Ch 1

62. Answers will vary, but possible answers are 1c, 2d, 3e, 4b, and 5a.

Ch2

35. An extensive property depends on the amount of matter; an intensive property depends on the type of matter. Mass and volume are extensive properties. Color and hardness are intensive properties.

37. melting point and boiling point

39. **a.** solid **b.** liquid **c.** gas **d.** liquid **e.** gas **f.** liquid

44. Heterogeneous mixtures have a non-uniform composition with two or more phases. Homogeneous mixtures have a uniform composition.

46. **a.** heterogeneous **b.** homogeneous **c.** depends on how well the batter is mixed **d.** homogeneous

48. Compounds can be separated by chemical means into simpler substances. Elements cannot.

b. Nitrogen and oxygen are elements present in the mixture air. **c.** Sodium and chlorine are elements in the compound sodium chloride (table salt). **d.** The element carbon and the compound water are the final products of heating table sugar.

54. **a.** physical **b.** chemical (color change) **c.** chemical (production of a gas) **d.** physical

49. **a.** Hydrogen and oxygen are the elements that make up the compound water.

67. **a.** physical **b.** physical **c.** physical **d.** physical **e.** chemical

Ch 4

34. The smallest particle of an element that still has the properties of that element.

35. Democritus's ideas were not helpful in explaining chemical behavior because they lacked experimental support.

36. Dalton would agree with all four statements because they all fit his atomic theory.

38. **a.** A beam of electrons (cathode rays) is deflected by an electric field toward the positively charged plate. **b.** The cathode rays were always composed of electrons regardless of the metal used in the electrodes or the gas used in the cathode-ray tube.

39. repel

42. The electrons were stuck in a lump of positive charge.

43. He did not expect alpha particles to be deflected at a large angle.

46. It has equal numbers of protons and electrons.

48. **a.** 15 **b.** 42 **c.** 13 **d.** 48 **e.** 24 **f.** 82

49. The atomic number is the number of protons. The mass number is the sum of the protons and neutrons.

50. **a.** 19 **b.** 9 **c.** F **d.** 14 **e.** 29 **f.** Si **g.** 22 **h.** 22 **i.** Ti **j.** 25 **k.** 30 **l.** Mn

51. mass numbers, atomic masses, number of neutrons, relative abundance

55. The atomic mass is the weighted average of the masses of all the isotopes.

56. according to their atomic numbers

Ch 5

27. 3

31. Electrons occupy the lowest possible energy levels. An atomic orbital can hold at most two electrons. One electron occupies each of a set of orbitals with equal energies before any pairing of electrons occurs.

34. **a.** $1s^2 2s^2 2p^6 3s^1$ **b.** $1s^2 2s^2 2p^6 3s^2 3p^4$ **c.** $1s^2 2s^2 2p^6 3s^2$ **d.** $1s^2 2s^2 2p^6$ **e.** $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

38. **a.** 8 **b.** 8 **c.** 8

50. **a.** Ar **b.** Ru **c.** Gd

57. **a.** Na, sodium **b.** N, nitrogen **c.** Si, silicon **d.** O, oxygen **e.** K, potassium **f.** Ti, titanium

Ch6

24. so that undiscovered elements with similar properties could be placed in the same group

28. **a.** nonmetal **b.** nonmetal **c.** metal **d.** nonmetal **e.** metal

30. Group 1A, Group 2A, Group 7A, and Group 8A, respectively

35. **a.** Ar: $1s^2 2s^2 2p^6 3s^2 3p^6$ **b.** Si: $1s^2 2s^2 2p^6 3s^2 3p^2$ **c.** Mg: $1s^2 2s^2 2p^6 3s^2$

36. **a.** sodium **b.** strontium **c.** germanium **d.** selenium

38. **a.** boron **b.** magnesium **c.** aluminum

51. Nonmetals; The trend is for ionization energy to increase from left to right across a period.

52. **a.** Ca^{2+} **b.** P^{3-} **c.** Cu^{+}

Ch 7

31. **a.** gain of 1 electron **b.** loss of one electron **c.** gain of 3 electrons **d.** loss of 2 electrons **e.** loss of 1 electron **f.** gain of 1 electron

32. **a.** bromide, anion **b.** sodium, cation **c.** arsenide, anion **d.** calcium, cation **e.** copper, cation **f.** hydride, anion

39. **a.** S^{2-} **b.** Na^{+} **c.** F^{-} **d.** P^{3-}

43. The positive charges balance the negative charges.

59. **a.** $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3$ **b.** $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4$ **c.** $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$

62. All have the noble-gas configuration of $1s^2 2s^2 2p^6 3s^2 3p^6$.

67. a, c, e, f

35. **a.** **b.** **c.**  **d.** Li·

36. **a.** 2 **b.** 3 **c.** 1 **d.** 2

37. **a.** Al^{3+} **b.** Li^{+} **c.** Ba^{2+} **d.** K^{+} **e.** Ca^{2+} **f.** Sr^{2+}

Ch 8

39. ionic

41. Nitrogen and oxygen achieve stability as diatomic molecules. Argon exists as individual atoms because it has a stable noble-gas electron

43. a. ionic **b.** ionic **c.** covalent **d.** covalent

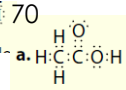
44. Ionic bonds depend on electrostatic attraction between ions. Covalent bonds depend on electrostatic attraction between shared electrons and nuclei of combining atoms.

