CHM 152LL: The Solubility Product of Calcium Hydroxide

Introduction:

Calcium hydroxide, $Ca(OH)_2$, is considered a slightly soluble substance in water.

$$Ca(OH)_2\ (s) \rightleftharpoons Ca^{2+}\ (aq) + 2OH^-\ (aq)$$
$$K_{sp} = [Ca^{2+}][OH^-]^2$$

In this experiment, we will measure and concentration of Ca^{2+} in a saturated solution of $Ca(OH)_2$ and calculate the K_{sp}, solubility product constant, for $Ca(OH)_2$.

We are going to obtain a saturated solution of $Ca(OH)_2$. Then filter out the solid $Ca(OH)_2$. The $[Ca^{2+}]$ will be obtained through titration with a solution of $EDTA^{4-}$ (ethylenediamine tetraacetate). $EDTA^{4-}$ and Ca^{2+} react to for the complex ion $Ca(EDTA)^{2-}$,

$$Ca^{2+}\ (aq) + EDTA^{4-}\ (aq) \longrightarrow Ca(EDTA)^{2-}(aq)$$

The indicator Eriochrome Black T (EBT) changes color in the presence of Ca^{2+}. Without Ca^{2+}, it is blue; with Ca^{2+}, it forms a red complex ion.

When $EDTA^{4-}$ reacts with all the Ca^{2+}, the indicator EBT looses it Ca^{2+} and reverts from red back to its original blue. This color change will indicate the endpoint where all the Ca^{2+} has reacted with the $EDTA^{4-}$. At this point, we can calculate the moles of EDTA added, the moles of Ca^{2+} it reacted with, thus $[Ca^{2+}]$, $[OH^-]$ and K_{sp}.

Material:
125 mL beaker
125 mL Erleneyer flask
10_mL pipet
EBT indicator solution
Saturated $Ca(OH)_2$ solution
___________ M EDTA solution

Experimental Procedure

1. Pour 50 mL of saturated $Ca(OH)_2$ solution into a 125 mL beaker. Do not shake up the solution bottle. It is saturated and there is solid on the bottom.

2. Filter your $Ca(OH)_2$ solution into a dry 125 mL Erlenmeyer flask.

3. Obtain a 30 mL (or 50 mL) beaker to be used to cover up the Erlenmeyer flask when it is not in use.

4. Measure the temperature of the solution in the Erlenmeyer flask with a clean, dry thermometer.

5. Rinse a clean burette with 5 mL portions of EDTA solution.

6. Fill the burette with the EDTA solution.

7. Pipet 10 mL of the filtered $Ca(OH)_2$ solution into another clean 125 mL Erlenmeyer flask. Add 2 drops of EBT indicator.

8. Titrate the $Ca(OH)_2$ solution with the EDTA solution until the indicator changes from reddish to a pure blue. (A purplish color is not the end point, but it does show that you are close to the end point.)

9. Repeat the titration (steps 7~8) two more times.

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Name ____________________
Section ___ Partner _________

Experimental Results:

Temperature			
Initial Burette Reading			
Final Burette Reading			
Volume of EDTA soln			
millimoles of EDTA			
millimoles of Ca^{2+}			
Volume of $Ca(OH)_2$ soln			
$[Ca^{2+}]$			
$[OH^-]$			
K_{sp}			

Average K_{sp} _____________

Book value K_{sp} _____________

Discussion:

Questions:

1. Based on your experimental K_{sp} value, How many grams of $Ca(OH)_2$ can be dissolved in 1-L solution?

2. Regular strength TUMS® contains 500 mg of Calcium carbonate per tablet. To design an experiment so that each titration would only require ~ 20 mL of the EDTA solution we have, what a portion of the TUMS® we should use for each run?