AP Chemistry Summer Assignment   **June 2018**

Utilize Internet Resources to complete the following problems. The URLs below represent a fraction of the available chemistry addresses available. Please feel free to expand the list and find other web sites that help prepare you for the coming year. We recommend that you complete as many online quizzes as possible, take detailed notes, and practice the items indicated in the packet.

Completed work must be submitted by the first day of school. Late work will not be accepted. You may email me with any questions, as I will be checking my email over the summer, but not every day. A list of books prescribed by the College Board has been provided for your reference. You do not need all the books to complete the assignment. Any basic chemistry text-book can help you find the information needed to complete the summer assignment.
http://highschoolhub.org/hub/chemistry.cfm ;
 http://www.chemistrycoach.com/home.htm
http://www.collegeboard.com/ap/students/chemistry/index.html
www.chemmybear.com

Balancing equations practice web links

http://science.widener.edu/svb/tutorial/rxnbalancingcsn7.html
http://www.chemistry-drills.com/balance.html
Show work for all the problems. (Hand written or typed solutions will be accepted)
Questions cover topics from general chemistry to basic Mole concepts. Certain topics   will be reviewed during regular school year.

USE SIGNIFICANT DIGITS in problems.

1. Write the **most common guidelines** to determine significant figures (digits) with an example?

2. Use **factor labeling** method to convert the following:
   a. 200 meters = ___ miles.
   b. 650 in = ____ meters
   c. 4 years= _____ seconds.
   d. 200 liters = _____ ml

3. Classify each of the following as units of mass, volume, length, density, energy, or pressure.
   a.Kg   b. Liter   c. m^3 d. mm   e. kg/m^3 f. Joule   g. atm   h. cal.

   I. Torr   J. g/ml

4. Most laboratory experiments are performed at room temperature at 75˚C. Express this temperature in:
   a.   ˚F   B. Kelvin

5. A cylinder rod formed from silicon is 46.0 cm long and has a mass of 3.00 kg. The density of silicon is 2.33 g/cm^3. What is the diameter of the cylinder? (the volume of cylinder is given by $\prod r^2h$, where r is the radius and h is the length)

6. How many **significant figures** are in each of the following?
   - a. 1.9200 mm
   - b. 0.0301001 kJ
   - c. 6.022 x10^{23} atoms
   - g. 460.000 L
   - e. 0.000036 cm^3
   - f. 10000   g.1001
   - h. 0.001345
   - i. 0.0101
   - J. 3.02 x 10^4
   - k. 3.21 x 10^{-2}

7. Record the following in correct **scientific notation**:
   - a. 4050,000,000 cal
   - b. 0.000123 mol
   - c. 0.00345 Å
   - d. 700,000,000 atoms

8. Calculate the following to the **correct number** of significant figures.
   - a. 1.270 g / 5.296 cm^3
   - b. 12.235 g / 1.010 L
   - c. 12 g + 0.38 g
   - d. 170g + 2.785 g
   - e. 2.100 x 3.2102
   - f. 200.1 x 120
   - g. 17.6 + 2.838 + 2.3 + 200
   - h. 2.35- 0.4 – 1.23 =

9. Give the **chemical symbols** for the following elements:
   a. Carbon   b. sulfur   c. Titanium   d. Nitrogen   e. Helium
   f. Krypton   g. Fluorine   h. Scandium   I. Arsenic   J. Potassium   K. Sodium
   l. chloride   m. Iron   n. Zinc   o. tin

10. Write **the latin** names for each of the elements symbols:
   a. Na   b. Au   c. Ag   d. Sn   e. Fe   f. Hg   g. K   h. Pb

11. A solid white substance A is heated strongly in the absence of air. It decomposes to form a new white substance B and a gas C. The gas has exactly the same properties as the product obtained when carbon is burned in an excess of oxygen. Based on these observations, can we determine whether solids A and B and the gas C are elements or compounds? Explain your conclusions for each substance.

