K_{sp} of Calcium Hydroxide

Student Handout

Purpose: To determine the solubility product of calcium hydroxide.

Introduction

Calcium hydroxide dissolves slightly in water:

$$Ca(OH)_2(s) + aq \rightleftharpoons Ca^{2+}(aq) + 2OH^-(aq)$$

In this experiment, $Ca(OH)_2(s)$ is dissolved in deionised water and NaOH(aq) of known concentrations. The concentration of $OH^-(aq)$ in equilibrium with $Ca(OH)_2(s)$ is determined by microscale titration using plastic pipette containing standard HCl(aq). As the volume of solution delivered is proportional to the number of drops, the volume can be replaced by the number of drops when calculating the number of mole. Conventional burette volume readings are replaced by number of drops from the plastic pipette. K_{sp} $Ca(OH)_2(s)$ is calculated from a derived concentration of $Ca^{2+}(aq)$ and the experimental concentration of $OH^-(aq)$.

Safety

Avoid skin contact with the chemicals.

Materials and Apparatus

$Ca(OH)_2$ solid, 0.05 M and 0.025 M NaOH(aq) 

Phenolphthalein indicator 

Standard 0.0096 M HCl(aq), deionised water, well-plate, plastic pipette, microspatula, light table (if available).

Experimental Procedures

1. Prepare saturated stock solutions of $Ca(OH)_2(aq)$ as follows:

Stock solution	About 1 g $Ca(OH)_2(s)$ in each of the following 50 cm^3 liquids
1	Deionised water
2	0.025 M NaOH(aq)
3	0.050 M NaOH(aq)

   Cover the saturated stock solutions and leave them overnight.

2. Measure the temperature of the saturated stock solutions.

3. Using three clean plastic pipettes, transfer 8 drops each of the supernatant liquids of the saturated stock solutions 1, 2 and 3 into three separate wells, and then dilute ***ten*** times by adding 72 drops of deionised water. Stir well with microspatula.

4. Place the well-plate on a light table (if available). Using a clean plastic pipette, transfer 25 drops of the ***diluted*** solution 1 into a well of the well-plate. Add one drop of phenolphthalein indicator. Clean and wash the ***same*** plastic pipette with deionised water. Rinse and fill the plastic pipette with 0.0096 M HCl(aq). Carefully titrate the diluted solution 1 (see Fig. 1) by adding drops of 0.0096 M HCl(aq) solution from the plastic pipette until the red colour is discharged. Occasionally stir the solution. Record the number of drops of 0.0096 M HCl(aq) added.

5. Repeat step (4) with the ***diluted*** stock solutions 2 and 3.

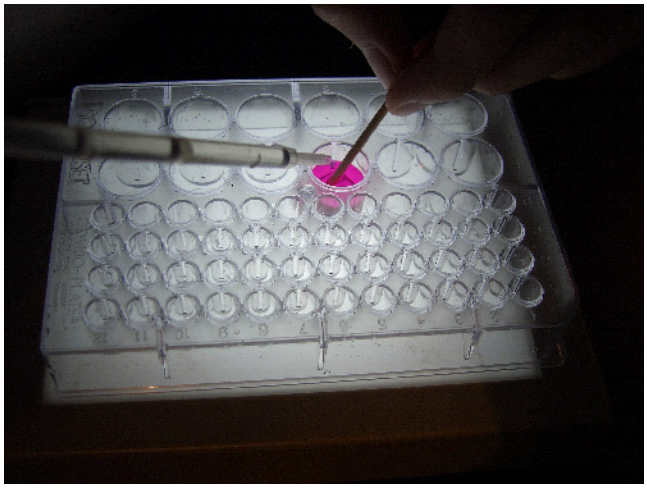

Fig. 1: Microscale titration

Results

Temperature = _____ ^{o}C

Stock solution	No. of drops of 0.0096M HCl (aq) used	Original conc. of OH^-(aq) / mol dm^{-3}
1		10^{-7}
2		0.025
3		0.050

Treatment of Data

Calculate the concentration of Ca^{2+}(aq) in the stock solutions 1, 2 and 3 and complete the following table.

Stock solution	[Ca^{2+}(aq)] / mol dm^{-3}	[OH^-(aq)] / mol dm^{-3}	K_{sp} = [Ca^{2+}(aq)] [OH^-(aq)]^2 / mol^3 dm^{-9}
1			
2			
3			

Discussion Questions

1. Write down the expression for the K_{sp} of calcium hydroxide.
2. Explain the variation in concentration of $Ca^{2+}(aq)$ in the saturated $Ca(OH)_2$ solutions as the concentration of $OH^-(aq)$ increases.
3. Calculate an average value of K_{sp} of calcium hydroxide and compare with the literature value from a data book. Comment on the discrepancy, if any.