Chapter 2: Atoms, Molecules, and Ions

1. The first people to attempt to explain why chemical changes occur were
   A) alchemists
   B) metallurgists
   C) physicians
   D) physicists
   E) the Greeks

   ANS: E PTS: 1 DIF: Easy REF: 2.1
   KEY: Chemistry | general chemistry | early atomic theory MSC: Conceptual

2. The Greeks proposed that matter consisted of four fundamental substances:
   A) fire, earth, water, air
   B) fire, metal, water, air
   C) earth, metal, water, air
   D) atoms, fire, water, air
   E) atoms, metal, fire, air

   ANS: A PTS: 1 DIF: Easy REF: 2.1
   KEY: Chemistry | general chemistry | early atomic theory MSC: Conceptual

3. The first chemist to perform truly quantitative experiments was
   A) Paracelsus
   B) Boyle
   C) Priestly
   D) Bauer
   E) Lavoisier

   ANS: B PTS: 1 DIF: Easy REF: 2.1
   KEY: Chemistry | general chemistry | early atomic theory MSC: Conceptual

4. The scientist who discovered the law of conservation of mass and is also called the father of modern chemistry is
   A) Proust
   B) Boyle
   C) Priestly
   D) Bauer
   E) Lavoisier

   ANS: E PTS: 1 DIF: Easy REF: 2.2
   KEY: Chemistry | general chemistry | general concepts | matter | Law of Conservation of Mass MSC: Conceptual

5. Which of the following pairs of compounds can be used to illustrate the law of multiple proportions?
   A) NH_4 and NH_4Cl
   B) ZnO_2 and $ZnCl_2$
   C) H_2O and HCl
   D) NO and NO_2

E) CH_4 and CO_2

ANS: D PTS: 1 DIF: Easy REF: 2.2
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | Dalton's atomic theory MSC: Conceptual

6. Which of the following pairs can be used to illustrate the law of multiple proportions?
   A) SO and SO_2
   B) CO and $CaCO_3$
   C) H_2O and $C_{12}H_{22}O_{11}$
   D) H_2SO_4 and H_2S
   E) KCl and $KClO_2$

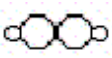
   ANS: A PTS: 1 DIF: Easy REF: 2.2
   KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter
   MSC: Conceptual

7. According to the law of multiple proportions:
   A) If the same two elements form two different compounds, they do so in the same ratio.
   B) It is not possible for the same two elements to form more than one compound.
   C) The ratio of the masses of the elements in a compound is always the same.
   D) The total mass after a chemical change is the same as before the change.
   E) None of these.

   ANS: E PTS: 1 DIF: Easy REF: 2.2
   KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | Dalton's atomic theory MSC: Conceptual

8. A sample of chemical X is found to contain 5.0 grams of oxygen, 10.0 grams of carbon, and 20.0 grams of nitrogen. The law of definite proportion would predict that a 70 gram sample of chemical X should contain how many grams of carbon?
   A) 5.0 grams
   B) 7.0 grams
   C) 10. grams
   D) 15 grams
   E) 20 grams

   ANS: E PTS: 1 DIF: Moderate REF: 2.2
   KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | Dalton's atomic theory MSC: Quantitative

9. Consider the following two compounds: H_2O  and H_2O_2  . According to the law of multiple proportions, the ratio of hydrogen atoms per gram of oxygen in H_2O to hydrogen atoms per gram of oxygen in H_2O_2 is
   A) 1:1
   B) 2:1
   C) 1:2
   D) 2:2
   E) 4:1

ANS: B PTS: 1 DIF: Moderate REF: 2.2
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | Dalton's atomic theory MSC: Conceptual

10. Which of the following statements from Dalton's atomic theory is no longer true, according to modern atomic theory?
A) Elements are made up of tiny particles called atoms.
B) Atoms are not created or destroyed in chemical reactions.
C) All atoms of a given element are identical.
D) Atoms are indivisible in chemical reactions.
E) All of these statements are true according to modern atomic theory.

ANS: C PTS: 1 DIF: Easy REF: 2.3
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | Dalton's atomic theory MSC: Conceptual

11. How many of the following postulates of Dalton's atomic theory are still scientifically accepted?
I. All atoms of the same element are identical.
II. Compounds are combinations of different atoms.
III. A chemical reaction changes the way atoms are grouped together.
IV. Atoms are indestructible.