12. Label each of the following as either a **physical process** or a **chemical process**.
   - a. Corrosion of aluminum metal.
   - b. Melting of ice.
   - c. Pulverizing an aspirin.
   - d. Digesting a candy bar.
   - e. Explosion of nitroglycerin.
   - f. Milk turning sour.
   - g. Burning of paper.
   - h. Forming of frost on a cold night.
   - i. Bleaching of hair with hydrogen peroxide.
   - j. A copper wire is hammered flat.

13. You may notice when water boils, you can see bubbles that rise to the surface of the water.
    a. What is inside these bubbles?
    b. Is the boiling of water a chemical or physical change? Explain

14. Dalton assumed that all atoms of the same element were identical in all their properties. Explain why this assumption is not valid.
15. Why do we call $Ba(NO_3)_2$ barium nitrate, but we call $Fe(NO_3)_2$ iron(II) nitrate?

16. Calculate the mass of O_2 produced if 3.450 g potassium chlorate is completely decomposed by heating in presence of a catalyst (Manganese dioxide).

17. Write the formula of the following compounds?
    a. Calcium sulfate.   b. Ammonium Phosphate   c. Lithium Nitrite

    d. potassium perchlorate.   e. Barium Oxide   f. Zinc sulfide.

    g. Sodium Perbromate   I. Calcium Iodide   J. Aluminum Carbonate.

18. Convert **0.50 atm** to: (Using **factor-labeling** method)

    a. torr Hg   b. kilo pascals   c. mm of Hg

  19. Define the words: **atomic number, atomic mass, mass number, molecular formula, structural formula, empirical formula, isotopes, cation, anion, metalloid, and allotrope**.

20. Determine **number of protons and neutrons** in each of the following.

    a. $K_{19}{}^{39}$ b. ${}^{23}_{11}Na$.   c. ${}^{208}_{82}Pb$ d. ${}^{33}_{15}P$

21. White gold is an alloy that typically contains 45.0% by mass gold and the remainder is platinum. If **154 g** of gold are available, how many grams of platinum are required to combine with the gold to form this alloy?
22. What is the empirical formula of a compound that contains 53.73% Fe and 46.27% of S ?

23. Determine the number of molecules present in   4.50 mol of Nitrogen dioxide, the number of atoms of oxygen,

24. List the following has diatomic molecule, molecular compound, ionic compound, Atomic element.
    a. F_2 b. Cl_2 c. C   d. NaCl   e. KF   f. CO_2 g. H_2 h. Ag
    i. Rust (Fe_2O_3)   j. MgO   k. O_2 l. I_2 m. CO   n. K_2CO_3

25. State the contribution of the following chemist in one line.
    a. Democritus   b. Mendeleev   c. Henry Becquerel   d. Roentgen   e. J.J Thompson

    f. Faraday   g. Chadwick   h. Millikan   i. Proust   j. Cavendish k. Madam Curie

26. What is the difference between
 a. Oxygen and Oxide   b. Magnesium atom and magnesium ion.

27. How many grams of methane (CH_4) are present in 10.0 moles of methane gas?
 (USE factor labeling method)

28. Calculate the **mass in grams** of each of the following: a. 2.01 x 10^{10} atoms of Mg.
          b. 3.01 x 10^{23} Formula units of BaI_2.
          c. 6.45 x 10^{15} atoms of potassium.

29. In an experiment, a student gently heated a hydrated copper compound to remove the water of hydration. The following data was recorded:
          1. Mass of crucible, cover, and contents before heating 23.4 g.
          2. mass of empty crucible and cover   18.82 g.
          3. mass of crucible, cover, and contents after heating to constant mass   20.94 g.

          Calculate the experimental percent of water in the compound.