46. a.  **b.**  **c.**  **d.** 

65. a. tetrahedral, 109.5°
b. trigonal planar, 120°
c. tetrahedral, 109.5°
d. bent, 105°

68. a. trigonal planar
b. pyramidal
c. linear
d. tetrahedral

70

a. 

b. No, the molecule contains one carbon-oxygen double bond and one carbon-oxygen single bond.
c. polar bond
d. Yes, it has polar oxygen atoms at one end of the molecule and a nonpolar CH_3^- group at the opposite end.

75. a. bent
b. tetrahedral
c. pyramidal

76. False. The bond dissociation energies exhibit no particular trend and, in fact, are fairly constant.

Ch 9

43. a. 2+ **b.** 2+ **c.** 3+ **d.** 1+

44. a. barium ion **b.** iodide ion **c.** silver ion **d.** mercury(II) ion

46. a. hydroxide ion **b.** lead(IV) ion **c.** sulfate ion **d.** oxide ion

53. NH_4NO_3, ammonium nitrate; $(NH_4)_2CO_3$, ammonium carbonate; NH_4CN, ammonium cyanide; $(NH_4)_3PO_4$, ammonium phosphate; $Sn(NO_3)_4$, tin(IV) nitrate; $Sn(CO_3)_2$, tin(IV) carbonate; $Sn(CN)_4$, tin(IV) cyanide; $Sn_3(PO_4)_4$, tin(IV) phosphate; $Fe(NO_3)_3$, iron(III) nitrate; $Fe_2(CO_3)_3$, iron(III) carbonate; $Fe(CN)_3$, iron(III) cyanide; $FePO_4$, iron(III) phosphate; $Mg(NO_3)_2$, magnesium nitrate; $MgCO_3$, magnesium carbonate; $Mg(CN)_2$, magnesium cyanide; $Mg_3(PO_4)_2$, magnesium phosphate

55. a. tri- **b.** mono- **c.** di- **d.** hexa- **e.** penta- **f.** tetra–

57. a. BCl_3 **b.** dinitrogen pentoxide **c.** N_2H_4 **d.** carbon tetrachloride

58. a. hydrochloric acid **b.** H_2SO_4 **c.** nitric acid **d.** $HC_2H_3O_2$

60. a. HNO_2 **b.** $Al(OH)_3$ **c.** H_2Se **d.** $Sr(OH)_2$ **e.** H_3PO_4

65. a. $KMnO_4$ **b.** $Ca(HCO_3)_2$ **c.** Cl_2O_7 **d.** Si_3N_4 **e.** NaH_2PO_4 **f.** PBr_5 **g.** CCl_4

67. a. sodium chlorate
b. mercury(I) bromide
c. potassium chromate
d. perchloric acid
e. tin(IV) oxide
f. iron(III) acetate
g. potassium hydrogen sulfate
h. calcium hydroxide
i. barium sulfide

71. binary molecular compound

81. a. N_2O, dinitrogen monoxide
b. NO_2, nitrogen dioxide
c. NO, nitrogen monoxide
d. N_2O_4, dinitrogen tetroxide

84. binary ionic compounds: *d* and *g*; binary molecular compounds: *a* and *f*; compounds with polyatomic ions: *b*, *c*, *e*, *h*, and *i*; acids: *b* and *e*; base: *c*

Ch 10

50. All contain 6.02×10^{23} molecules

52. a. 1.81×10^{24} atoms Sn
b. 2.41×10^{23} formula units KCl
c. 4.52×10^{24} molecules SO_2
d. 2.89×10^{21} formula units NaI

53. a. 98.0 g/mol
b. 76.0 g/mol
c. 100.1 g/mol
d. 132.1 g/mol
e. 89.0 g/mol
f. 159.8 g/mol

58. a. 0.258 mol SiO_2
b. 4.80×10^{-4} mol AgCl
c. 1.12 mol Cl_2
d. 0.106 mol KOH
e. 5.93 mol $Ca(C_2H_3O_2)_2$
f. 2.00×10^{-2} mol Ca

59. a. 108 g C_5H_{12}
b. 547 g F_2
c. 71.8 g $Ca(CN)_2$
d. 238 g H_2O_2
e. 224 g NaOH
f. 1.88 g Ni

60. a. 1.7×10^2 L Ar
b. 9.9 L C_2H_6

63. a. 5.9% H, 94.1% S
b. 22.6% N, 6.5% H, 19.4% C, 51.6% O
c. 41.7% Mg, 54.9% O, 3.4% H
d. 42.1% Na, 18.9% P, 39.0% O

75. a. CO
b. $C_2O_2NH_5$
c. Cl_2OC

Ch 11

36. a. reactants: sodium and water; products: hydrogen and sodium hydroxide
b. reactants: carbon dioxide and water; products: oxygen and glucose

39. a. Gaseous ammonia and oxygen react in the presence of a platinum catalyst to produce nitrogen monoxide gas and water vapor.
b. Aqueous solutions of sulfuric acid and barium chloride are mixed to produce a precipitate of barium sulfate and aqueous hydrochloric acid.
c. The gas dinitrogen trioxide reacts with water to produce an aqueous solution of nitrous acid.