A) 0
B) 1
C) 2
D) 3
E) 4

ANS: C PTS: 1 DIF: Easy REF: 2.3
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | Dalton's atomic theory MSC: Conceptual

12. The chemist credited for inventing a set of symbols for writing elements and a system for writing the formulas of compounds (and for discovering selenium, silicon, and thorium) is
A) Boyle
B) Lavoisier
C) Priestly
D) Berzelius
E) Dalton

ANS: D PTS: 1 DIF: Easy REF: 2.3
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | chemical formula MSC: Conceptual

13. Avogadro's hypothesis states that:
A) Each atom of oxygen is 16 times more massive than an atom of hydrogen.
B) A given compound always contains exactly the same proportion of elements by mass.

C) When two elements form a series of compounds, the ratios of masses that combine with 1 gram of the first element can always be reduced to small whole numbers.
D) At the same temperature and pressure, equal volumes of different gases contain an equal number of particles.
E) Mass is neither created nor destroyed in a chemical reaction.

ANS: D PTS: 1 DIF: Easy REF: 2.3
KEY: Chemistry | general chemistry | early atomic theory MSC: Conceptual

14. The first scientist to show that atoms emit any negative particles was
A) J. J. Thomson
B) Lord Kelvin
C) Ernest Rutherford
D) William Thomson
E) John Dalton

ANS: A PTS: 1 DIF: Easy REF: 2.4
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | structure of the atom | discovery of electron MSC: Conceptual

15. Many classic experiments have given us indirect evidence of the nature of the atom. Which of the experiments listed below did not give the results described?
A) The Rutherford experiment proved the Thomson "plum-pudding" model of the atom to be essentially correct.
B) The Rutherford experiment was useful in determining the nuclear charge on the atom.
C) Millikan's oil-drop experiment showed that the charge on any particle was a simple multiple of the charge on the electron.
D) The electric discharge tube proved that electrons have a negative charge.
E) All of the above experiments gave the results described.

ANS: A PTS: 1 DIF: Easy REF: 2.4
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | structure of the atom MSC: Conceptual

16. The scientist whose alpha-particle scattering experiment led him to conclude that the nucleus of an atom contains a dense center of positive charge is
A) J. J. Thomson
B) Lord Kelvin
C) Ernest Rutherford
D) William Thomson
E) John Dalton

ANS: C PTS: 1 DIF: Easy REF: 2.4
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | structure of the atom | nuclear model of atom MSC: Conceptual

17. Alpha particles beamed at thin metal foil may
A) pass directly through without changing direction
B) be slightly diverted by attraction to electrons
C) be reflected by direct contact with nuclei

D) A and C
E) A, B, and C

ANS: E PTS: 1 DIF: Easy REF: 2.4
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | structure of the atom | nuclear model of atom MSC: Conceptual

18. Which one of the following statements about atomic structure is false?
A) An atom is mostly empty space.
B) Almost all of the mass of the atom is concentrated in the nucleus.
C) The protons and neutrons in the nucleus are very tightly packed.
D) The number of protons and neutrons is always the same in the neutral atom.
E) All of the above statements (A-D) are true.

ANS: D PTS: 1 DIF: Easy REF: 2.4
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | structure of the atom | nuclear model of atom MSC: Conceptual

19. If the Thomson model of the atom had been correct, Rutherford would have observed:
A) Alpha particles going through the foil with little or no deflection.
B) Alpha particles greatly deflected by the metal foil.
C) Alpha particles bouncing off the foil.
D) Positive particles formed in the foil.
E) None of the above observations is consistent with the Thomson model of the atom.

ANS: A PTS: 1 DIF: Easy REF: 2.4
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | structure of the atom | nuclear model of atom MSC: Conceptual

20. Which statement is *not* correct?
A) The mass of an alpha particle is 7300 times that of the electron.
B) An alpha particle has a 2+ charge.
C) Three types of radioactive emission are gamma rays, beta rays, and alpha particles.
D) A gamma ray is high-energy light.
E) There are only three types of radioactivity known to scientists today.

ANS: E PTS: 1 DIF: Easy REF: 2.4
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter
MSC: Conceptual

21. Rutherford's experiment was important because it showed that:
A) Radioactive elements give off alpha particles.
B) Gold foil can be made to be only a few atoms thick.
C) A zinc sulfide screen scintillates when struck by a charged particle.
D) The mass of the atom is uniformly distributed throughout the atom.
E) An atom is mostly empty space.

