Determination of Hydrogen Peroxide Concentration by Reaction with Permanganate: A Redox Titration

Background/Theory: address each point listed below in a cohesive paragraph. Include calculations as appropriate.

- Why isn't it necessary to add an indicator to a titration involving permanganate?
- How will the endpoint of the titration be recognized?
- How many grams of $KMnO_4$ are needed to prepare 500mL of 0.1M solution?
- Why is it necessary to make, standardize, and titrate potassium permanganate in the same day?
- Why is it necessary to keep the sodium oxalate solution warm?
- Provide the balanced reactions (use the ½ reaction method)
    - Standardization in acidic solution: reduction of permanganate ion to manganese(II) ion; oxidation of oxalate ion to carbon dioxide
    - Lab in acidic solution: reduction of permanganate ion to manganese(II) ion; oxidation of hydrogen peroxide to oxygen
- How does titration allow the determination of an unknown concentration?

Hazards: Potassium permanganate, Sodium oxalate, Sulfuric acid, Hydrogen peroxide

Procedure

Part 1: Prepare and standardize the $KMnO_4$

The standardization of the $KMnO_4$ solution will be done with two trials due to time; if your numbers are appreciably different, a third trial should be completed.

1) Accurately weigh out the $KMnO_4$. Dissolve this in 100-150mL of distilled water in a 500mL volumetric flask. Fill the flask to the appropriate point then transfer the solution to a clean 1L bottle. During the transfer, swirl the flask periodically as you pour.
2) Clean out a buret by rinsing it with several portions of tap water, followed by rinsings with distilled water. Finally, rinse the buret with the $KMnO_4$ solution you are going to standardize.
3) Allow a few mL of $KMnO_4$ to run out of the tip to remove air bubbles.
4) Label two 250mL Erlenmeyer flasks as samples 1 and 2. Weigh out approximately 0.5-0.8g of $Na_2C_2O_4$, along with 35mL of 3M H_2SO_4 and 40mL of distilled water into each flask. Then, heat gently to between 80-90° C.
5) Place sample 1 under the buret and begin addition of $KMnO_4$ a few milliliters at a time, swirling the flask after each addition, being careful not to let the temperature drop below 60°C.
6) Record the final volume of the $KMnO_4$ solution used when you reach the endpoint.
7) Repeat for the second sample.
8) From the mass of each sample of sodium oxalate and the volume of $KMnO_4$ used calculate the molarity of each $KMnO_4$ solution, as well as the average molarity.

Part 2: Determination of Hydrogen Peroxide Concentration

1) Prepare two samples of H_2O_2 by precisely measuring out 10mL of H_2O_2 , along with 15mL of 3M H_2SO_4 and 25mL of distilled water.
2) Place the flask on a stir plate and titrate to the end point.
3) Repeat for the second sample.

Data: create a data table for Part 1 and 2.

Calculations

Show detailed calculations for all values obtained. You only need to show calculations for one trial in both parts 1 and 2.

Conclusion

- What was the concentration of hydrogen peroxide?
- A potential source of error for this lab could arise if not enough acid was added to the solution before the titration was started. This would allow much of the permanganate to go to $MnO_2(s)$ rather than to Mn^{2+}. How would this affect the molarity of hydrogen peroxide found at the end of the experiment?