Redox Titration Experiment

CHEM 251
Week of September 27th, 2010
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CHEM 251 Laboratory

The week of October 4th

- Experiment: Redox Titration of Oxalate with Permanganate, pp. 131-136
- Prelab
- Quiz: Material in laboratory manual
- Due this week: Coordination Compound lab report

An Overview

- Titration is a method that is commonly used to determine the unknown concentration of a known reactant.
- The titrant is the reagent of known concentration and the volume is used to react with the analyte, which is the reagent of unknown concentration.
- Redox titration is a type of titration based on a redox reaction between the analyte and titrant.
- A redox reaction is one in which the atoms have their oxidation numbers (or states) changed.
  - Oxidation = loss of electrons, increase in oxidation number
  - Reduction = gain of electrons, decrease in oxidation number

An Overview, con't

- Today you will be analyzing your coordination compound from last semester's experiment for its oxalate content by performing a redox titration with potassium permanganate.
  - The reaction of permanganate tends to be pretty slow (30-60 seconds), which may make the concept of titration seem impractical.
    - However, this rxn is sped up by the addition of a catalyst.
    - The catalyst in this case is manganese. The addition of manganate will speed up the reaction in an example of autocatalysis.
- The method to today's madness can be summarized in one statement:

Vol ($KMnO_4$) x M ($KMnO_4$) x mole ratio x M.W. (oxalate)

- All in all, if you are left with the unit you are trying to find when all is said and done, you are in good shape.

The Titration

1. Place ~0.1 g of coordination compound into three 250mL Erlenmeyer flasks and add ~20 mL of 1.0 M sulfuric acid.

2. Fill a buret half-full with $KMnO_4$ and make sure there are no air bubbles in the tip of the buret. Perform the titration in the following fashion:
   - Gently heat the solution until the coordination compound dissolves and the temperature of the solution is 80-90 degrees. Please do not boil the solution or use the thermometer as a stirring rod.
   - Titrate the solution with the $KMnO_4$ in the buret while maintaining the solution temperature above 60 degrees.
   - Because our coordination compound is yellow-green, our solution will appear orange in the flask. As we near the endpoint, the solution will turn colorless. The endpoint itself is marked by a clear pink color.
   - Titrate until the solution remains pink for 15 seconds after a drop is added.
   - Do three trials of this titration and make sure your volumes agree with one another.

Outside of Class

- Calculate the following:
  - moles of $KMnO_4$
  - moles of oxalate in the samples
  - mass of oxalate
  - experimental weight percent of oxalate for each titration
  - average weight percent of oxalate
  - standard deviation
  - theoretical weight percent
  - percent error
- Create a histogram of the distribution of experimental weight percent results.

Outside of Class, con't

- Answer the questions in the accompanying handout.
- You should have the following in your lab report:
  - Class data (as downloaded)
  - Results table
  - Sample calculations
  - One histogram

A few reminders

- Hand in your carbon copies to me at the end of class.
- Your lab report will be a formal lab report, which includes:
  1. Cover page/abstract
  2. Introduction/Purpose/Procedure
  3. Data
  4. Sample calculations
  5. Results
  6. Discussion/Conclusion

The Cheat Sheet

- # moles of MnO_4^- = (concentration of titrant) x (volume of titrant, liters)
- # moles of oxalate = (5/2) x (# moles of permanganate)
- Molarity = moles/liter