ANS: E PTS: 1 DIF: Easy REF: 2.4
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | structure of the atom | nuclear model of atom MSC: Conceptual

22. Bromine exists naturally as a mixture of bromine-79 and bromine-81 isotopes. An atom of bromine-79 contains
A) 35 protons, 44 neutrons, 35 electrons
B) 34 protons and 35 electrons, only
C) 44 protons, 44 electrons, and 35 neutrons
D) 35 protons, 79 neutrons, and 35 electrons
E) 79 protons, 79 electrons, and 35 neutrons

ANS: A PTS: 1 DIF: Easy REF: 2.5
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | nuclear structure MSC: Conceptual

23. Which of the following atomic symbols is incorrect?
A) $^{14}_{6}C$
B) $^{37}_{17}Cl$
C) $^{32}_{15}P$
D) $^{39}_{19}K$
E) $^{14}_{8}N$

ANS: E PTS: 1 DIF: Easy REF: 2.5
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | structure of the atom MSC: Conceptual

24. The element rhenium (Re) exists as two stable isotopes and 18 unstable isotopes. Rhenium-185 has in its nucleus
A) 75 protons, 75 neutrons
B) 75 protons, 130 neutrons
C) 130 protons, 75 neutrons
D) 75 protons, 110 neutrons
E) not enough information

ANS: D PTS: 1 DIF: Easy REF: 2.5
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | isotope
MSC: Conceptual

25. Which among the following represent a set of isotopes? Atomic nuclei containing:

I. 20 protons and 20 neutrons
II. 21 protons and 19 neutrons
III. 22 neutrons and 18 protons
IV. 20 protons and 22 neutrons
V. 21 protons and 20 neutrons

A) I, II, III
B) III, IV
C) I, V
D) I, IV and II, V

E) No isotopes are indicated.

ANS: D PTS: 1 DIF: Easy REF: 2.5
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | isotope
MSC: Conceptual

26. By knowing the number of protons a neutral atom has, you should be able to determine
A) the number of neutrons in the neutral atom
B) the number of electrons in the neutral atom
C) the name of the atom
D) two of the above
E) none of the above

ANS: D PTS: 1 DIF: Easy REF: 2.5
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | nuclear structure MSC: Conceptual

27. Which of the following statements are *true* of uranium-238?

I. Its chemical properties will be exactly like those of uranium-235.
II. Its mass will be slightly different from that of an atom of uranium-235.
III. It will contain a different number of protons than an atom of uranium-235.
IV. It is more plentiful in nature than uranium-235.

A) III, IV
B) I, II, III
C) I, II, IV
D) II, III, IV
E) all of these

ANS: C PTS: 1 DIF: Easy REF: 2.5
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | isotope
MSC: Conceptual

28. An isotope, *X*, of a particular element has an atomic number of 15 and a mass number of 31. Therefore:
A) *X* is an isotope of phosphorus.
B) *X* has 16 neutrons per atom.
C) *X* has an atomic mass of 30.973.
D) A and B.
E) A, B, and C.

ANS: D PTS: 1 DIF: Easy REF: 2.5
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | isotope
MSC: Conceptual

29. Which of the following statements is true?
    A) Ions are formed by adding or removing protons or electrons.
    B) Scientists believe that solids are mostly open space.
    C) Heating water with a Bunsen burner results in a 2:1 mixture of hydrogen and oxygen gases.
    D) At least two of the above statements (A-C) are true.
    E) All of the statements (A-C) are false.

    ANS: B PTS: 1 DIF: Moderate REF: 2.5
    KEY: Chemistry | general chemistry | early atomic theory MSC: Conceptual

30. The number of neutrons in an atom is the same for all neutral atoms of that element.

    ANS: F PTS: 1 DIF: Easy REF: 2.5
    KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | isotope
    MSC: Conceptual

31. The number of electrons in an atom is the same for all neutral atoms of that element.

    ANS: T PTS: 1 DIF: Easy REF: 2.5
    KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | nuclear structure MSC: Conceptual

32. $^{40}_{20}Ca^{2+}$ has
    A) 20 protons, 20 neutrons, and 18 electrons
    B) 22 protons, 20 neutrons, and 20 electrons
    C) 20 protons, 22 neutrons, and 18 electrons
    D) 22 protons, 18 neutrons, and 18 electrons
    E) 20 protons, 20 neutrons, and 22 electrons

    ANS: A PTS: 1 DIF: Easy REF: 2.6
    KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | isotope
    MSC: Conceptual

