AP Chemistry Problem Set #4

1. Answer each of the following regarding neutralization.
a. Calculate the volume of 0.150 M $Ba(OH)_2$ needed to neutralize 75.0 mL of 0.150 M HOCl.
b. Calculate the volume of 0.0736 M $Ba(OH)_2$ needed to neutralize 87.0 mL 0f 0.0500 M H_2SO_4.
c. Calculate the volume of 0.0800 M NaOH needed to neutralize 123.0 mL of 0.750 M H_3PO_4.
d. Calculate the volume of 0.0200 M $Ba(OH)_2$ needed to neutralize 15.00 mL of 3.0 M H_3PO_4.
e. Calculate the volume of 0.300 M NaOH needed to neutralize 1.65 L of 0.0750 M H_2SO_4.

2. Use the following equation for all parts of this question.

$$Zn(s) + NO_3^- \rightarrow Zn^{2+}(aq) + NH_4^+(aq)$$

a. Write the complete balanced half-reaction for the oxidation in an acidic solution.
b. Write the complete balanced half-reaction for the reduction in an acidic solution.
c. Identify the oxidizing agent and the reducing agent.
d. Write the complete balanced reduction oxidation equation in an acidic solution
e. Write the complete balanced reduction oxidation equation in a basic solution

3. Use the following equation for all parts of this question.

$$2Mg(s) + 2CuSO_4(aq) + H_2O(l) \rightarrow 2MgSO_4(aq) + Cu_2O(s) + H_2(g)$$

a. If 2.46 grams of Mg(s) are added to 500. mL of a 0.300 M solution of $CuSO_4$, what is the maximum molar yield of $H_2(g)$?
b. What is the limiting reagent?
c. When all of the limiting reagent has been consumed in (a), how many moles of the other reactant (not water) remain?
d. Assuming that the volume of the solution does not change, calculate the concentration of Mg^{2+} in solution.
e. If a student declares that her percent yield of copper(I) oxide is 87.9%, how many grams of copper(I) oxide did she actually produce?

4. Sodium hydroxide reacts with iron(III) nitrate to produce sodium nitrate and iron(III) hydroxide
a. Write a complete balanced equation for this reaction.
b. Write the net ionic equation for this reaction.
c. If you have 450.0 mL of a 0.750 M sodium hydroxide solution and 0.850 L of a 0.250 M iron(III) nitrate solution, what is greatest mass of your precipitate that you could produce?
d. If only 7.73 grams of precipitate are collected when the experiment is carried out, what is your percent yield?

5. Use the following equation for all parts of this question.

$$MnO_4^- + SO_3^{2-} \rightarrow Mn^{2+} + SO_4^{2-}$$

a. Write the complete balanced half-reaction for the oxidation in an acidic solution.
b. Write the complete balanced half-reaction for the reduction in an acidic solution.
c. Which substance is oxidized? Which substance is reduced?
d. Write the complete balanced reduction oxidation equation in an acidic solution.
e. Write the complete balanced reduction oxidation equation in a basic solution.

AP Chemistry Problem Set #4

1. Answer each of the following regarding neutralization.
a. Calculate the volume of 0.150 M $Ba(OH)_2$ needed to neutralize 75.0 mL of 0.150 M HOCl. **0.0375 L**
b. Calculate the volume of 0.0736 M $Ba(OH)_2$ needed to neutralize 87.0 mL 0f 0.0500 M H_2SO_4. **0.0591 L**
c. Calculate the volume of 0.0800 M NaOH needed to neutralize 123.0 mL of 0.750 M H_3PO_4. **3.46 L**
d. Calculate the volume of 0.0200 M $Ba(OH)_2$ needed to neutralize 15.00 mL of 3.0 M H_3PO_4. **3.38 L**
e. Calculate the volume of 0.300 M NaOH needed to neutralize 1.65 L of 0.0750 M H_2SO_4. **0.825 L**

2. Use the following equation for all parts of this question.

$$Zn(s) + NO_3^- \rightarrow Zn^{2+}(aq) + NH_4^+(aq)$$

a. Write the complete balanced half-reaction for the oxidation in an acidic solution. **$Zn \rightarrow Zn^{2+} + 2e^-$**
b. Write the complete balanced half-reaction for the reduction in an acidic solution.
$10H^+ + NO_3^- + 8e^- \rightarrow NH_4^+ + 3H_2O$
c. Identify the oxidizing agent and the reducing agent. **OA: NO_3^- RA: Zn**
d. Write the complete balanced reduction oxidation equation in an acidic solution.
$10H^+ + NO_3^- + 4Zn \rightarrow 4Zn^{2+} + NH_4^+ + 3H_2O$
e. Write the complete balanced reduction oxidation equation in a basic solution.
$7H_2O + NO_3^- + 4Zn \rightarrow 4Zn^{2+} + NH_4^+ + 10OH^-$

3. Use the following equation for all parts of this question.

$$2Mg(s) + 2CuSO_4(aq) + H_2O(l) \rightarrow 2MgSO_4(aq) + Cu_2O(s) + H_2(g)$$

a. If 2.46 grams of Mg(s) are added to 500. mL of a 0.300 M solution of $CuSO_4$, what is the maximum molar yield of $H_2(g)$? **0.0506 moles H_2**
b. What is the limiting reagent? **Mg**
c. When all of the limiting reagent has been consumed in (a), how many moles of the other reactant (not water) remain? **0.049 moles**
d. Assuming that the volume of the solution does not change, calculate the concentration of Mg^{2+} in solution. **0.202 M**
e. If a student declares that her percent yield of copper(I) oxide is 87.9%, how many grams of copper(I) oxide did she actually produce? **6.36 g**

4. Sodium hydroxide reacts with iron(III) nitrate to produce sodium nitrate and iron(III) hydroxide
a. Write a complete balanced equation for this reaction. **$3NaOH + Fe(NO_3)_3 \rightarrow Fe(OH)_3 + 3NaNO_3$**
b. Write the net ionic equation for this reaction. **$3OH^- + Fe^{3+} \rightarrow Fe(OH)_3$**
c. If you have 450.0 mL of a 0.750 M sodium hydroxide solution and 0.850 L of a 0.250 M iron(III) nitrate solution, what is greatest mass of your precipitate that you could produce? **12.0 g**
d. If only 7.73 grams of precipitate are collected when the experiment is carried out, what is your percent yield? **64.4%**

5. Use the following equation for all parts of this question.

$$MnO_4^- + SO_3^{2-} \rightarrow Mn^{2+} + SO_4^{2-}$$

a. Write the complete balanced half-reaction for the oxidation in an acidic solution.
$H_2O + SO_3^{2-} \rightarrow SO_4^{2-} + 2H^+ + 2e^-$
b. Write the complete balanced half-reaction for the reduction in an acidic solution.
$5e^- + 8H^+ + MnO_4^- \rightarrow Mn^{2+} + 4H_2O$
c. Which substance is oxidized? Which substance is reduced? **Ox: SO_3^{2-} Red: MnO_4^-**
d. Write the complete balanced reduction oxidation equation in an acidic solution.
$6H^+ + 2MnO_4^- + 5SO_3^{2-} \rightarrow 2Mn^{2+} + 5SO_4^{2-} + 3H_2O$
e. Write the complete balanced reduction oxidation equation in a basic solution.
$3H_2O + 2MnO_4^- + 5SO_3^{2-} \rightarrow 2Mn^{2+} + 5SO_4^{2-} + 6OH^-$