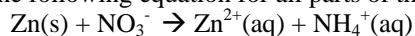


## AP Chemistry Problem Set #4

1. Answer each of the following regarding neutralization.

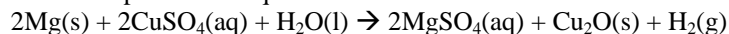
- Calculate the volume of 0.150 M Ba(OH)<sub>2</sub> needed to neutralize 75.0 mL of 0.150 M HOCl.
- Calculate the volume of 0.0736 M Ba(OH)<sub>2</sub> needed to neutralize 87.0 mL of 0.0500 M H<sub>2</sub>SO<sub>4</sub>.
- Calculate the volume of 0.0800 M NaOH needed to neutralize 123.0 mL of 0.750 M H<sub>3</sub>PO<sub>4</sub>.
- Calculate the volume of 0.0200 M Ba(OH)<sub>2</sub> needed to neutralize 15.00 mL of 3.0 M H<sub>3</sub>PO<sub>4</sub>.
- Calculate the volume of 0.300 M NaOH needed to neutralize 1.65 L of 0.0750 M H<sub>2</sub>SO<sub>4</sub>.

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



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

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

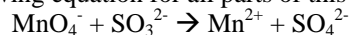


- If 2.46 grams of Mg(s) are added to 500. mL of a 0.300 M solution of CuSO<sub>4</sub>, what is the maximum molar yield of H<sub>2</sub>(g)?
- What is the limiting reagent?
- When all of the limiting reagent has been consumed in (a), how many moles of the other reactant (not water) remain?
- Assuming that the volume of the solution does not change, calculate the concentration of Mg<sup>2+</sup> in solution.
- 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

- Write a complete balanced equation for this reaction.
- Write the net ionic equation for this reaction.
- 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?
- 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.



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

## AP Chemistry Problem Set #4

- Answer each of the following regarding neutralization.
  - Calculate the volume of 0.150 M Ba(OH)<sub>2</sub> needed to neutralize 75.0 mL of 0.150 M HOCl. **0.0375 L**
  - Calculate the volume of 0.0736 M Ba(OH)<sub>2</sub> needed to neutralize 87.0 mL of 0.0500 M H<sub>2</sub>SO<sub>4</sub>. **0.0591 L**
  - Calculate the volume of 0.0800 M NaOH needed to neutralize 123.0 mL of 0.750 M H<sub>3</sub>PO<sub>4</sub>. **3.46 L**
  - Calculate the volume of 0.0200 M Ba(OH)<sub>2</sub> needed to neutralize 15.00 mL of 3.0 M H<sub>3</sub>PO<sub>4</sub>. **3.38 L**
  - Calculate the volume of 0.300 M NaOH needed to neutralize 1.65 L of 0.0750 M H<sub>2</sub>SO<sub>4</sub>. **0.825 L**
- Use the following equation for all parts of this question.
$$\text{Zn(s)} + \text{NO}_3^- \rightarrow \text{Zn}^{2+}(\text{aq}) + \text{NH}_4^+(\text{aq})$$
  - Write the complete balanced half-reaction for the oxidation in an acidic solution. **Zn → Zn<sup>2+</sup> + 2e<sup>-</sup>**
  - Write the complete balanced half-reaction for the reduction in an acidic solution.  
**10H<sup>+</sup> + NO<sub>3</sub><sup>-</sup> + 8e<sup>-</sup> → NH<sub>4</sub><sup>+</sup> + 3H<sub>2</sub>O**
  - Identify the oxidizing agent and the reducing agent. **OA: NO<sub>3</sub><sup>-</sup> RA: Zn**
  - Write the complete balanced reduction oxidation equation in an acidic solution.  
**10H<sup>+</sup> + NO<sub>3</sub><sup>-</sup> + 4Zn → 4Zn<sup>2+</sup> + NH<sub>4</sub><sup>+</sup> + 3H<sub>2</sub>O**
  - Write the complete balanced reduction oxidation equation in a basic solution.  
**7H<sub>2</sub>O + NO<sub>3</sub><sup>-</sup> + 4Zn → 4Zn<sup>2+</sup> + NH<sub>4</sub><sup>+</sup> + 10OH<sup>-</sup>**
- Use the following equation for all parts of this question.
$$2\text{Mg(s)} + 2\text{CuSO}_4(\text{aq}) + \text{H}_2\text{O(l)} \rightarrow 2\text{MgSO}_4(\text{aq}) + \text{Cu}_2\text{O(s)} + \text{H}_2(\text{g})$$
  - If 2.46 grams of Mg(s) are added to 500. mL of a 0.300 M solution of CuSO<sub>4</sub>, what is the maximum molar yield of H<sub>2</sub>(g)? **0.0506 moles H<sub>2</sub>**
  - What is the limiting reagent? **Mg**
  - When all of the limiting reagent has been consumed in (a), how many moles of the other reactant (not water) remain? **0.049 moles**
  - Assuming that the volume of the solution does not change, calculate the concentration of Mg<sup>2+</sup> in solution. **0.202 M**
  - 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**
- Sodium hydroxide reacts with iron(III) nitrate to produce sodium nitrate and iron(III) hydroxide
  - Write a complete balanced equation for this reaction. **3NaOH + Fe(NO<sub>3</sub>)<sub>3</sub> → Fe(OH)<sub>3</sub> + 3NaNO<sub>3</sub>**
  - Write the net ionic equation for this reaction. **3OH<sup>-</sup> + Fe<sup>3+</sup> → Fe(OH)<sub>3</sub>**
  - 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**
  - If only 7.73 grams of precipitate are collected when the experiment is carried out, what is your percent yield? **64.4%**
- Use the following equation for all parts of this question.
$$\text{MnO}_4^- + \text{SO}_3^{2-} \rightarrow \text{Mn}^{2+} + \text{SO}_4^{2-}$$
  - Write the complete balanced half-reaction for the oxidation in an acidic solution.  
**H<sub>2</sub>O + SO<sub>3</sub><sup>2-</sup> → SO<sub>4</sub><sup>2-</sup> + 2H<sup>+</sup> + 2e<sup>-</sup>**
  - Write the complete balanced half-reaction for the reduction in an acidic solution.  
**5e<sup>-</sup> + 8H<sup>+</sup> + MnO<sub>4</sub><sup>-</sup> → Mn<sup>2+</sup> + 4H<sub>2</sub>O**
  - Which substance is oxidized? Which substance is reduced? **Ox: SO<sub>3</sub><sup>2-</sup> Red: MnO<sub>4</sub><sup>-</sup>**
  - Write the complete balanced reduction oxidation equation in an acidic solution.  
**6H<sup>+</sup> + 2MnO<sub>4</sub><sup>-</sup> + 5SO<sub>3</sub><sup>2-</sup> → 2Mn<sup>2+</sup> + 5SO<sub>4</sub><sup>2-</sup> + 3H<sub>2</sub>O**
  - Write the complete balanced reduction oxidation equation in a basic solution.  
**3H<sub>2</sub>O + 2MnO<sub>4</sub><sup>-</sup> + 5SO<sub>3</sub><sup>2-</sup> → 2Mn<sup>2+</sup> + 5SO<sub>4</sub><sup>2-</sup> + 6OH<sup>-</sup>**