33. Which of the following statements is (are) true?
    A) $^{18}_{8}O$ and $^{19}_{9}F$ have the same number of neutrons.
    B) $^{14}_{6}C$ and $^{14}_{7}N$ are isotopes of each other because their mass numbers are the same.
    C) $^{18}_{8}O^{2-}$ has the same number of electrons as $^{20}_{10}Ne$.
    D) A and B
    E) A and C

    ANS: E PTS: 1 DIF: Easy REF: 2.6
    KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | isotope
    MSC: Conceptual

34. A species with 12 protons and 10 electrons is

A) Ne^{2+}
B) Ti^{2+}
C) Mg^{2+}
D) Mg
E) Ne^{2-}

ANS: C PTS: 1 DIF: Easy REF: 2.6
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | nuclear structure MSC: Conceptual

35. The numbers of protons, neutrons, and electrons in $^{39}_{19}K^{+}$ are:

A) 20 p, 19 n, 19 e
B) 20 p, 19 n, 20 e
C) 19 p, 20 n, 20 e
D) 19 p, 20 n, 19 e
E) 19 p, 20 n, 18 e

ANS: E PTS: 1 DIF: Easy REF: 2.6
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | nuclear structure MSC: Conceptual

36. An ion is formed
A) By either adding or subtracting protons from the atom.
B) By either adding or subtracting electrons from the atom
C) By either adding or subtracting neutrons from the atom.
D) All of the above are true.
E) Two of the above are true.

ANS: B PTS: 1 DIF: Easy REF: 2.6
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance MSC: Conceptual

37. The formula of water, H_2O, suggests:
A) There is twice as much mass of hydrogen as oxygen in each molecule.
B) There are two hydrogen atoms and one oxygen atom per water molecule.
C) There is twice as much mass of oxygen as hydrogen in each molecule.
D) There are two oxygen atoms and one hydrogen atom per water molecule.
E) None of these.

ANS: B PTS: 1 DIF: Easy REF: 2.6
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | chemical formula | molecular substance MSC: Conceptual

38. All of the following are true *except*:
A) Ions are formed by adding electrons to a neutral atom.
B) Ions are formed by changing the number of protons in an atom's nucleus.
C) Ions are formed by removing electrons from a neutral atom.
D) An ion has a positive or negative charge.
E) Metals tend to form positive ions.

ANS: B PTS: 1 DIF: Easy REF: 2.6
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance MSC: Conceptual

39. Which of the following are incorrectly paired?
A) K, alkali metal
B) Ba, alkaline earth metal
C) O, halogen
D) Ne, noble gas
E) Ni, transition metal

ANS: C PTS: 1 DIF: Easy REF: 2.7
KEY: Chemistry | general chemistry | early atomic theory | periodic table | group
MSC: Conceptual

40. Which of the following are *incorrectly* paired?
A) Sr, alkaline earth metal
B) Ta, transition metal
C) F, halogen
D) H, noble gas
E) Ru, transition metal

ANS: D PTS: 1 DIF: Easy REF: 2.7
KEY: Chemistry | general chemistry | early atomic theory | periodic table | group
MSC: Conceptual

41. Which of the following are *incorrectly* paired?
A) Phosphorus, Pr
B) Palladium, Pd
C) Platinum, Pt
D) Lead, Pb
E) Potassium, K

ANS: A PTS: 1 DIF: Easy REF: 2.7
KEY: Chemistry | general chemistry | early atomic theory | periodic table
MSC: Conceptual

42. Which of the following are *incorrectly* paired?
A) Copper, Cu
B) Carbon, C
C) Cobalt, Co
D) Calcium, Ca
E) Cesium, Ce

ANS: E PTS: 1 DIF: Easy REF: 2.7
KEY: Chemistry | general chemistry | early atomic theory | periodic table
MSC: Conceptual

43. Which of the following are *incorrectly* paired?
A) Antimony, Sb
B) Silicon, Si

C) Silver, Ag
D) Argon, Ar
E) Astatine, As

ANS: E PTS: 1 DIF: Easy REF: 2.7
KEY: Chemistry | general chemistry | early atomic theory | periodic table
MSC: Conceptual

44. All of the following are characteristics of metals *except*:
A) good conductors of heat
B) malleable
C) ductile
D) often lustrous
E) tend to gain electrons in chemical reactions

