Assignment 04 (A)

1- Which of the following are nonelectrolytes in water?
   (i) HF
   (ii) ethanol, C₂H₅OH
   (iii) C₁₂H₂₂O₁₁
   (iv) KClO₃
   (v) Cu(NO₃)₂
   
   a) ii and iii  
   b) i, ii, and iii  
   c) i, iv, and v  
   d) iii  
   e) ii  
   (These are molecular compounds.)

2- Complete and balance the equation HClO₄(aq) + Cu(OH)₂(s)
   a) 2HClO₄(aq) + Cu(OH)₂(s) \rightarrow 2H₂O(l) + Cu(ClO₄)₂(s)
   b) HClO₄(aq) + Cu(OH)₂(s) \rightarrow H₂O(l) + Cu⁺(aq) + ClO₄⁻(aq)
   c) HClO₄(aq) + Cu(OH)₂(s) \rightarrow H₂O(l) + Cu²⁺(aq) + 2ClO₄⁻(aq)
   d) HClO₄(aq) + Cu(OH)₂(s) \rightarrow H₂O(l) + Cu(ClO₄)₂(s)
   e) 2HClO₄(aq) + Cu(OH)₂(s) \rightarrow 2H₂O(l) + Cu²⁺(aq) + 2ClO₄⁻(aq)
   (Cu(ClO₄)₂ is soluble and remains as ions in solution.)

3- Write a balanced molecular equation for the reaction of hydrofluoric acid and calcium.
   a) Ca(s) + 2HF(aq) \rightarrow CaF₂(aq) + 2H⁺(aq)
   b) Ca(s) + HF(aq) \rightarrow CaF₂(aq) + H₂(g)
   c) Ca(s) + 2HF(aq) \rightarrow CaF₂(aq) + H₂(g)
   (Calcium is oxidized, and hydrogen is reduced.)

4- Which reactions will not produce a precipitate from aqueous solution?
   a) AgNO₃ + KI
   b) FeSO₄ + Ba(OH)₂
   c) Pb(NO₃)₂ + Na₂CO₃
   d) ZnCl₂ + (NH₄)₂S
   e) NaBr + Al₂(SO₄)₃
   (Both AlBr₃ and Na₂SO₄ are soluble.)

5- In the reaction Cl₂(aq) + 2I⁻(aq) \rightarrow 2Cl⁻(aq) + I₂(aq), the species that is reduced is
   a) Cl₂  
   b) I⁻  
   c) Cl⁻  
   d) I₂  
   (Cl₂ goes from an oxidation state of zero to −1.)

6- What volume of 0.125 M H₂SO₄ is required to neutralize 2.50 g of Ca(OH)₂?
   a) 0.270 mL  
   b) 0.135 mL  
   c) 135 mL  
   d) 270 mL  
   (The neutralization requires 0.0338 moles of H₂SO₄.)
7- Which species is reduced in the reaction

\[ 2\text{MnO}_4^-(aq) + 10\text{I}^-(aq) + 16\text{H}^+(aq) \rightarrow 2\text{Mn}^{2+}(aq) + 5\text{I}_2(aq) + 8\text{H}_2\text{O}(l) \]?

a) \text{MnO}_4^-

b) \text{H}^+

c) \text{Mn}^{2+}

d) \text{I}_2

e) \text{I}^-(This reagent causes the oxidation of \text{I}^- to \text{I}_2, and is itself reduced to \text{Mn}^{2+}.)

8- When NaCl is added to a solution of (i) AgNO$_3$, (ii) Pb(NO$_3$)$_2$, or (iii) Ca(NO$_3$)$_2$, in which case(s) does a precipitate form?

a) Pb(NO$_3$)$_2$ only

b) in all three cases
c) \text{AgNO}_3 and \text{Pb(NO}_3)_2 only

d) AgNO$_3$ only

e) Ca(NO$_3$)$_2$ only

(These two salts, which are soluble, react with NaCl to form AgCl and PbCl$_2$, which are insoluble.)

9- You want to perform an electrolysis experiment in which an electric current successfully passes through an aqueous solution. Which of the following substances would you add to a beaker of pure water to make this happen?

a) CO$_2$

b) C$_2$H$_5$OH

c) CCl$_4$

d) NH$_4$NO$_3$

e) CH$_4$

(This compound is soluble in water and dissociates into NH$_4^+$ and NO$_3^-$.)

10- Based on the activity series, which of the following reactions will occur?