30. How do you distinguish: Use a specific example to show the difference?
                    a. An element from a compound.
                    b. An element from a mixture.
                    c. A true solution from a heterogeneous mixture.
                    d. Distillation from filtration.
                    e. Chromatography from crystallization

31. An **extensive property** is one that depends on the amount of the sample. Which of the following properties are extensive?
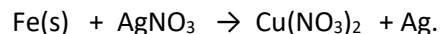   a. volume   b. density   c. temperature   d. energy   e. melting point.   F. pressure

32. A hydrated compound has an analysis of 18.29% Ca, 32.37% Cl, and 49.34% water. What is its Empirical formula?

33. Name the types of **general inorganic reactions** with example of each?

34. Define an Arrhenius Acid, Arrhenius base and salt? Give some examples of each.

35. What mass of Iron is required to replace silver from 8.00g of silver nitrate dissolved in water?
          Fe(s) + $AgNO_3$ → $Cu(NO_3)_2$ + Ag.
        b. Draw a particle diagram to represent the reacton.

36. Write the chemical formulas for the following compounds:
a. Calcium Carbonate   b. Ammonium Phosphate   c. Sodium Chloride   d. Sodium Oxide e. Calcium Sulfate   f. Sodium Nitrite   g. Magnesium Acetate   h. Potassium cyanide
        i. Zinc(II) Nitrate   j. Iron(III) Phosphate   k. Nickel (II) Fluoride l. Ammonium Acetate

37. Define and give examples a. Law of conservation of mass.   b. Law of multiple proportion.

38.Strontium consists of four isotopes with masses and their percent abundance of 83.9134 amu (0.5%), 85.9094 amu (9.9%) , 86.9089 amu (7.0 %) , and 87.9056 amu (82.6 %). Calculate the atomic mass of Sr ?

39.Nitrogen has two isotopes, N-14 and N-15, with atomic masses of 14.00031 amu and 15.001 amu, respectively. What is the percent abundance of N-15?

40.Write the number of protons and electrons? a P_4 molecule   b. a PCl_5 molecule   c. a P^{3-} Ion d. P^{5+} ion.

41.Mercury has an atomic mass of 200.59 amu. Calculate the a.Mass of 3.0×10^{10} atoms. b.Number of atoms in one nanogram of Mercury.

41.Calculate the molar masses (g/ mol) of
            a. Ammonia (NH_3) b. Baking soda ($NaHCO_{3)}$)   c. Osmium Metal (Os)

42.Convert the following to moles
                        a.3.86 grams of Carbon tetrachloride
                        b.6.0×10^5 g of Hydrazine ($N_2 H_4$), a rocket propellant.

43.The molecular formula of morphine, a pain-killing narcotic, is $C_{17}H_{19}NO_3$.
                        a.What is the molar mass?
                        b.What fraction of atoms in morphine is accounted for by carbon?
                        c.Which element contributes least to the molar mass?

44.Complete the list ionic compounds (name or formula)
                        a.Cupric Hydroxide
                        b.Strontium Chromate
                        c.Ammonium Per chlorate
                        d.$NaHCO_3$
                        e.$Fe_2 (CO_3)_3$
                        f.Sodium Hydroxide.
                        g.Potassium Chloride.

43.The hormone, thyroxine is secreted by the thyroid gland, and has the formula: $C_{15}H_{17}NO_4I_4$. How many milligrams of Iodine can be extracted from 15.0 Grams of thyroxine?

44.Determine the **formula weight** for the following:

            a. N_2O_5 b. $CuSO_4$ C. $Ca(HCO_3)_2$ d. $CaSO_4. 2 H_2O$

45. Calculate the percentage by mass of the following compounds:
            a. SO_3 b. CH_3COOCH_3 c. Ammonium Nitrate.

46. Determine the empirical formula of the compounds with the following compositions by mass:

  a. 10. 4 % C, 27. 8% S , 61. 7 % Cl

  b. 21.7 % C, 9.6 % O, and 68.7 % F

47. Arsenic reacts with chlorine to form a chloride. If 1.587 g of arsenic reacts with 3.755 g of chlorine, what is the simplest formula of the chloride?

