Chapter 4 Reading Guide   Name:
AP Chemistry 2016-2017   Date: Per:

This chapter combines mathematical concepts and reactions which are included in the AP Chemistry curriculum under Big Ideas 1, 2, 3, 4, and 5, as well as forming foundational concepts for Big Idea 6. Understanding the different types of reactions, their reactants, products and how to predict them will be valuable tools to use in the laboratory section of your course.

4.1 Climate Change and the Combustion of Fossil Fuels
1. What is meant by the Earth's average temperature?

    a. What factors determine this?

    b. What data is used to determine the Earth's average temperature?

    c. Has the Earth's average temperature change over the last forty years?

2. Explain what is meant by the *greenhouse effect*.

3. What is a greenhouse gas?

    a. Which greenhouse gases are scientists most concerned with and why?

    b. What data is used to determine the amount of greenhouse gases present in the atmosphere?

4.2 Reaction Stoichiometry: How Much Carbon Dioxide?
4. Gasoline used as a fuel for cars is a complex mixture.
    a. What compound is a major component of gasoline?

    b. Write a balanced chemical equation for the combustion of octane.

    c. What does this equation indicate?

5. How many moles of carbon dioxide are produced for every two moles of octane burned?

6. Define *stoichiometry*

7. What is stoichiometry similar to in cooking?

8. In stoichiometry, what are coefficients and how are they used?

9. Given a simple chemical reaction A + B → C:
   a. What is the general plan for determining how the mass, in grams, of one reagent consumed in a chemical reaction is related to the mass, in grams, of another reagent consumed in a chemical reaction?

   b. How does this plan apply to determining the mass of product formed knowing the mass of reactant?

10. Set up a problem with units showing how to convert 2.5 grams of hydrogen to grams of oxygen used during the reaction: $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$.

4.3 Limiting Reactant, Theoretical Yield, and Percent Yield
11. Define the following terms
    a. Limiting Reactant

    b. Theoretical yield

    c. Percent yield

    d. Actual yield

12. What is the relationship between actual yield and theoretical yield?

13. Explain how to identify the limiting reactant.

14. Explain how to calculate the theoretical yield of a reaction.

15. What is meant by an excess reactant?

16. Write the equation for the synthesis of ammonia from the elements nitrogen and hydrogen.

17. Given 50.0 g of N_2 and 20.0 g of H_2, determine the limiting reactant and theoretical yield.

18. In problem #17, if 19.0 gram of ammonia is formed when the experiment is performed, what is the percent yield?

4.4 Solution Concentration and Solution Stoichiometry

19. Define the following terms
    a. Solution

    b. Solvent

    c. Solute

    d. Aqueous solution

    e. Dilute solution

    f. Concentrated solution

    g. Molarity

20. Explain how to make a solution of a specified molarity. Include a diagram in your answer.

21. If 32.4 g of NaCl are dissolved in 500 mL of water, what is the molarity of the resulting NaCl solution.

22. How can molarity be used as a conversion factor in calculations involving the mass of a solute?

23. What is a stock solution?

24. What is the dilution equation and what does each symbol in the equation represent?

25. Given an aqueous solution, what does molarity times volume (in liters) equal?

26. Explain, in general, how to stock solution and prepare a dilute solution. Include a diagram in your answer.

27. Calculate the amount of stock solution needed to make 250.0 mL of 3.00 M KOH from a stock solution of 5.50 M KOH. Show all work.

28. What is a safety rule to when diluting concentrated acids?

29. Explain the strategy to use with stoichiometry problems when given the molarities of the reactants in reactions with solutions.

30. According to the reaction $2KCl(aq) + Pb(NO_3)_2(aq) \rightarrow PbCl_2(s) + 2KNO_3(aq)$, what volume of 0.100 M KCl would be needed to react completely with 25.0 mL of 0.150 M $Pb(NO_3)_2$?

4.5 Types of Aqueous Solutions and Solubility

31. Explain how a common salt dissolves in water. Include an ionic-level diagram in your answer.

32. Why is water able to dissolve so many substances?

33. Explain why a common salt solution, NaCl (aq), can conduct electricity, but a sugar solution cannot.

34. Explain how sugar dissolves in water. Include a diagram in your answer. Explain the differences from your answer in question #30.