(i) Al(s) + NiCl$_2$(aq)

(ii) Ag(s) + Pb(NO$_3$)$_2$(aq)

(iii) Cr(s) + NiSO$_4$(aq)

a) i only

b) ii only

c) iii only

d) i and ii

e) i and iii

(Al is more easily oxidized than Ni, and Cr is more easily oxidized than Ni.)

11- What mass of ethanol, C$_2$H$_5$OH, is required to produce 300. mL of a 0.500 M solution?

a) 46.1 g

b) 23.0 g
c) \textbf{6.91 g}

d) 92.1 g
e) 13.8 g

(There are 0.150 moles of ethanol.)
12- If 5.20 g of a salt are found in 2.50 L of a 0.500 M solution, how many grams would be present in 2.50 L of a 1.50 M solution?
   a) 5.20 g
   b) 10.4 g
   c) 15.6 g
   d) 1.73 g
   e) 7.8 g
   (There is three times more of the salt in the more concentrated solution.)

13- What is the mass of the precipitate formed when 12.0 mL of 0.150 M NaCl is added to 25.00 mL of a 0.0500 M AgNO₃ solution?
   a) 258 g
   b) 0.258 g
   c) 179 g
   d) 0.179 g
   e) 36.0 g
   (AgCl is the precipitate, and AgNO₃ is the limiting reagent.)

14- A 25.0-g sample of garden compost was analyzed for chloride content. The sample was dissolved in water, and the chloride was precipitated as silver chloride. 1.58 g of dried precipitate was obtained. Calculate the mass percent of chloride in the sample.
   a) 6.32 percent
   b) 4.76 percent
   c) 62.3 percent
   d) 3.15 percent
   e) 1.6 percent
   (0.39 g of chloride was precipitated.)

15- The minerals chalcocite (Cu₂S) and malachite (Cu₂CO₃(OH)₂) are two primary sources of copper. What is the oxidation state of copper in each of these minerals?
   a) The oxidation state of copper in chalcocite is +1, and in malachite it is +2.
   b) The oxidation state of copper in chalcocite is +2, and in malachite it is +1.
   c) The oxidation state of copper in chalcocite is +2, and in malachite it is +2.
   d) The oxidation state of copper in chalcocite is +1, and in malachite it is +1.
   e) The oxidation state of copper in chalcocite is +2, and in malachite it is +4.
   (Sulfide has a charge of 2⁻, carbonate has a charge of 2⁻, and hydroxide has a charge of 1⁻.)

16- An aqueous solution of an unknown solute is tested with litmus paper and found to be acidic. The solution is weakly conducting compared with a solution of NaCl of the same concentration. Which of the following substances could the unknown be: KOH, NH₃, HNO₃, KClO₂, H₃PO₃, or CH₃COCH₃?
   a) KOH
   b) NH₃
   c) HNO₃
   d) H₃PO₃
   e) KClO₂
   f) CH₃COCH₃
   (KOH is a strong base, NH₃ a weak base, HNO₃ a strong acid, KClO₂ a basic salt, and CH₃COCH₃ a molecular compound.)

17- An aqueous solution of nickel ions will oxidize each of the following metals except
   a) aluminum.
   b) chromium.
   c) barium.
18- How many milliliters of 0.1000 \( M \) \( \text{Ca(OH)}_2 \) solution are needed to supply 0.05000 mol of \( \text{Ca(OH)}_2 \)?

a) \( 500.0 \text{ mL} \)

b) \( 250.0 \text{ mL} \)

c) \( 2000 \text{ mL} \)

d) \( 167.0 \text{ mL} \)

\[
\frac{0.05000 \text{ mol}}{0.1000 \text{ M}} = 0.5000 \text{ L}
\]

19- Indicate the concentration of each ion or molecule present in a \( 0.25 \text{ M} \) \( \text{CaBr}_2 \) solution.

a) \( 0.25 \text{ M Ca}^{2+}, 0.25 \text{ M Br}^- \)

b) \( 0.25 \text{ M Ca}^{2+}, 0.50 \text{ M Br}^- \)

c) \( \text{CaBr}_2 \)

d) \( 0.50 \text{ M Ca}^{2+}, 0.50 \text{ M Br}^- \)

e) \( 0.50 \text{ M Ca}^{2+}, 0.25 \text{ M Br}^- \)

(There are two times the moles of Br\(^-\) compared to Ca\(^{2+}\).)