48. Vanillin, a flavoring agent, is made up of carbon, hydrogen, and Oxygen atoms. When a sample of Vanillin weighing 2.500g burns in Oxygen, 5.79 g of carbon dioxide and 1.18 g of water are obtained. What is the empirical formula of Vanillin?

49. Washing soda is a hydrate of sodium carbonate. Its formula is $Na_2CO_3. x H_2O$. A 2.714 g Sample of washing soda is heated until a constant mass of 1.006 g of Na_2CO_3 is reached. What is x ?

50. Explain heat and temperature. Use an example .

51. Determine the empirical and molecular formula of each of the following substances:

  a. Ibufuren, a headache remedy contains 75.6 % C, 8.80 % H , and 15.5 % O by mass and has a molar mass about 206 g/mol.

  b. Epinerphine(adrenaline) a hormone secreted into the bloodstream in times of danger or stress contains 59% C, 7.1% H, 26.2% O, and 7.7% N by mass, its MW is about 180 amu.

52. Write balanced chemical equations for the reactions of **sodium** with the following nonmetals to form ionic solids.
    a. Nitrogen   b. Oxygen   c. Sulfur   d. Bromine

53. Write a **balanced equation** for the following:
a. Reaction of boron trifluoride gas with water to give liquid hydrogen fluoride and solid boric acid,(H_3BO_3).

b. Reaction of magnesium Oxide with Iron to form Iron (III) Oxide and Magnesium.

c. The decomposition of dinitrogen Oxide gas to its elements.

d. The reaction of Calcium Carbide solid with water to form calcium hydroxide and acetylene (C_2H_2) gas.

e. The reaction of solid calcium cyan amide ($CaCN_2$) with water to from calcium carbonate and ammonia gas.

f. Ethane burns in air (Oxygen).

g. Hydrogen reacts with oxygen to from Water.

h.Nitrogen gas reacts with Hydrogen to form Ammonia.

j.Hydrogen reacts with Iodine gas to form Hydrogen Iodide.

k. Sodium reacts with Iodine gas to form Sodium Iodide.

l.Sodium Oxide reacts with water to form sodium hydroxide and hydrogen.

m.Carbon dioxide combines with water to form carbonic acid.

n.Magnesium and nitrogen gas combine to form magnesium nitride.

o.Conc. Hydrochloric acid reacts with Conc. Sodium hydroxide to form sodium chloride and water.

54. DEFINE limiting reagent, theoretical yield , and actual yield?

55.Sodium hydroxide reacts with carbondioxide as follows:

$$2\ NaOH(s)\ +\ CO_2\ (g)\ \rightarrow Na_2CO_3\ (s)\ +\ H_2O(l)$$
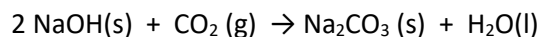
Which reagent is the limiting reactant when 1.85 mol of sodium hydroxide and 1.00 mol carbondixide are allowed to react? How many moles of sodium carbonate can be produced? How many moles of the excess reactant remain after the completion of the reaction?

56. WHEN   benzene (C_6H_6) reacts with bromine (Br_2) bromobenzene(C_6H_5Br) is obtained:
$$C_6H_6\ +\ Br_2\ \rightarrow\ C_6H_5Br\ +\ HBr$$
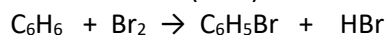
a.What is the theoretical yield of bromobenzene in this reaction when 30.0g of benzene reacts with 65.0 g of bromine?
b. If the actual yield of bromobenzene was 56.7 g what was the percentage yield?

