Chapter 4: Chemical Reactions and Solutions Stoichiometry

1. An unknown substance dissolves readily in water but not in benzene (a nonpolar solvent). Molecules of what type are present in the substance?
   A) neither polar nor nonpolar
   B) polar
   C) either polar or nonpolar
   D) nonpolar
   E) none of these

2. Which of the following is paired incorrectly?
   A) H_2SO_4 – strong acid
   B) HNO_3 – weak acid
   C) $Ba(OH)_2$ – strong base
   D) HCl – strong acid
   E) NH_3 – weak base

3. Which of the following aqueous solutions contains the greatest number of ions?
   A) 400.0 mL of 0.40 *M* LiCl
   B) 300.0 mL of 0.40 *M* $CaCl_2$
   C) 200.0 mL of 0.40 *M* $AlCl_3$
   D) 200.0 mL of 0.40 *M* NaBr
   E) 800.0 mL of 0.40 *M* glucose

4. A 38.1-g sample of $SrCl_2$ is dissolved in 112.5 mL of solution. Calculate the molarity of this solution.
   A) 27.0 *M*
   B) 2.14 *M*
   C) 53.7 *M*
   D) 0.339 *M*
   E) none of these

5. What mass of solute is contained in 256 mL of a 0.838 *M* ammonium chloride solution?
   A) 11.5 g
   B) 175 g
   C) 16.3 g
   D) 215 g
   E) 3.27 g

6. A 74.28-g sample of $Ba(OH)_2$ is dissolved in enough water to make 2.450 liters of solution. How many mL of this solution must be diluted with water in order to make 1.000 L of 0.100 *M* $Ba(OH)_2$?
   A) 565 mL
   B) 177 mL
   C) 17.7 mL
   D) 4.34 mL
   E) 231 mL

7. You have two solutions of sodium chloride. One is a 2.00 *M* solution, the other is a 4.00 *M* solution. You have much more of the 4.00 *M* solution and you add the solutions together. Which of the following could be the concentration of the final solution?
   A) 2.70 *M*
   B) 3.00 *M*
   C) 3.50 *M*
   D) 6.00 *M*
   E) 8.10 *M*

8. A 230.0-mL sample of a 0.275 *M* solution is left on a hot plate overnight; the following morning the solution is 1.29 *M*. What volume of solvent has evaporated from the 0.275 *M* solution?
   A) 49.0 mL
   B) 63.3 mL
   C) 181.0 mL
   D) 230. mL
   E) 279.0 mL

9. The following reactions

$$ZnBr_2(aq) + 2AgNO_3(aq) \rightarrow Zn(NO_3)_2(aq) + 2AgBr(s)$$
$$KBr(aq) + AgNO_3(aq) \rightarrow AgBr(s) + KNO_3(aq)$$

   are examples of
   A) oxidation-reduction reactions
   B) acid-base reactions
   C) precipitation reactions
   D) A and C
   E) none of these

10. All of the following reactions

$$2Al(s) + 3Br_2(l) \rightarrow 2AlBr_3(s)$$
$$2Ag_2O(s) \rightarrow 4Ag(s) + O_2(g)$$
$$CH_4(l) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$$

   can be classified as
   A) oxidation-reduction reactions
   B) combustion reactions
   C) precipitation reactions
   D) A and B
   E) A and C

11. Aqueous solutions of sodium sulfide and copper(II) chloride are mixed together. Which statement is correct?
   A) Both NaCl and CuS precipitate from solution.
   B) No reaction will occur.
   C) CuS will precipitate from solution.
   D) NaCl will precipitate from solution.
   E) A gas is released.

12. Which of the following salts is insoluble in water?
    A) Na_2S
    B) $Pb(CO_3)_2$
    C) $Mg(NO_3)_2$
    D) $CaCl_2$
    E) All of these are soluble in water.

