



Experiment 9. Molar Solubility; Common- ion Effect

**Experimental
Procedure
Lab 406**

Overview

The supernatant from a saturated calcium hydroxide solution is titrated with a standardized hydrochloric acid solution to the methyl orange end-point. An analysis of the data results in the determination of the molar solubility and solubility product of calcium hydroxide. The procedure is repeated on the supernatant from a saturated calcium hydroxide solution containing added calcium ion.



***Part A. Standardization of
HCl Solution***

1. PREPARATION OF 0.05 M HCl SOLUTION

Prepare approximately **0.05 M HCl solution** in a 250 mL-volumetric flask by dilution of 1.0 M HCl solution.

Set up the titration apparatus.

_ Prepare a clean, 50-mL buret for titration. Rinse the clean buret and tip with three 5-mL portions of the 0.05 M HCl solution and discard. Fill the buret with 0.05 M HCl solution and discard. Fill the buret with it, remove the air bubbles in the buret tip, and, after 10-15 seconds, read and record the initial volume in the buret to the correct number of significant figures.

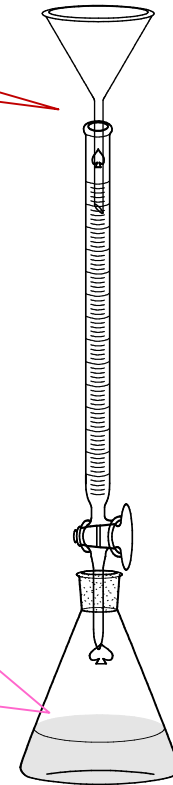
_ Place a sheet of white paper beneath the receiving flask.

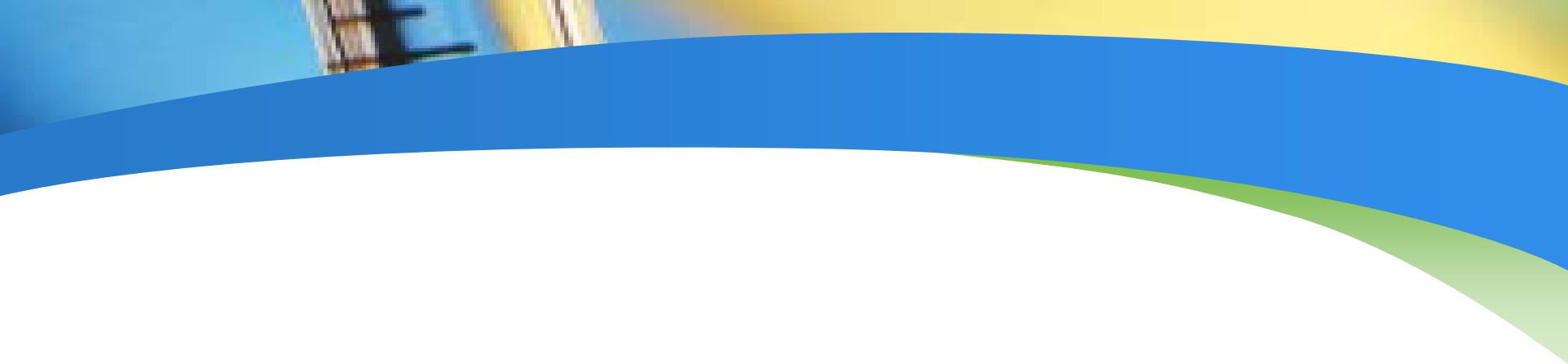
2. USING THE STANDARD SODIUM CARBONATE SOLUTION TO TITRATE HYDROCHLORIC ACID

- 1) Transfer 10 mL of standard sodium carbonate solution to a clean 250-mL Erlenmeyer flask by using a 10-mL pipet.
- 2) Add 2 - 3 drops of methyl orange indicator to the flask.
- 3) Record the initial buret reading on the report sheet.
- 4) Titrate the sodium carbonate solution against hydrochloric acid solution while continuously swirling until the color of solution was just changed from yellow to orange.
- 5) Record the final buret reading .
- 6) Repeat for 3 more times.