57.One way to remove Nitrogen Oxide (NO) from smokestack emissions is to react it with ammonia: $$4\ NH_3\ (g) +\ 6\ NO\ (g)\ \text{--------> } 5\ N_2\ (g)\ +\ 6\ H_2O\ (l)$$
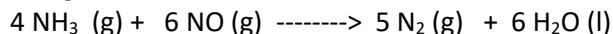
Fill in the blanks below:

f.   12.3 mol of NO reacts with _____ mol of ammonia.
g. 5.87 mol NO yields _____ mol nitrogen.

58.Define exothermic and endothermic reactions. What happens to the temperature of the surrounding during endo and exothermic reactions.

59.To prevent a condition called the "bends", deep sea divers breathe a mixture containing, in mole percent, 10.0% O_2, 10.0% N_2 , and 80.0% He.

a.Calculate the molar mass of this mixture.

b.What is the ratio of the density of this gas to that of pure Oxygen?

60.A 2.0g sample of SX_6 (g) has a volume of 329.5 cm^3 at 1.00 atm and 20°C. Identify the element 'X'. Name the compound.

61.When Hydrogen sulfide gas, H_2S, reacts with oxygen, Sulfur dioxide gas and steam are produced.

a.Write the balanced chemical equation for this reaction.

b.How many liters of sulfur dioxide would be produced from 10.0 l of Oxygen? Assume 100% yield and that all gases are measured at the same temperature and pressure.

62.Hydrogen cyanide, HCN is a poisonous gas. It can be formed by the reaction:

NaCN (s)   + H$^+$ (aq) ---------> HCN (g) + Na$^+$(aq)
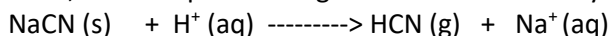
what mass of sodium cyanide is required to make 12.0 Liter of Hydrogen Cynaide at 20°C and 745 mm Hg?

63.A gaseous mixture contains 5.78 g of methane, 2.15 g of neon, and 6.8 g of sulfur dioxide. What pressure is exerted by the mixture inside a 75.0 L cylinder at 85°C and 751 mm Hg?

64.A sample of Methane gas is at 50°C and 20 atm. Would you expect it to behave more ideally or less ideally if:

a.The pressure was reduced to 1 atm.

b.The temperature were reduced to - 50° C?

65.Define solubility. Prepare a list of solubility rules for ionic compounds in water. (online resources) (IMPORTANT)

66.Name the following: a. CO_2 b. P_4S_{10} c. NI_3 d. PCl_5 e. CCl_4 f. SF_6 g. CH_4

h. C_2H_6 i. C_3H_8

67.Define **Oxidation and reduction**. Provide at least five examples of oxidation and reduction with chemical reactions. (Example: Rusting of Iron; $4Fe + 3O_2 \rightarrow 2Fe_2O_3$)

68.Define **Oxidation number**. Find the **Oxidation number** of
a. Cl in $HClO_4$
b.Sulfur in H_2SO_4.
c.Phosphorus in PO_4^{3-}
d.Manganese in MnO_4^{2-}

69. Which of the following statements are always true? Never true? Not always true?

a. A compound wit the molecular formula C_6H_6 has the same simplest formula.

b. The mass percent of copper in CuO is less than in Cu_2O.

c. The limiting reactant is the one present in the smallest number of grams.

d. Since $C_3H_6O_3$ and $C_6H_{12}O_6$ reduce to the same formula, they represent the same compound.

70. A bedroom 11 ft x 12 ft x 8.0 ft contains 35.41 kg of air at 25˚C. Express the volume of the room in liters, the amount of air in moles (molar mass of air is 29.0 g/mol) and the temperature in Kelvin.

71. A sample of carbon dioxide gas, CO_2 (g), occupies a volume of 5.75 L at 0.890 atm. If the temperature and the number of moles remain constant, calculate the volume when the pressure

a. increased to 1.25 atm

b. decrease to 0.350 atm

72. A nitrogen sample at 30˚C has a volume of 1.75L. If the pressure and the amount of gas remain unchanged, determine the volume when:

a. The Celsius temperature is doubled

73. An open flask contains 0.200 mol of air. Atmospheric pressure is 745 mmHg and room temperature is 68˚F. How many moles are present in the flask when the pressure is 1.10 atm and the temperature is 33˚C?

