Name _____

Period ____ Date ____/____/____

5 • Reactions in Aqueous Solution

STUDY QUESTIONS AND PROBLEMS

1. Classify each of the following solutes as a strong electrolyte, weak electrolyte, or nonelectrolyte:

    sugar   sodium hydroxide

    common salt (NaCl)   hydrochloric acid

    alcohol   copper sulfate

    acetic acid   carbonic acid

2. Predict the solubility of the following salts:

        sodium sulfate

        potassium chromate

        silver bromide

        nickel (II) hydroxide

        aluminum nitrate

        barium sulfide

        ammonium acetate

        strontium iodide

3. Write the ions that are produced when the following substances dissolve in water:

        $Mg(OH)_2$

        K_2SO_4

        $NaHCO_3$

        $(NH_4)_3PO_4$

        $NaClO$

4. Predict whether or not the following reactions will lead to a precipitate. Write detailed and net ionic equations for all the reactions.

    a. potassium chromate and lead acetate

    b. silver perchlorate and ammonium chloride

    c. potassium carbonate and copper acetate

    d. sodium fluoride and magnesium iodide

    e. barium nitrate and potassium sulfate

5. Write the overall chemical reaction, the detailed ionic equation, and the net ionic equation, for the following acid-base reactions:

    a. acetic acid and potassium hydroxide
    b. hydrocyanic acid and ammonia
    c. nitric acid and sodium hydroxide
    d. sulfuric acid and ammonia (1:1 mole ratio)
    e. carbonic acid and sodium hydroxide (1:2 mole ratio)

6. Write equations for, and classify, the following reactions:

    a. nitric acid and cobalt (II) carbonate
    b. sodium sulfate and barium nitrate
    c. ammonia and acetic acid
    d. hydrochloric acid and calcium carbonate
    e. sodium hydroxide and nickel carbonate
    f. lead acetate and hydrochloric acid
    g. iron (III) nitrate and sodium hydroxide

7. Assign oxidation numbers to the underlined atoms in the following compounds:

    a. $\underline{N}O_3^-$ e. $\underline{S}O_2$
    b. $Cl\underline{F}_3$ f. $K_2\underline{Cr}_2O_7$
    c. $NaH_2\underline{P}O_4$ g. $\underline{Cu}(NO_3)_2$
    d. $Na\underline{Cl}O_4$ h. $K_2\underline{S}_2O_3$

8. In the following reactions determine which element is oxidized, which element is reduced, which reactant is the reducing agent, and which reactant is the oxidizing agent:

    a. $N_2H_4(aq) + 2O_2(g) \rightarrow N_2(g) + 2H_2O(g)$

    b. $3Cl_2(g) + NaI(aq) + 3H_2O(l) \rightarrow 6HCl(aq) + NaIO_3(aq)$

9. Determine whether the following reactions are acid-base reactions or oxidation-reduction reactions:

   a. $2N_2O(g) + 3O_2(g) \rightarrow 4NO_2(g)$
    b. $2NO_2(g) + H_2O(l) \rightarrow HNO_2(aq) + HNO_3(aq)$
    c. $MgCO_3(s) + H_2SO_4(aq) \rightarrow MgSO_4(s) + H_2O(l) + CO_2(g)$
    d. $Cu(s) + CuCl_2(aq) + 2Cl^-(aq) \rightarrow 2[CuCl_2]^-(s)$
    e. $HNO_3(aq) + KOH(aq) \rightarrow KNO_3(aq) + H_2O(l)$

10. a. If 5.00 grams of sodium hydroxide is dissolved to make 600 mL of solution, what is its molarity?

    b. How much potassium chloride has to be dissolved in water to produce 2.0 liters of a 2.45 M solution?

    c. If 24.63 grams of magnesium chloride is dissolved to make exactly 3 liters of solution calculate the concentrations of the ions in the solution (in moles/liter).

11. a. What is the molarity of the solution that results from adding 25 mL of a 0.15 M solution of sodium hydroxide to sufficient water to make 500 mL of solution?

   b. What volume of a 2.50 M solution of hydrochloric acid is required to prepare 2.0 liters of a 0.30 M solution?

12. When excess silver nitrate was added to a 25.0 mL sample of a solution of calcium chloride, 0.9256 gram of silver chloride precipitated. What is the concentration of the calcium chloride solution?

13. What volume of a 0.291 M solution of NaOH is required to reach the equivalence point in a titration against 25.0 mL of a 0.350 M HCl?

14. KHP (potassium hydrogen phthalate $KHC_8H_4O_4$) is often used as a primary standard for sodium hydroxide standardization:

$$HC_8H_4O_4^-(aq) + OH^-(aq) \rightarrow C_8H_4O_4^{2-}(aq) + H_2O(l)$$
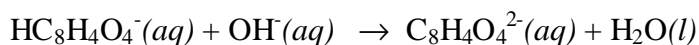
   If a 0.4856 gram sample of KHP is dissolved in sufficient water to prepare 250 mL of solution, and 25 mL of the solution requires 18.76mL of sodium hydroxide solution to reach the equivalence point, what is the molarity of the sodium hydroxide?