ANS: E PTS: 1 DIF: Easy REF: 2.7
KEY: Chemistry | general chemistry | early atomic theory | periodic table | metal
MSC: Conceptual

45. All of the following are characteristics of nonmetals *except*:
A) poor conductors of electricity
B) often bond to each other by forming covalent bonds
C) tend to form negative ions in chemical reactions with metals
D) appear in the upper left-hand corner of the periodic table
E) do not have a shiny (lustrous) appearance

ANS: D PTS: 1 DIF: Easy REF: 2.7
KEY: Chemistry | general chemistry | early atomic theory | periodic table | nonmetal
MSC: Conceptual

46. Which of the following has 61 neutrons, 47 protons, and 46 electrons?
A) $^{80}_{61}\text{Pm}$
B) $^{108}_{47}\text{Ag}^{+}$
C) $^{108}_{46}\text{Pd}^{-}$
D) $^{108}_{47}\text{Cd}^{+}$
E) $^{108}_{47}\text{Ag}$

ANS: B PTS: 1 DIF: Easy REF: 2.7
KEY: Chemistry | general chemistry | early atomic theory | periodic table
MSC: Conceptual

47. How many protons and electrons does the most stable ion for oxygen have?

	# protons	# electrons
A)	10 p	8 e

B) 8 p 6 e
C) 6 p 8 e
D) 8 p 8 e
E) 8 p 10 e

ANS: E PTS: 1 DIF: Moderate REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | periodic table | group
MSC: Conceptual

48. You are given a compound with the formula MCl_2, in which M is a metal. You are told that the metal ion has 26 electrons. What is the identity of the metal?
A) Fe
B) Al
C) Zn
D) Co
E) Ni

ANS: E PTS: 1 DIF: Moderate REF: 2.7
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance MSC: Conceptual

49. Which of the following names is incorrect?
A) cobalt(II) chloride
B) magnesium oxide
C) aluminum(III) oxide
D) diphosphorus pentoxide
E) All of the above names are correct.

ANS: C PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound MSC: Conceptual

50. Which of the following pairs is incorrect?
A) iodine trichloride, ICl_3
B) phosphorus pentoxide, P_2O_5
C) ammonia, NH_3
D) sulfur hexafluoride, SF_6
E) All of the above pairs are correct.

ANS: B PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | binary molecular compound MSC: Conceptual

51. The correct name for LiCl is
A) lithium monochloride
B) lithium(I) chloride
C) monolithium chloride
D) lithium chloride
E) monolithium monochloride

ANS: D PTS: 1 DIF: Easy REF: 2.8

KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound MSC: Conceptual

52. How many oxygen atoms are there in one formula unit of $Ca_3(PO_4)_2$?
A) 2
B) 4
C) 6
D) 8
E) none of these

ANS: D PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance MSC: Conceptual

53. How many oxygen atoms are there in 4 formula units of $Al_2(CO_3)_3$?
A) 9
B) 24
C) 36
D) 13
E) 39

ANS: C PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance MSC: Conceptual

54. The correct name for FeO is
A) iron oxide
B) iron(II) oxide
C) iron(III) oxide
D) iron monoxide
E) iron(I) oxide

ANS: B PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound MSC: Conceptual

55. The correct name for Ca^{2+} is
A) calcium
B) calcium(II) ion
C) calcium ion
D) calcium(I) ion
E) monocalcium ion

ANS: C PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance MSC: Conceptual

56. The correct name for V^{3+} is
A) vanadide
B) vanadite ion
C) vanadium(III) ion

D) vanadium(V) ion
E) trivanadium ion

ANS: C PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance MSC: Conceptual

57. The correct name for P^{3-} is
A) phosphide ion
B) phosphorus ion
C) phosphorus(III) ion
D) phospho(III) ion
E) phosphite

ANS: A PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance MSC: Conceptual

58. What is the subscript of barium in the formula of barium sulfate?
A) 1
B) 2
C) 3
D) 4
E) 0

ANS: A PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance MSC: Conceptual

59. The formula for calcium bisulfate is
A) $Ca(SO_4)_2$
B) CaS_2
C) $Ca(HSO_4)_2$
D) Ca_2HSO_4
E) Ca_2S

ANS: C PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound MSC: Conceptual

60. The formula for sodium dihydrogen phosphate is
A) NaH_2PO_4
B) $Na(HPO_4)_2$
C) $NaHPO_4$
D) Na_2HPO_4
E) $Na_2H_2PO_4$

