**Analysis of Hydrogen Peroxide**

A Redox Titration

**Balance the following redox reaction:**

**MnO4- + H2O2 🡪 Mn+2 + O2**

**Experiment Overview**

The purpose of this experiment is to analyze the percent hydrogen peroxide in a common "drugstore" solution by titrating it with potassium permanganate. Standard potassium permanganate solution will be added via buret to the hydrogen peroxide solution. As the dark purple solution is added, it will react with the hydrogen peroxide and the color will fade. When all of the hydrogen peroxide has been used up, the "last drop" of potassium permanganate that is added will keep its color. The endpoint of the titration is the point at which the last drop of potassium permanganate added to the solution causes it to turn pink.

**Materials**

Distilled or deionized water, 100 mL

Hydrogen peroxide, H2O2, commercial antiseptic solution, 3 mL

Potassium permanganate solution, KMnO4, 0.025 M, 75 mL

Sulfuric acid solution, HzSO4' 6 M, 15 mL

Beaker, 100- or 150-mL Buret, 50-mL, and buret clamp

Erlenmeyer flasks, 125-mL, 2 Graduated cylinder, 10- or 25-mL

Labels and/or markers Pipet, volumetric or serological, I-mL

Pipet bulb Ring stand

Wash bottle Waste disposal beaker, 250 mL

**Safety Precautions**

***Sulfuric acid solution is severely corrosive to eyes, skin, and other body tissues. Always add acid to water, never the reverse. Notify your teacher and clean up all acid spills immediately. Potassium permanganate solution is a skin and eye irritant and a strong stain-it will stain skin and clothing. Avoid contact of all chemicals with eyes and skin. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Wash hands thoroughly with soap and water before leaving the lab.***

**Procedure**

1. Obtain about 75 mL of potassium permanganate standard solution in a small beaker.  
 Record the precise molarity of the solution in the data table.

2. Rinse a clean 50-mL buret first with dH2O, then with two 5-mL portions of potassium  
 permanganate solution.

3. Clamp the buret to a ring stand using a buret clamp and place a waste beaker under  
 the buret.

4. Fill the buret with potassium permanganate solution until the liquid level is just above  
 the zero mark.

5. Open the stopcock on the buret to allow any air bubbles to escape from the tip. Close  
 the stopcock when the liquid level in the buret is between the 0- and 5-mL mark.

6. Record the precise level of the solution in the buret. This is the *initial volume* of the  
 potassium permanganate solution for Trial 1. *Note:* Volumes are read from the  
 top down in a buret. Always read from the bottom of the meniscus and remember  
 to include the appropriate number of significant figures.

7. Using a buret, transfer 1.00 mL of the commercial hydrogen peroxide solution into a  
 125-mL Erlenmeyer flask.

8. Add about 25 mL of distilled or deionized water to the flask.

9. Add 5 mL of 6M sulfuric acid to the solution in the Erlenmeyer flask. Gently swirl the  
 flask to mix the solution.

10. Position the flask under the buret so that the tip of the buret is within the flask but at  
 least 2 cm above the liquid surface. Place a piece of **white paper under the  
 flask** to make it easier to detect the endpoint.

11. Open the buret stopcock and allow 5-8 mL of the potassium permanganate solution  
 to flow into the flask. Swirl the flask and observe the color changes in the  
 solution.

12. Continue to add the potassium permanganate solution slowly, drop-by-drop, while  
 swirling the flask. Use a wash bottle to rinse the sides of the flask with distilled  
 water during the titration to ensure that all of the reactants mix thoroughly.

13. When a light pink color persists in the titrated solution while swirling the flask, the  
 endpoint has been reached. Close the stopcock and record the *final volume* of  
 the permanganate solution in the data table (Trial 1).

14. Subtract the initial volume of the permanganate solution from the final volume to  
 obtain the volume of KMnO4 added. Enter the answer in the data table.

15. Pour the titrated solution into a waste disposal beaker and rinse the flask with  
 distilled water.

16. Repeat the titration (steps 6-15) two more times (Trials 2 and 3). Record all data in  
 the datatable.

17. Dispose of the solution in the waste beaker as directed by your instructor.

**Data Table**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Trial 1** | **Trial 2** | **Trial 3** |
| Molarity of KMnO4 |  |  |  |
| Initial Volume KMnO4 solution (mL) |  |  |  |
| Final Volume KMnO4 solution (mL) |  |  |  |
| Volume of KMnO4 solution used (mL) |  |  |  |

**Calculations**

1. Calculate the average volume of permanganate ion used.

1. Calculate the moles of permanganate ion used.

1. Calculate the number of moles hydrogen peroxide titrated.

1. Calculate the number of grams of hydrogen peroxide titrated.

1. Assuming the density of the hydrogen peroxide solution to be 1.00 g/mL, calculate the percent hydrogen perioxide by mass in the solution.
2. Calculate the percent error:

Things to include in the conclusion:

What is a redox reaction/?  
 Write the balanced equation  
 What color change will occur, and how will that be used to determine the endpoint? What was your average percent of hydrogen peroxide in the solution, what is the actual  
 and what is your percent error…  
 What experimental errors may have caused your percent error?  
 What other factor may have caused your error? (not rounding or math errors)  
 \*what is the equation representing this error?