number ratio of atoms in the formula and a molecular formula is the true formula of a molecule which is a whole number multiple of its empirical formula.

104. (10.0129)(0.199) + (11.0093)(0.801) = 10.81 amu

105. It is one that separates from the molecule upon dissolving and becomes a hydrogen ion, H^+.

106. A functional group is a group of atoms that have replaced one of the hydrogen atoms in an organic compound.