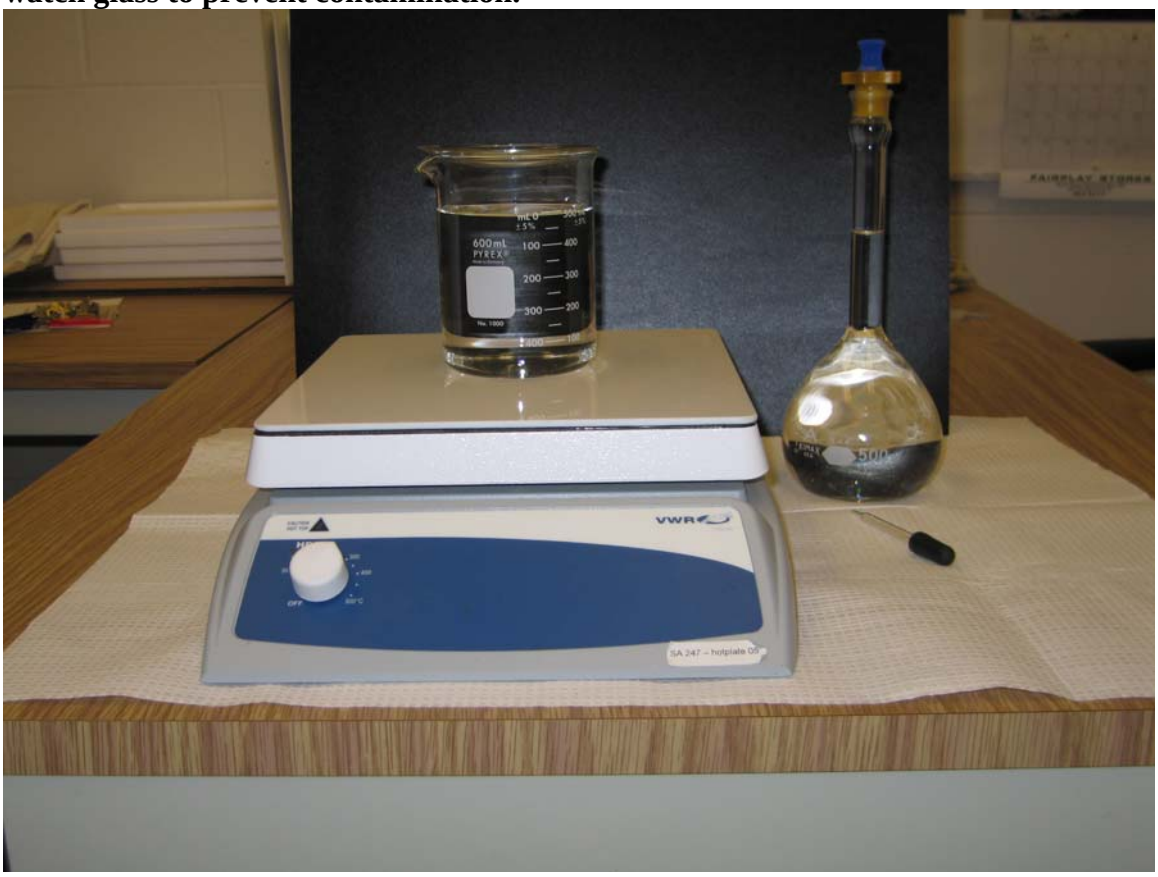
# Experiment #1: Determination of the Hardness of Tap Water

## Detailed information on volumetric apparatus can be found in the Laboratory Manual, Appendix 5.

### 1. A medicine dropper is used to fill the volumetric flask to the zero mark.

**2. 500 mL volumetric flask is used to measure tap water. Water is transferred into a 600 mL beaker and boiled for 30 min (setting $300^0$C). Beaker is covered with a watch glass to prevent contamination.**



