

AP INQUIRY LAB 03b: How accurate are the labels on drugstore H₂O₂ bottles?

Your Tasks:

- Answer the **Pre-Lab Questions**
- Read the sections below on **Safety, Background & Prior Knowledge, Equipment Available** and **Chemicals Available**
- To design an experiment (i.e., to outline an experimental procedure) to answer the question posed above. You MUST have your plan reviewed BEFORE you start the experiment
- To produce and turn in, a lab report (see separate document on lab reports)
- Answer the **Post-Lab Questions**

Safety:

- Follow all the normal safety procedures in the laboratory
- Potassium manganate(VII) solution and sulfuric acid are hazardous and must be handled with great care. You must wear goggles, aprons and gloves at all times. Potassium manganate(VII) can stain skin and sulfuric acid is corrosive

Background & Prior Knowledge:

- Potassium manganate(VII) (aka potassium permanganate) is an oxidizing agent
- When in acidic conditions, the manganate(VII) ions are converted to Mn²⁺ ions. A few mL of acid (less than 10) are usually sufficient to ensure acidic conditions are in place
- A solution of hydrogen peroxide can be oxidized according to the equation;
$$\text{H}_2\text{O}_{2(\text{aq})} \rightarrow 2\text{H}^+_{(\text{aq})} + \text{O}_{2(\text{g})} + 2\text{e}^-$$
- Typical drugstore hydrogen peroxide solutions are labeled '3%' and are stored in opaque bottles to prevent sunlight from decomposing the hydrogen peroxide. Over time, even with this protection, the H₂O₂ will still break down into water and oxygen gas
- In order to make the titration easier to perform, it may be a good idea to add distilled water to otherwise very small volumes of analyte

Equipment Available:

- All of the normal equipment associated with a titration; Erlenmeyer flasks, burets, graduated and regular pipets of various sizes (from 1 mL up to 25 mL), retort stands, white tiles, pipet (safety) fillers, funnels, wash bottles etc.

Chemicals Available:

- The drugstore hydrogen peroxide solution to be analyzed (the analyte)
- 3 M sulfuric acid
- Distilled water
- Potassium manganate(VII) of known concentration equal to 0.0250 M (the titrant)



Pre-Lab Questions:

1. Write the half-reaction for the reduction of manganate(VII) ions in acidic solution.
2. Combine the half-reaction you have written in #1, with the hydrogen peroxide half-reaction, in order to form the full, REDOX equation for the reaction of manganate(VII) with hydrogen peroxide.
3. If a solution of hydrogen peroxide is labeled as 5%, it means '5% hydrogen peroxide by mass'. Assuming the density of such a solution to be 1.00 g/mL, what is the concentration of a solution that is labeled '5% hydrogen peroxide'?



Post Lab Questions:

1. What is the difference between the end-point and the equivalence point in a titration?

2. A sample of a salt that contains iron (II) ions, with a mass of 9.252 g, was dissolved in distilled water and made up to the mark in a 250.0 mL volumetric flask. 25.00 mL aliquots are pipetted from the stock solution, acidified, and titrated with 0.02500 M potassium manganate(VII) solution. The manganate(VII) solution acts as an oxidizing agent in acid solution.

The volumes of manganate(VII) solution required to reach the end-point in three separate experiments were found to be, 20.95 mL, 20.75 mL and 20.90 mL respectively.

Use these data to calculate the % of iron in the salt.