0.05M HCl solution

Standard Sodium Carbonate Solution 10 mL+ + Methyl orange indicator (2-3 drops)





***PART B. Molar Solubility and
Solubility Product of Calcium
Hydroxide***

1. OBTAIN A SATURATED CALCIUM HYDROXIDE SOLUTION. Submit a clean, dry 150-mL beaker to you TA for the purpose of obtaining 90 mL of supernatant from a saturated $\text{Ca}(\text{OH})_2$ solution for analysis. (Carefully decant about 90 mL of the saturated $\text{Ca}(\text{OH})_2$ solution into the beaker. Do not disturb the finely divided $\text{Ca}(\text{OH})_2$ solid.)

2. PREPARE A SAMPLE FOR ANALYSIS. Rinse a 25-mL pipet at least twice with 1- to 2-mL portions of the saturated $\text{Ca}(\text{OH})_2$ solution and discard. Pipet 25 mL of the saturated $\text{Ca}(\text{OH})_2$ solution a clean 125-mL flask and add 2 drops of methyl orange indicator.

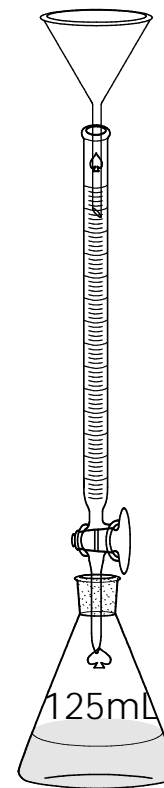
3. TITRATE. Titrate the Ca(OH)_2 solution with the standardized HCl solution to the methyl orange endpoint, where the color changes from yellow to a faint red-orange. Remember the addition of HCl should stop within one-half drop of the endpoint. After 10-15 seconds of the persistent endpoint, read and record the final volume of standard HCl in the buret.

4. REPEAT. Titrate two additional samples of the saturated Ca(OH)_2 solution until 1% reproducibility is achieved.

5. DO THE CALCULATIONS. Complete your calculations.

Standardized HCl solution

**Ca(OH)₂ solution 25 mL
+ methyl orange indicator (2 drops)**





***PART C. Molar Solubility of
Calcium Hydroxide in the
Presence of a Common Ion***

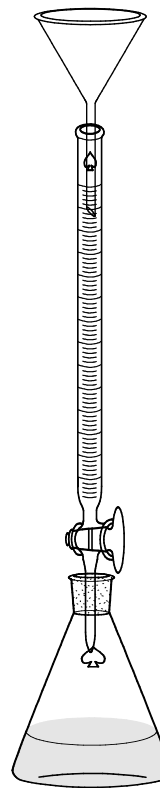
Complete **PART C.2** in its entirety for the analysis of the saturated Ca(OH)_2 solution with the added CaCl_2 .

1. Obtain the saturated Ca(OH)_2 solution with the added CaCl_2 for analysis from the TA.

2. Prepare a buret for analysis, prepare the sample, and titrate. Repeat PARTs B.2-B.5.

Standardized HCl solution

**[Ca(OH)₂ + CaCl₂ Solution] 25 mL
+ methyl orange solution (2 drops)**



Using of Buret

Cleaning the Buret

In order for your buret to perform optimally, it must be properly cleaned. To clean the buret, use the following procedure:

1. Rinse with distilled water:

With the stopcock closed, add some distilled water to the buret. Tip and roll the buret, allowing the water to have contact with all of the inside surfaces. Open the stopcock and allow the water to drain. If the water drains without leaving any droplets on the side, repeat the rinse twice more then move to step two. If droplets remain on the inside surface, wash the buret with detergent solution, rinse several times with tap water, then rinse three times with distilled water.

2. Rinse with solution:

After draining the final distilled water rinse, close the stopcock and add about 5 mL of the solution to be dispensed from the buret. Again, roll and tip the buret so the solution has contact with all the inside surfaces. Open the stopcock and allow the solution to drain. Repeat this twice more. Discard the solution used in the rinses.

After you are finished with the buret in your experiment, rinse it by filling it with distilled water and allowing it to drain.