13. Consider an aqueous solution of calcium nitrate added to an aqueous solution of sodium phosphate. What is the formula of the solid formed in the reaction?
    A) $Ca(PO_4)_2$
    B) $CaPO_4$
    C) $Ca_3(PO_4)_2$
    D) $Ca_3(PO_3)_2$
    E) none of these

14. When solutions of phosphoric acid and iron(III) nitrate react, which of the following terms will be present in the balanced molecular equation?
    A) $HNO_3(aq)$
    B) $3HNO_3(aq)$
    C) $2FePO_4(s)$
    D) $3FePO_4(s)$
    E) $2HNO_3(aq)$

15. You have separate solutions of HCl and H_2SO_4 with the same concentrations in terms of molarity. You wish to neutralize a solution of NaOH. Which acid solution would require more volume (in mL) to neutralize the base?
    A) The HCl solution.
    B) The H_2SO_4 solution.
    C) You need to know the acid concentrations to answer this question.
    D) You need to know the volume and concentration of the NaOH solution to answer this question.
    E) C and D

16. With what volume of 5.00 *M* HF will 4.72 g of calcium hydroxide react completely, according to the following reaction?

$$2HF + Ca(OH)_2 \rightarrow CaF_2 + 2H_2O$$

    A) 12.7 mL
    B) 127 mL
    C) 637 mL
    D) 25.5 mL
    E) 39.2 mL

17. A student weighs out 0.512 g of KHP (molar mass = 204.22 g/mol) and titrates to the equivalence point with 36.78 mL of a stock NaOH solution. What is the concentration of the stock NaOH solution? KHP is an acid with one acidic proton.
    A) 0.00251 *M*
    B) 0.092 *M*
    C) 0.0139 *M*
    D) 0.0682 *M*
    E) none of these

18. In which of the following does nitrogen have an oxidation state of +4?
    A) HNO_3
    B) NO_2
    C) N_2O
    D) NH_4Cl
    E) $NaNO_2$

19. In the reaction $2Ca(s) + O_2(g) \rightarrow 2CaO(s)$, which species is oxidized?
    A) O_2
    B) O^{2-}
    C) Ca
    D) Ca^{2+}
    E) none of these

20. In the reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, N_2 is
    A) oxidized
    B) reduced
    C) the electron donor
    D) the reducing agent
    E) two of these

21. Which of the following reactions does *not* involve oxidation-reduction?
    A) $CH_4 + 3O_2 \rightarrow 2H_2O + CO_2$
    B) $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
    C) $2Na + 2H_2O \rightarrow 2NaOH + H_2$
    D) $MnO_2 + 4HCl \rightarrow Cl_2 + 2H_2O + MnCl_2$
    E) All are oxidation-reduction reactions.

22. Which of the following are oxidation-reduction reactions?
    I. $PCl_3 + Cl_2 \rightarrow PCl_5$
    II. $Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$
    III. $CO_2 + 2LiOH \rightarrow Li_2CO_3 + H_2O$
    IV. $FeCl_2 + 2NaOH \rightarrow Fe(OH)_2 + 2NaCl$

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

23. How many of the following are oxidation-reduction reactions?

$NaOH + HCl \rightarrow NaCl + H_2O$

$Cu + 2AgNO_3 \rightarrow 2Ag + Cu(NO_3)_2$

$Mg(OH)_2 \rightarrow MgO + H_2O$

$N_2 + 3H_2 \rightarrow 2NH_3$

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

24. 1.00 mL of a 3.50×10^{-4} *M* solution of acetic acid is diluted with 9.00 mL of ethylene glycol, forming solution X. Then 2.00 mL of solution X is diluted with 8.00 mL of petroleum ether, forming solution Y. What is the concentration of solution Y?

A) 3.50×10^{-6} *M*
B) 9.72×10^{-6} *M*
C) 7.00×10^{-5} *M*
D) 7.78×10^{-5} *M*
E) 7.00×10^{-6} *M*

25. In which of the following does nitrogen have the highest oxidation state?

A) HNO_3
B) NO_2
C) N_2O
D) NH_4Cl
E) $NaNO_2$

Go Vikings!!