**3. Previously boiled water is cooled down in a cold, tap water bath.**

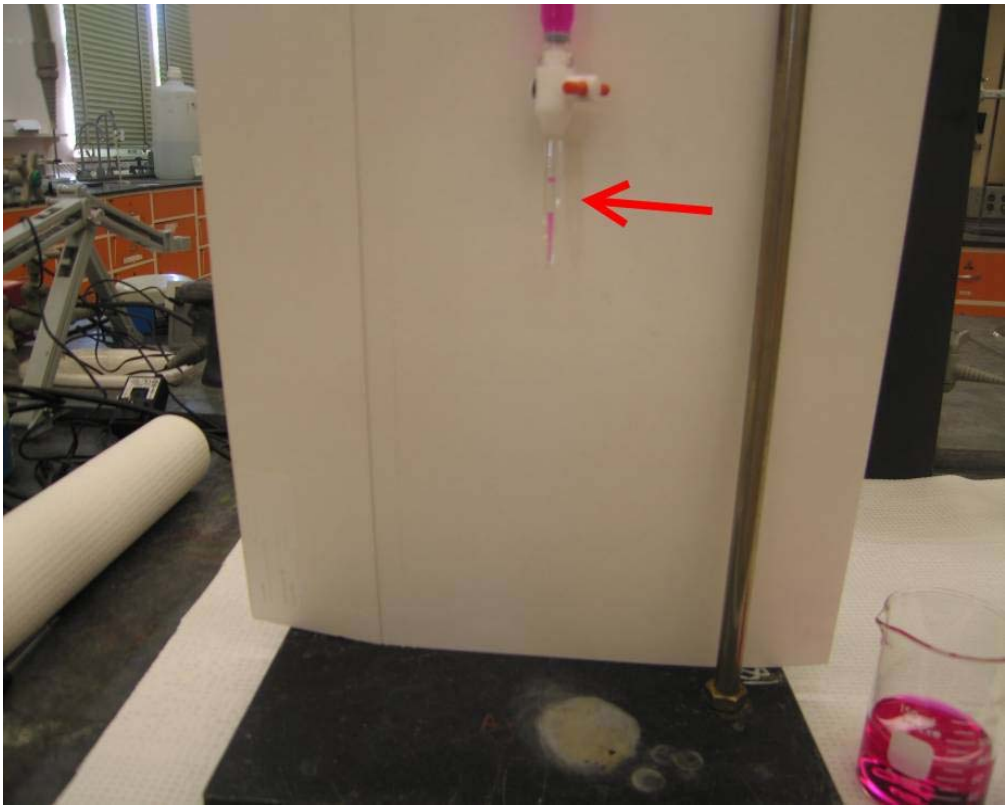
**4. Filter paper is folded twice to form a conical shape, which will fit into the long stem funnel.**

**5. The gravity filtration set-up and technique.**

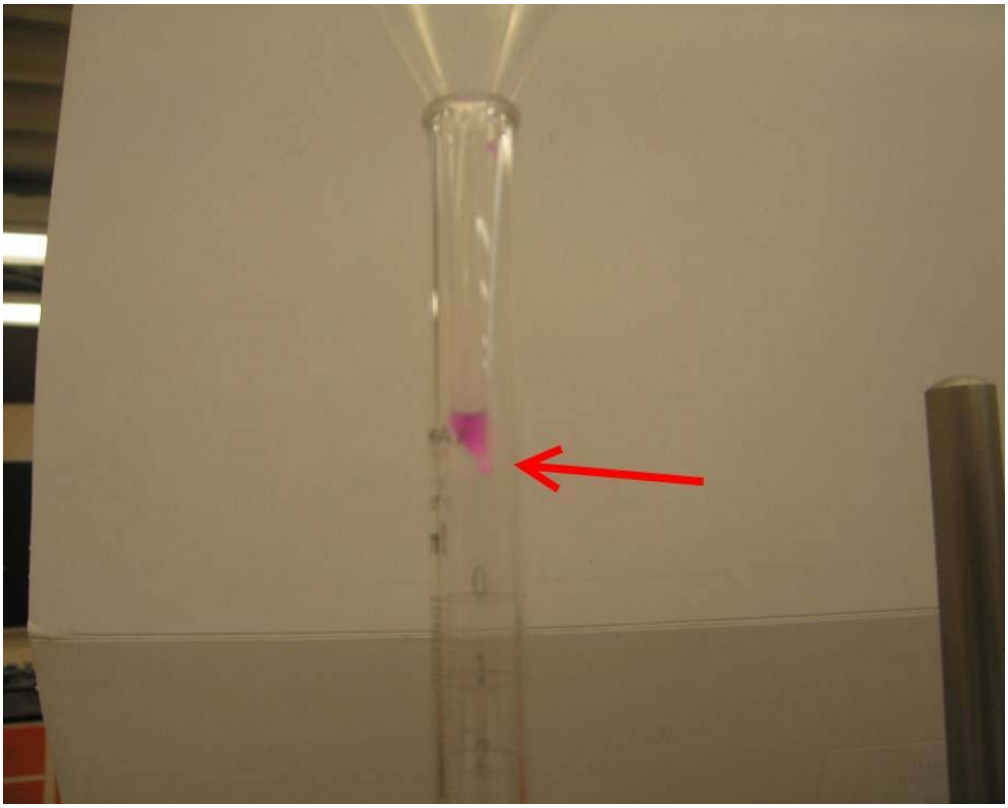
**6. The pipet tip is submerged under the surface of the liquid without touching the bottom of the container, while the liquid is being drawn into the pipet.**

