**TEACHER INSTRUCTIONS:**

For each lab group, you’ll need:

* Titration equipment
* about 20 mL 0.0188M KMnO4
* about 10 mL 3M H2SO4
* about 1 mL FRESH hydrogen peroxide from the drugstore

You will need to set up several burets around the room. At each buret, place a bottle of 0.0188M KMnO4 so that students can quickly and easily fill the burets. Under each buret, place a magnetic stirrer, a small flask or beaker, a magnetic stir bar, and a magnetic stir bar retriever.

At the front of the room, I would place a SINGLE bottle of FRESH Hydrogen peroxide from the drug store. (Over time, peroxide decomposes, so it will not be a 3% solution if it’s old). Also, have a graduated pipet and bulb at the front so students can accurately measure out their H2O2 volume. I would also place a single bottle of 3M H2SO4 at the front of the room so that students can obtain 10 mL from it.

Students will measure out 1 mL of H2O2 and titrate it with KMnO4 in the presence of acid (H2SO4). From the endpoint, they can find the volume of titrant needed. Using stoichiometry, students find the grams of H2O2 in their 1-gram sample and find the percent.

It may be helpful to have students titrate with a WHITE background. Also, students often think that adding water changes the concentration of peroxide, but you’ll need to explain that it doesn’t change the MOLES of peroxide, so it won’t affect the titration.

**AP Chem Investigation 12 – Redox Titration Lab**

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period \_\_\_\_\_\_

1. Check to be sure you have at least 20 mL of KMnO4 in your buret. If not, add some KMnO4 to your buret.
2. Be sure there are no air bubbles in the buret. If there are, stream some KMnO4 out of the buret into a waste beaker until the air bubble comes out. You can dump this solution down the sink with running water.
3. Take an initial reading of KMnO4 from the buret. Record this value in the data table.
4. Measure out exactly 1.00 mL of H2O2 using a graduated pipet and add it to a clean flask.
5. Add 10 mL of 3M H2SO4 to the flask using a graduated cylinder. This is so that the titration can occur in acidic conditions.
6. Add water to the flask to bring the solution up to about 30-50mL of volume. (This is just to improve your ability to see the color change at the endpoint. Adding water will NOT affect the number of moles of H2O2 present in the flask, so it won’t affect the volume of titrant required to reach the equivalence point).
7. Titrate the H2O2 to the endpoint (until a faint pink color persists). Try not to add even just 1 drop of KMnO4 past the endpoint! Record the volume of titrant
8. Dump your solution down the sink. Leave the leftover KMnO4 in your buret for the next class.
9. Check the label on the KMnO4 bottle and record the molarity of the KMnO4 solution in your data section.

**Data Table**

| **Volume of H2O2 titrated** |  |
| --- | --- |
| **Initial reading of MnO4- volume on buret** |  |
| **Final reading of MnO4- volume on buret** |  |
| **Concentration of MnO4- solution on bottle** |  |

**Questions:**

1. Balance the equation below using the half-reaction method. Show all work.

 MnO4-(aq) + H2O2(aq) 🡪 O2(g) + Mn2+(aq)

2. What volume of MnO4- was added to reach the endpoint?

3. Knowing the volume and concentration of KMnO4, how many moles of MnO4- were added to reach the endpoint?

4. Using the balanced equation, how many moles of H2O2 were in your sample?

5. Convert the moles of H2O2 into grams.

6. Imagine that your sample of H2O2 was mostly water and contained very little H2O2 molecules. If it was mostly water, it would be expected to have a density similar to water. The density of water is 1.00 g/mL. Let’s assume the sample had a density of 1.00 g/mL. Using the mass of H2O2 calculated in the previous question along with the fact that your sample was exactly 1.00 mL, calculate the percentage of your sample that was H2O2.

7. The label on the bottle states that the bottle of H2O2 is a 3% solution. Compare this value to your calculation in the previous question. Is the label correct? Why or why not?

8. Is it necessary to know the exact volume of…

a) H2O2 sample added to the flask? b) water added to the flask? c) KMnO4 added to the flask?

**Review Questions:**

1. A 25.00mL sample of oxalic acid, H2C2O4, was titrated with a standardized solution of KMnO4 under acidic conditions. To reach the

endpoint, 17.30mL of 0.0200M KMnO4 was needed. At that point, a pink color persisted.

MnO4-(aq) + H2C2O4(aq) 🡪 CO2(g) + Mn2+(aq)

1. What does the pink color suggest?
2. Balance the equation using the half-reaction method. Show all work.
3. How many moles of MnO4- reacted with the oxalic acid?
4. Based on your previous answer, how many moles of oxalic acid were present in the original sample?
5. Calculate the molarity of the H2C2O4 solution, given your previous answer and the fact that 25.00 mL were used?

2. Our titration was performed in an acidic solution. Research the products of the redox reaction between MnO4- ions and H2O2 in a

basic solution. How might the products under basic conditions impact your ability to know when you’ve reached the endpoint of the

titration?