20- What is/are the spectator ion(s) when a \( \text{BaCl}_2 \) solution is combined with an \( \text{H}_2\text{SO}_4 \) solution?

a) \( \text{Ba}^{2+}(aq), \text{H}^+(aq) \)

b) \( \text{SO}_4^{2-}(aq), \text{H}^+(aq) \)

c) \( \text{Cl}^-(aq) \)

d) \( \text{Cl}^-(aq), \text{H}^+(aq) \)

e) \( \text{H}^+(aq) \)

(\( \text{BaCl}_2(aq) + \text{H}_2\text{SO}_4(aq) \rightarrow \text{BaSO}_4(s) + 2\text{HCl}(aq) \))

21- Complete and balance the molecular equation \( \text{HBr}(aq) + \text{Ca(OH)}_2(aq) \)

a) \( \text{HBr}(aq) + \text{Ca(OH)}_2(aq) \rightarrow \text{H}_2\text{O}(l) + \text{CaBr}(aq) \)

b) \( 2\text{HBr}(aq) + \text{Ca(OH)}_2(aq) \rightarrow 2\text{H}_2\text{O}(l) + \text{CaBr}_2(aq) \)

c) \( \text{HBr}(aq) + \text{Ca(OH)}_2(aq) \rightarrow \text{H}_2\text{O}(l) + \text{CaBr}_2(aq) \)

d) \( 2\text{HBr}(aq) + \text{Ca(OH)}_2(aq) \rightarrow 2\text{H}_2\text{O}(l) + \text{Ca}_2\text{Br}_2(s) \)

e) \( 2\text{HBr}(aq) + \text{Ca(OH)}_2(aq) \rightarrow \text{H}_2\text{O}(l) + \text{CaBr}_2(s) \)

(\( \text{CaBr}_2 \) is soluble.)

22- A solution is made by mixing 30.0 mL of 8.00 \( M \) \( \text{HCl} \), 100 mL of 2.00 \( M \) \( \text{HCl} \), and enough water to make 200.0 mL of solution. What is the molarity of \( \text{HCl} \) in the final solution?

a) \( 0.455 \text{ M} \)

b) \( 1.00 \text{ M} \)

c) \( 1.20 \text{ M} \)

d) \( 2.20 \text{ M} \)

e) \( 0.440 \text{ M} \)

f) \( 10.00 \text{ M} \)

(There are 0.240 moles in the first solution and 0.200 moles in the second.)

23- Which one of the following results in the formation of 0.200 \( M \) \( \text{K}_2\text{SO}_4 \) solution?

a) dilution of 250.0 mL of 1.00 M \( \text{K}_2\text{SO}_4 \) to 1.00 L

b) dissolving 43.6 g of \( \text{K}_2\text{SO}_4 \) in water and diluting to a total volume of 250.0 mL

c) **diluting 20.0 mL of 5.00 M \( \text{K}_2\text{SO}_4 \) solution to 500.0 mL**

d) dissolving 20.2 g of \( \text{K}_2\text{SO}_4 \) in water and diluting to 250.0 mL, then diluting 25.0 mL of this solution to a total volume of 500.0 mL.
24- What volume of 0.125 \( M \) \( \text{H}_2\text{SO}_4 \) is required to completely precipitate all of the barium in 10.00 mL of a 0.150 \( M \) barium nitrate solution?

a) **12.0 mL**
b) 24.0 mL
c) 6.00 mL
d) 0.206 mL
e) 0.010 mL

(0.0015 moles of \( \text{BaSO}_4 \) are created, and the reaction stoichiometry shows that 0.0015 moles of \( \text{H}_2\text{SO}_4 \) are needed)

25- If 5.20 g of a salt are found in 0.180 L of a 0.500 \( M \) solution, how many grams would be present in 0.180 L of a 1.50 \( M \) solution?

a) 5.20 g
b) 10.4 g
c) **15.6 g**
d) 1.73 g
e) 7.8 g

(There is three times more of the salt in the same volume of the more concentrated solution.)

26- A solution is made of 25.0 mL of 0.250 \( M \) nitric acid and 15.0 mL of 0.500 \( M \) hydrochloric acid all diluted to 250. mL. What is the resulting concentration of the hydrogen ion?

a) 55.0 M
b) 0.0800 M
c) 0.0300 M
d) 0.0500 M
e) **0.0550 M**

(Just 0.00625 moles of \( H^+ \) are provided by the \( \text{HNO}_3 \), and 0.00750 moles are provided by the \( \text{HCl} \).)