ANS: A PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound MSC: Conceptual

61. Which of the following is *incorrectly* named?
    A) $Pb(NO_3)_2$, lead(II) nitrate
    B) NH_4ClO_4, ammonium perchlorate
    C) PO_4^{3-}, phosphate ion
    D) $Mg(OH)_2$, magnesium hydroxide
    E) NO^{3-}, nitrite ion

    ANS: E PTS: 1 DIF: Easy REF: 2.8
    KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound MSC: Conceptual

62. Which of the following is *incorrectly* named?
    A) SO_3^{2-}, sulfite ion
    B) $S_2O_3^{2-}$, thiosulfate ion
    C) PO_4^{3-}, phosphate ion
    D) ClO_3^-, chlorite ion
    E) CN^-, cyanide ion

    ANS: D PTS: 1 DIF: Easy REF: 2.8
    KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound MSC: Conceptual

63. All of the following are in aqueous solution. Which is *incorrectly* named?
    A) H_2SO_4, sulfuric acid
    B) H_2CO_3, carbonic acid
    C) H_3PO_4, phosphoric acid
    D) HCN, cyanic acid
    E) HCl, hydrochloric acid

    ANS: D PTS: 1 DIF: Easy REF: 2.8
    KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | acid MSC: Conceptual

64. All of the following are in aqueous solution. Which is *incorrectly* named?
    A) $HC_2H_3O_2$, acetic acid
    B) HBr, bromic acid
    C) H_2SO_3, sulfurous acid
    D) HNO_2, nitrous acid
    E) $HClO_3$, chloric acid

    ANS: B PTS: 1 DIF: Easy REF: 2.8
    KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | acid MSC: Conceptual

65. Which of the following pairs is *incorrect?*
    A) NH_4Br, ammonium bromide
    B) K_2CO_3, potassium carbonate
    C) $BaPO_4$, barium phosphate
    D) CuCl, copper(I) chloride
    E) MnO_2, manganese(IV) oxide

ANS: C PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound MSC: Conceptual

66. Which of the following name(s) is(are) correct?
    1. sulfide, S^{2-}
    2. ammonium chloride, NH_4Cl
    3. acetic acid, $HC_2H_3O_2$
    4. barium oxide, BaO

    A) all
    B) none
    C) 1, 2
    D) 3, 4
    E) 1, 3, 4

    ANS: A PTS: 1 DIF: Easy REF: 2.8
    KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound MSC: Conceptual

67. Which metals form cations with varying positive charges?
    A) transition metals
    B) Group 1 metals
    C) Group 2 metals
    D) Group 3 metals
    E) metalloids

    ANS: A PTS: 1 DIF: Easy REF: 2.8
    KEY: Chemistry | general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance MSC: Conceptual

68. Three samples of a solid substance composed of elements A and Z were prepared. The first contained 4.31 g A and 7.70 g Z. The second sample was 35.9% A and 64.1% Z. It was observed that 0.718 g A reacted with Z to form 2.00 g of the third sample. Show that these data illustrate the law of definite composition.

    ANS:
    Sample (1): ratio of masses (Z/A) = 7.70/4.13 = 1.785
    Sample (2): ratio of masses (Z/A) = 64.1/35.9 = 1.785
    Sample (3): ratio of masses (Z/A) = (2.00-0.718)/0.718 = 1.785
    These three samples thus illustrate that a given compound always contains the same proportion of elements by mass.
    See Sec. 2.2 of Zumdahl, *Chemistry*.

    PTS: 1 DIF: Moderate REF: 2.2
    KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | Dalton's atomic theory MSC: Conceptual

69. Explain how Dalton’s atomic theory accounts for:
    a) the law of conservation of mass

b) the law of definite composition
c) the law of multiple proportion

ANS:
(a) Chemical reactions involve only reorganization of the atoms.
(b) A given compound always has the same relative numbers and types of atoms.
(c) Since, according to Dalton, atoms of a given element are identical and a given compound always has the same relative numbers and types of atoms, the observation of different mass ratio combinations of the same elements to give different compounds supports the law of multiple proportion.
See Sec. 2.3 of Zumdahl, *Chemistry*.