**7. The index finger is used, rather than the thumb, to control the flow of the liquid from a pipet.**

**8. Buret tip must not retain any air.**



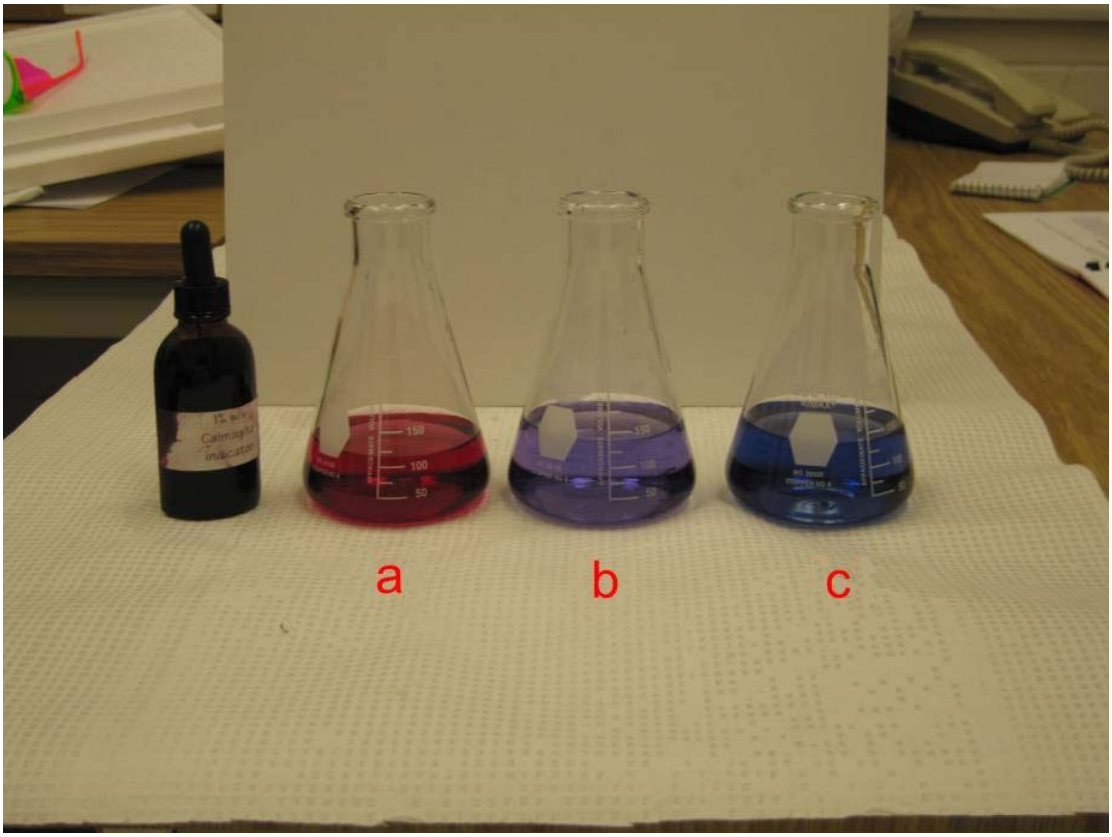
**9. Before reading the initial volume of the titrant, the buret funnel should be removed. Otherwise it may release a few remaining drops of the titrant into the buret, which will change the result.**



**10. The position of the bottom of the meniscus should be read.**

**11. Buret and conical flask should be held properly, during a titration.**

**12. Mixture of water, buffer and calmagite indicator**




a) before the titration started (red)
b) after adding some EDTA but before the end-point was reached (purple)
c) at the end-point (blue)

**Data**

Determination of Permanent and Temporary Hardness of Tap Water

| | Titration 1 | Titration 2 | Titration 3 |
|---|---|---|---|
| Initial buret reading, mL | | | |
| Final buret reading, mL | | | |
| Volume of $Na_2EDTA$ used, mL | | | |

Determination of Total Hardness of Tap Water

| | Titration 1 | Titration 2 | Titration 3 |
|---|---|---|---|
| Initial buret reading, mL | | | |
| Final buret reading, mL | | | |
| Volume of $Na_2EDTA$ used, mL | | | |

**[$Na_2EDTA$] _____ M**

**Sample Introduction**

Two sets of complexometric titrations were performed in order to determine the permanent and the total hardness of Calgary tap water. The first set of titrations was performed with tap water, previously boiled for the temporary hardness to be removed, while the second set was performed with untreated tap water.
The method used disodium salt of ethylenediaminetetraacietic acid, $Na_2EDTA$, as the complexometric agent. Calmagite was used as the indicator, and the titrations were carried in the mild basic solution, at pH 9-11, maintained by the added buffer.
Using the average value of the titre for each set of three consistent titrations, the permanent and total hardness of Calgary tap water were calculated. Finally, the temporary hardness was calculated from the previous two. Obtained values were compared to the standard ones and thus, the hardness rating was determined.

**Marking Scheme**

| **Section** | **Points** |
|---|---|
| Introduction | 1.5 |
| Data | 1.5 |
| Calculations:<br>-Total hardness<br>-Permanent and Temporary Hardness | <br>3<br>2+1 |
| Structural formulas | 1 |
| Discussion and Conclusions | 4 |
| Quality of writing | 2 |