43. a. $2PbO_2 \rightarrow 2PbO + O_2$
b. $2Fe(OH)_3 \rightarrow Fe_2O_3 + 3H_2O$
c. $(NH_4)_2CO_3 \rightarrow 2NH_3 + H_2O + CO_2$
c. $2NaCl + H_2SO_4 \rightarrow Na_2SO_4 + 2HCl$

45. a. $2Mg + O_2 \rightarrow 2MgO$
b. $4P + 5O_2 \rightarrow 2P_2O_5$
c. $Ca + S \rightarrow CaS$

47. a. $2Ag_2O \xrightarrow{\Delta} 4Ag + O_2$

b. $NH_4NO_3 \xrightarrow{\Delta} N_2O + 2H_2O$

49. a. $H_2C_2O_4(aq) + 2KOH(aq) \rightarrow K_2C_2O_4(aq) + 2H_2O(l)$
b. $CdBr_2(aq) + Na_2S(aq) \rightarrow CdS(s) + 2NaBr(aq)$

51. a. $C_4H_8 + 6O_2 \rightarrow 4CO_2 + 4H_2O$
b. $C_3H_6O + 4O_2 \rightarrow 3CO_2 + 3H_2O$

52. a. $3Hf + 2N_2 \rightarrow Hf_3N_4$; combination

b. $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$; single replacement
c. $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$; combustion
d. $Pb(NO_3)_2 + 2NaI \rightarrow PbI_2 + 2NaNO_3$; double replacement
e. $3Fe + 2O_2 \rightarrow Fe_3O_4$; combination

54. a. $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
b. $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$

57. a. $Cl_2(g) + 2KI(aq) \rightarrow I_2(aq) + 2KCl(aq)$
b. $2Fe(s) + 6HCl(aq) \rightarrow 2FeCl_3(aq) + 3H_2(g)$
c. $P_4O_{10}(s) + 6H_2O(l) \rightarrow 4H_3PO_4(aq)$

70. a. $3NaI + H_3PO_4 \rightarrow 3HI + Na_3PO_4$; double-replacement
b. $K_2O + H_2O \rightarrow 2KOH$; combination
c. $2H_2SO_4 \xrightarrow{\Delta} 2H_2O + O_2 + 2SO_2$; decomposition
d. $2Al + 3H_2SO_4 \rightarrow 3H_2 + Al_2(SO_4)_3$; single-replacement
e. $C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$; combustion

Ch 12

40. a. 0.54 mol **b.** 13.6 mol
c. 0.984 mol **d.** 236 mol

41. a. 11.3 mol CO, 22.5 mol H_2
b. 112 g CO, 16.0 g H_2
c. 11.4 g H_2

42. a. 372 g F_2
b. 1.32 g NH_3
c. 123 g N_2F_4

45. The amount of the limiting reagent determines the maximum amount of product that can be formed. The excess reagent is only partially consumed in the reaction.

47. a. Al
b. 3.0 mol $AlCl_3$
c. 0.8 mol Cl_2

48. 91.5%

50. a. 5.70×10^{21} atoms Zn
b. 95.2 g Zn

52. a. 96.4%
b. 45.0 g

Ch 15

32. Water: solvent; sugar: solute

33. Polar water molecules electrostatically attract ions and polar covalent molecules, but nonpolar compounds are unaffected because they have no charges.

36. a. HCl (polar) dissolves. **b.** NaI (ionic) dissolves. **c.** NH_3 (polar) dissolves. **d.** $MgSO_4$ (ionic) dissolves. **e.** CH_4 (nonpolar) will not dissolve. **f.** $CaCO_3$ (strong ionic forces) will not dissolve.

40. A strong electrolyte is almost totally ionized.

61. a. gasoline **b.** water
c. gasoline **d.** water

Ch 16

44. solubility: the amount of a substance that dissolves in a given quantity of solvent at specified conditions of temperature and pressure to produce a saturated solution; saturated solution: a solution containing the maximum amount of solute for a given amount of solvent at a constant temperature and pressure; unsaturated solution: a solution that contains less solute than a saturated solution at a given temperature and pressure; miscible: describes liquids that dissolve in each other; immiscible: describes liquids that are insoluble in each other

51. Molarity is the number of moles of solute dissolved in one liter of solution. **a.** 1.3*M* KCl
b. 3.3×10^{-1}*M* $MgCl_2$

52. 2.00×10^{1} mL

53. a. 5.0×10^{-1} mol NaCl, 29 g NaCl
b. 1.0 mol KNO_3, 1.0×10^{2} g KNO_3
c. 2.5×10^{-2} mol $CaCl_2$, 2.8 g $CaCl_2$