PTS: 1 DIF: Moderate REF: 2.3
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | Dalton's atomic theory MSC: Conceptual

70. Complete the following table.

Symbol	# Protons	# Neutrons	# Electrons	Net Charge
^{206}Pb				
	31	38		3_+
	52	75	54	
Mn^{2+}		30		2_+

ANS:

Symbol	# Protons	# Neutrons	# Electrons	Net Charge
^{206}Pb	82	124	82	0
Ga^{3+}	31	38	28	3+
Te^{2-}	52	75	54	2-
Mn^{2+}	25	29	23	2+

PTS: 1 DIF: Easy REF: 2.5
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | nuclear structure MSC: Conceptual

71. Complete the following table.

Symbol	**$^{69}Ga^{3+}$**	
Number of protons		34
Number of neutrons		46
Number of electrons		

Atomic number		
Mass number		
Net charge		2–

ANS:

Symbol	**$^{69}Ga^{3+}$**	$^{80}Se^{2-}$
Number of protons	31	34
Number of neutrons	38	46
Number of electrons	28	36
Atomic number	31	34
Mass number	69	80
Net charge	+3	2–

PTS: 1 DIF: Easy REF: 2.5
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | nuclear structure MSC: Conceptual

72. Arsenopyrite is a mineral containing As, Fe, and S. Classify each element as metal, nonmetal, or metalloid.

ANS:
As = metalloid, Fe = metal, S = nonmetal

PTS: 1 DIF: Easy REF: 2.7
KEY: Chemistry | general chemistry | early atomic theory | periodic table
MSC: Conceptual

73. Write the symbol for each of the following elements.
a) silver _____
b) calcium _____
c) iodine _____
d) copper _____
e) phosphorus _____

ANS:
a) Ag, b) Ca, c) I, d) Cu, e) P

PTS: 1 DIF: Easy REF: 2.7
KEY: Chemistry | general chemistry | early atomic theory | periodic table
MSC: Conceptual

74. Write the names of the following compounds:
a) $FeSO_4$ _____
b) $NaC_2H_3O_2$ _____
c) KNO_2 _____

d) $Ca(OH)_2$ _____
e) $NiCO_3$ _____

ANS:
a) iron(II) sulfate
b) sodium acetate
c) potassium nitrite
d) calcium hydroxide
e) nickel(II) carbonate

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound MSC: Conceptual

75. Write the chemical formulas for the following compounds or ions.
a) nitrate ion _____
b) aluminum oxide _____
c) ammonium ion _____
d) perchloric acid _____
e) copper(II) bromide _____

ANS:
a) NO_3^- b) Al_2O_3 c) NH_4^+ d) $HClO_4$ e) $CuBr_2$

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance MSC: Conceptual

76. How many atoms (total) are there in one formula unit of $Ca_3(PO_4)_2$?

ANS:
13

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance MSC: Conceptual

Name the following compounds:

77. $Al_2(SO_4)_3$

ANS:
aluminum sulfate

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound MSC: Conceptual

78. NH_4NO_3

ANS:
ammonium nitrate

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound MSC: Conceptual

79. NaH

ANS:
sodium hydride

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound MSC: Conceptual

80. $K_2Cr_2O_7$

ANS:
potassium dichromate

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound MSC: Conceptual

81. CCl_4

ANS:
carbon tetrachloride

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | binary molecular compound MSC: Conceptual

82. AgCl

ANS:
silver chloride

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound MSC: Conceptual

83. $CaSO_4$

ANS:
calcium sulfate

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound MSC: Conceptual

84. HNO_2

ANS:
nitrous acid

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | acid MSC: Conceptual

85. N_2O_3

ANS:
dinitrogen trioxide

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | binary molecular compound MSC: Conceptual

86. SnI_2

ANS:
tin(II) iodide

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound MSC: Conceptual

Write the formula for:

87. sodium thiosulfate

ANS:
$Na_2S_2O_3$

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance MSC: Conceptual

88. iron(III) oxide

ANS:
Fe_2O_3

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | chemical

formula | ionic substance MSC: Conceptual

89. dichlorine heptoxide

ANS:
Cl_2O_7

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | chemical formula | molecular substance MSC: Conceptual

90. cobalt(II) chloride

ANS:
$CoCl_2$

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance MSC: Conceptual

91. aluminum hydroxide

ANS:
$Al(OH)_3$

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance MSC: Conceptual

92. sulfurous acid

ANS:
H_2SO_3

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | acid MSC: Conceptual

93. nitric acid

ANS:
HNO_3

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | acid MSC: Conceptual

94. phosphoric acid

ANS:
H_3PO_4

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | acid MSC: Conceptual

95. acetic acid

ANS:
CH_3COOH

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | acid MSC: Conceptual

96. phosphorus trichloride

ANS:
PCl_3

PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | binary molecular compound MSC: Conceptual