74. On a warm day, an amusement park balloon is filled with 47.8 g He. The temperature is 33˚C and the pressure in the balloon is 2.25 atm. Calculate the volume of the balloon.

75. A drum use to transport crude oil has a volume of 162 L. How many water molecules, as steam, are required to fill the drum at 1.00 atm and 100˚C? What volume of liquid water (density of water is 1.0 g/cm^3) is required to produce that amount of steam?

76. Calculate the densities of the following gases at 27˚C and 763 mmHg

a. Carbon monoxide

b. Chlorine

77. Define strong electrolyte, weak electrolyte, precipitation reactions and solubility?

78. What is an **Activity series** of metal? How does it help us in studying properties of elements?

79. A volatile liquid (one that evaporates) is put into a jar and the Jar is then sealed. Does the mass of the sealed jar and its contents change upon the vaporization of the liquid?

80. Identify each of the following as being most like an **observation, a law, or a theory**.

a.   All coastal areas experience two high tides and two low tides each day.

b. The tides in Earth's oceans are caused mainly by the gravitational attraction of the moon.
c. Yesterday, high tide in San Francisco Bay occurred at 2.43 a.m. and 3.07 P.m.
d. Tides are higher at the full moon and ne moon than at other times of the month.

81. Define the terms: Exothermic, endothermic reactions?   How much heat is required to raise the temperature of 100 grams of water from 25^0C to 82^0C?

82. A piece of unknown metal with mass 30 g is heated to 110^0C and dropped into 100.0 g of water at 20^0C. The final temperature of the system is 25 degree Celsius. What is the specific heat of the metal?

83.What is a solute and solvent? Define Molarity, Molality, mole-fraction and Mass percent of a solution?
84. Calculate the molarity of a solution that contains 0.2 mol NH_4Br in exactly 200 ml of solution?

85. Calculate the molarity of a solution that contains 20.0grams of sodium hydroxide in 200ml?

86. How many grams of solute are present in 50.0 ml of 0.360 M sodium chloride?

87. The compound adrenaline contains 56.7 % C, 6.56 % H, 28.37% O and 8.28 % N by mass. What is the empirical formula for adrenaline?

88. DDT, an insecticide harmful to fish, birds, and humans, is produced by the following reaction:

$2C_6H_5Cl$ + C_2HOCl_3 → $C_{14}H_9Cl_5$ + H_2O
Chloro benzene   Choral   DDT
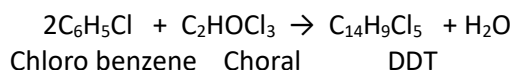
If 1142 g of chlorobenzene is reacted with 485 g of chloral.

a. What mass of DDT is formed?
b. Which reactant is limiting? Which is in excess?
c. What mass of excess reactant is left over?
d. If the actual yield of DDT is 200.0 g, what is the percent yield?

89. A 2.25 g sample of scandium metal is reacted with excess hydrochloric acid to produce 0.1502 g hydrogen gas. What is the formula of the scandium chloride produced in the reaction?
90. What volume of 0.100 M HCl solution is needed to neutralize 50.0 ml of 0.350 M KOH?