35. Define the following terms
    a. Electrolyte

    b. Strong electrolyte

    c. Nonelectrolyte

    d. Strong acid

e. Weak acid

f. Weak electrolyte

g. Insoluble

h. Soluble

36. When an equation is written to illustrate what happens when a strong acid is put in water, what type of arrow goes in the equation and why?

37. When an equation is written to illustrate what happens when a weak acid is put in water, what type of arrow goes in the equation and why?

38. What is the solubility of ionic compounds with elements from group I on the periodic table?

39. What is the solubility of ammonium ions and nitrate ions?

Note: for the AP Exam, you are expected to know any compounds containing sodium, potassium, ammonium, and/or nitrate ions are always soluble in water. You do not need to memorize other solubility rules.

4.6 Precipitation Reactions

40. What does the term hard water refer to? What makes water "hard"?

41. What are precipitate reactions?

42. What types of compounds form precipitates?

43. How do you predict the products of a precipitation reaction?

44. After predicting the products, how do you determine if one of the products is going to actually precipitate?

4.7 Representing Aqueous Reactions: Molecular, Ionic, and Complete Ionic Equations

45. Explain the difference between molecular, complete ionic, and net ionic equations.

46. What are spectator ions and how are they identified in an equation?

47. How does one decide if a species should be written together as a substance or as distinct ions in an ionic equation?

48. Using the reaction of aqueous solutions of silver nitrate and sodium sulfide
    a. Write a balanced molecular equation

    b. Write a balanced complete ionic equation

    c. Write a balanced net ionic equation

49. What is observed in a gas-evolution reaction?

50. What is a neutralization reaction?

51. What is the difference between an Arrhenius acid and an Arrhenius base?

52. How do hydronium ions form? Include the equation for their formation.

53. What are polyprotic acids?

54. Give an example of a diprotic acid. Write the two equations for the successive release of its hydrogen ions.

55. Why does H_2SO_4 have different arrows in the equations for the successive release of its hydrogen ions?

56. Write names and formulas of three common acids.
    a.

    b.

    c.

57. Write the names and formulas of three common bases.
    a.

    b.

    c.

58. What products are formed when aqueous solutions of strong acids and bases react together?

59. Explain the chemical definition of a salt. Write chemical equations showing how two salts are formed.

60. Explain the process of titration.

61. What is the equivalence point of a titration and how is it determined?

62. What are indicators?

63. When used appropriately, what color does the indicatory phenolphthalein show at the equivalence point of the titration of an acid with a strong base?

64. What would the color of the phenolphthalein be if at the equivalence point of a base with a strong acid?

65. What are the reactants in a gas-evolution reaction?

66. What gas or gases are formed when carbonates are added to an acid solution?

67. What types of compounds produce SO_2 when reacted with acid?

68. For the reaction between sodium bicarbonate and hydrochloric acid
    a. Write a balanced molecular equation

    b. Write a balanced net ionic equation

4.9 Oxidation-Reduction Reactions
69. What is another name for an oxidation-reduction reaction?

70. Explain what happens in oxidation-reduction reactions.

71. Explain the difference between oxidation and reduction.

72. Do all redox reactions reactions involve oxygen as a reactant?

73. What is an oxidation number?

74. What is the oxidation state of an atom in a free element?

75. What is the oxidation state of Group I ions?

76. What is the normal oxidation state of Group II ions?

77. Explain how to determine the oxidation state of S in SO_4^{2-}. What is it?

78. What is the difference between a charge of a polyatomic ion and the oxidation state of atoms that compose it?

79. Explain how to determine which atom is oxidized and which is reduces by examining a balanced chemical equation.

80. For the reaction represented by $Mg(s) + 2H_2O(l) \rightarrow Mg(OH)_2(aq) + H_2(g)$, identify which element is oxidized and which is reduced.

81. Define the following terms
    a. Oxidizing agent

    b. Reducing agent

**Note: the AP chemistry exam does not use this phrasing, and instead will say "substance reduced" or "substance oxidized." However, it still appears in many other contexts, including chemical safety warnings, so is significant nonetheless. **
    82. In a combustion reaction, what species is oxidized and what species is reduced?

    a. Write an example equation to explain.

Self-Assessment Answers
1. _____   4. _____   7. _____   10. _____   13. _____

2. _____   5. _____   8. _____   11. _____   14. _____

3. _____   6. _____   9. _____   12. _____   15. _____