97. Which of these statements is a consequence (follows from) the Law of Definite Proportion?
A) All samples of chlorine contain ^{35}Cl and ^{37}Cl in the same (definite) ratio.
B) The mass of oxygen that is combined with a fixed mass of nitrogen in each of the binary nitrogen oxides can be expressed as a ratio of small whole numbers.
C) The atomic masses of all of the elements in the periodic table have fixed values.
D) The % lead by mass in the compound galena is the same for all pure samples obtained from any source.
E) None of these is correct

ANS: D PTS: 1 DIF: Easy REF: 2.2
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | Dalton's atomic theory MSC: Conceptual

98. Which of these statements is a consequence (follows from) the Law of Multiple Proportions?
A) All samples of chlorine contain ^{35}Cl and ^{37}Cl in the same (definite) ratio.
B) The mass of oxygen that is combined with a fixed mass of nitrogen in each of the binary nitrogen oxides can be expressed as a ratio of small whole numbers.
C) The atomic masses of all of the elements in the periodic table have fixed values.
D) The % lead by mass in the compound galena is the same for all pure samples obtained from any source.
E) None of these is correct

ANS: B PTS: 1 DIF: Easy REF: 2.2
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter |

Dalton's atomic theory MSC: Conceptual

99. Which of the following elements does NOT have a symbol taken from a LATIN name for the element or one of its compounds?
A) iron
B) copper
C) sodium
D) potassium
E) titanium

ANS: E PTS: 1 DIF: Easy REF: 2.7
KEY: Chemistry | general chemistry | early atomic theory | periodic table
MSC: Conceptual

100. Which of the following statements is FALSE?
A) sulfur does not conduct electricity
B) gold is malleable
C) germanium is a metal
D) silicon is a metalloid
E) hydrogen is a non-metal

ANS: C PTS: 1 DIF: Easy REF: 2.7
KEY: Chemistry | general chemistry | early atomic theory | periodic table |
MSC: Conceptual

101. Which of the following ions is NOT likely to form from the appropriate atom?
A) C^{4+}
B) As^{3-}
C) Mg^{2+}
D) Ti^{4+}
E) Na^{+}

ANS: A PTS: 1 DIF: Moderate REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | periodic table | group
MSC: Conceptual

102. How many protons, neutrons and electrons, in that order are present in the anion formed by one atom of ^{125}I?
A) 53, 74, 54
B) 52, 72, 53
C) 54, 72, 53
D) 53, 72, 54
E) 54, 74, 54

ANS: D PTS: 1 DIF: Moderate REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | isotope | periodic table MSC: Conceptual

103. How many protons, neutrons and electrons, in that order are present in the anion formed by one atom of ^{79}Se?
A) 34, 34, 45
B) 34, 45, 34
C) 32, 45, 34
D) 34, 45, 36
E) 36, 45, 36

ANS: D PTS: 1 DIF: Moderate REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | isotope | periodic table MSC: Conceptual

104. Which statement is INCORRECT?

A) An atom of ^{60}Zn has an equal number of protons and neutrons
B) An atom of ^{50}Mn has an equal number of electrons and neutrons
C) An atom of ^{18}O has an equal number of protons and neutrons
D) An atom of ^{41}K has an equal number of protons and electrons
E) An atom of ^{238}U contains 146 neutrons.

ANS: C PTS: 1 DIF: Moderate REF: 2.5
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | isotope | MSC: Conceptual

105. Which of the following atoms, isotopes or ions contains 23 protons, 18 electrons and 27 neutrons?
A) $^{45}Co^{5+}$
B) ^{50}Kr
C) $^{50}V^{5+}$
D) $^{41}Kr^{5-}$
E) $^{50}V^{5-}$

ANS: C PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | atomic theory of matter | isotope | periodic table MSC: Conceptual

106. Which of the following compounds is incorrectly named?
A) $Mg(OH)_2$ is magnesium dihydroxide
B) CaO is calcium oxide
C) NH_4NO_3 is ammonium nitrate
D) K_3PO_4 is potassium phosphate
E) $MgSO_3$ is magnesium sulfite

ANS: A PTS: 1 DIF: Easy REF: 2.8
KEY: Chemistry | general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound MSC: Conceptual