91. Differentiate between what happens when the following are dissolved in water. Use a particular example

a. Polar solute Vs non polar solute.
b. Ionic Vs Molecular

92. Write net Ionic reactions for the following by predicting the products? Assume the reactions are in solution. Use Solubility Rules to figure out the net ionic equation and write the spectator ions.
   a. Hydrochloric acid reacts with lithium Hydroxide
   b. Barium Chloride reacts with magnesium sulfate ..
   c. Aluminium Chloride reacts with silver nitrate
   d. Calcium Iodide reacts with sodium carbonate solution.
   e. Iron(III) sulfate reacts with sodium sulfide

(Section is followed by naming ions)

AP CHEMISTRY (Common mono, di & polyatomic ions.)
I)   Name (Ion)   Symbol(Ion)
   a) Sodium
   b) Potassium
   c) Cesium
   d) Beryllium
   e) Calcium
   f)   Strontium
   g) Barium
   h) Gallium
   i)   Aluminum
   j)   Nitrogen
   k) Arsenic
   l)   Bismuth
   m) Oxygen
   n) Fluorine
   o) Chlorine
   p) Bromine
   q) Iodine

Common ions of transition elements
   Ion Name   Ion
a) Chromium(III)
b) Manganese(II)
c) Iron(II) or Ferrous
d) Iron(III) or Ferric
e) Cobalt(II)
f) Nickel(II) or nickel
g) Copper(II) or Cupric
h) Zinc
i) Silver
j) Cadmium

k) Mercury(II) or mercuric

Common Polyatomic Ions

Name	Formula	Name	Formula
a) Acetate		b) Ammonium	
c) Carbonate		d) Chlorate	
e) Chlorite		f) Chromate	
g) Cyanide		h) Dichromate	
i) Dihydrogen Phosphate		j) Dihydrogen Phosphate	
k) Hydrogen Carbonate		l) Hydrogen Sulfate	
m) Hydrogen Sulfite		n) Hypochlorite	
o) Hydroxide		p) Nitrate	
q) Nitrite		r) Oxalate	
s) Perchlorate		t) Permanganate	
u) Perioxide		v) Phosphate	
w) Sulfate		x) Sulfite	
y) Thiosulfate			

Common Acids	Formula	Common Acids	Formula
Hydrochloric Acid		Phosphoric acid	Perchloric acid
Carbonic acid		Sulfurous Acid	
Nitrous acid		Sulfuric Acid	
Nitric Acid		Hypochlorous Acid	
Chlorous Acid		Chloric Acid	

Certain prescribed textbooks for AP CHEM. We follow   the highlighted book in school for AP Course.

Bell, Jerry. *Chemistry*. Bedford, NJ: W. H. Freeman.

Brady, James E., and Fred Senese. *Chemistry: Matter and Its Changes*. New York: John Wiley & Sons.

Brown, Theodore E., H. Eugene LeMay, and Bruce E. Bursten. *Chemistry: The Central Science*. Upper Saddle River, NJ: Prentice Hall.

Chang, Raymond, and Brandon Cruickshank. *Chemistry*. New York: McGraw-Hill.

Hill John W., Ralph H. Petrucci, Terry W. McCreary, and Scott S. Perry. *General Chemistry: An Integrated Approach*. Upper Saddle River, NJ: Pearson/Prentice Hall.

Kotz, John C., Paul M. Treichel, Gabriela C. Weaver. *Chemistry & Chemical Reactivity*. Pacific Grove, CA: Brooks/Cole Thomson Learning.

Masterton, William L., and Cecile N. Hurley. *Chemistry: Principles and Reactions*. Pacific Grove, CA: Brooks/Cole Thomson Learning.

Moore, John W., Conrad L. Stanitski, and Peter C. Jurs. *Chemistry: The Molecular Science*. Pacific Grove, CA: Brooks/Cole Thomson Learning.

Olmsted, John A., and Gregory M. Williams. *Chemistry*. New York: John Wiley & Sons.

Silberberg, Martin. *The Molecular Nature of Matter and Change*. New York: McGraw-Hill.

Spencer, James N., George M. Bodner, and Lyman H. Rickard. *Chemistry: Structure and Dynamics*. New York: John Wiley & Sons.

Zumdahl, Steven, and Susan Zumdahl. *Chemistry*. Boston: Houghton Mifflin

Visit www.collegeboard.com for more information. These books are listed on College Board website.