Loading the Buret

Once the buret is clean, clamp it to a stand using a buret clamp. Always make sure the burette is clamped in a perfectly vertical position before taking any readings.

When adding solutions to the buret, make sure the stopcock is closed (horizontal position). Unclamp the buret and tilt it slightly while pouring the solution slowly down the inside surface. This will prevent the formation of air bubbles.

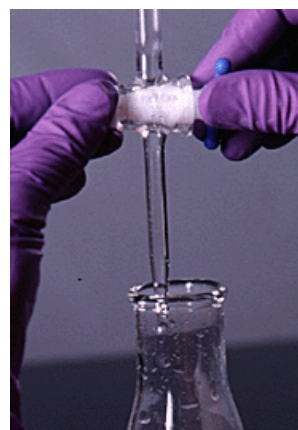
1. Get the appropriate amount of solution in a clean, dry beaker.
2. Pour a few milliliters of solution into the buret. Open the stopcock all the way in order to force all the air out of the stopcock and tip. Close the stopcock before the solution drains below the stopcock. If the tip still contains air, add a few more milliliters of solution and repeat the process. Repeat this until you are convinced no more air is left in the stopcock or tip. Discard the solution that you have run through the buret.



3. Using the procedure described above for adding solutions to the buret, fill it to a level just above 0.00 mL. Drain the buret to just under 0.00 mL. This will properly form the meniscus. **DO NOT ATTEMPT TO ADJUST THE MENISCUS TO EXACTLY 0.00 mL. THIS IS AN INCREDIBLE WASTE OF TIME.**

4. Touch the tip of the buret to the inside wall of a beaker in order to remove any drops on the tip. Do not wipe the tip. Wait a few seconds for the solution to drain to the top of the fluid level, then record the initial buret reading in your notebook.

5. Loosely cover the top of the buret with a cocked, small beaker or a loosely fitting piece of aluminum foil. This will keep dust out of the buret.



Reading the Buret

In order to make the meniscus easier to see, place a white card with a black mark on it behind the buret. Align the black mark so that it is just under the meniscus.

1. Get your eye level with the bottom of the meniscus. Looking up or down on the meniscus will cause a **parallax error**.
2. Read the buret to the nearest 0.01 mL. The marks occur every 0.1 mL, so the last number will have to be an estimate. With practice, you should be able to do this quite accurately.



Operating the Buret

Proper buret technique is an important laboratory skill that may take some practice to develop. Although it may seem initially awkward, a right handed person should operate the buret with the left hand, and a left handed person should operate the buret with the right. This leaves your more coordinated hand to swirl the reaction flask if needed.

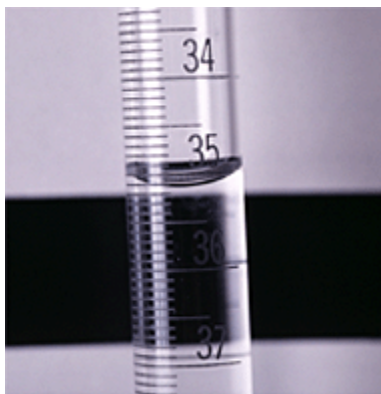
1. Before delivering any solution, record the initial **buret reading** in your notebook.
2. Open the stopcock by twisting it 90 degrees into the vertical position and allow the solution to drain. As you near the desired volume, slow the flow by turning the stopcock back toward the closed position. You should be able to control the buret to deliver one drop at a time. When the desired volume has been delivered, close the stopcock.



3. Wait a couple of seconds, then record the final buret reading.

4. Calculate the volume delivered by subtracting the initial reading from the final reading: initial reading - final reading

When delivering solutions, you must not allow the solution to drain below the bottom of the calibration range. If this is about to occur, close the stopcock and take a final reading. Refill the buret, get an initial reading, and continue delivering solution. The total volume delivered is the sum of the volume delivered the first time and the volume delivered the second time.



Cleanup

Discard the sodium hydroxide solution remaining in the buret as directed by TA. Rinse the buret twice with tap water and twice with deionized water, discard each rinse through the buret tip into the sink.