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KELSEY SMITH- LAB B

I. EXPERIMENTAL PROCEDURES FOR HCL TITRATION LAB

Preparing the THAM Solution: (a) Select and calibrate an analytical balance. (b) Weigh out 2.1 g of THAM, and record the mass in the Experimental Results section. (c) Obtain a clean 250 mL volumetric flask. (d) Completely transfer the THAM to the flask, and add about 200 mL of de-ionized water. Use de-ionized water to remove any THAM left in the weighing jar, and transfer those washes to the volumetric flask. (e) Swirl the flask to dissolve the THAM, and fill the flask up to the 250 mL mark with de-ionized water. (f) Invert the flask multiple times to ensure the THAM is completely dissolved. (g) Determine the molarity of the THAM solution, and record the value in the Experimental Results section.

Performing the Titration: (a) Obtain four clean 250 mL Erlenmeyer flasks, and divide the stock solution of THAM into 50 mL aliquots using a 50 mL pipet. Record this volume in the Experimental Results section. (b) Add 3 or 4 drops of the indicator dye (bromocresol green) to each aliquot. (c) Using a clean 50 mL buret filled with approximately 0.1 M HCl, titrate the aliquot by adding HCl until the indicator dye changes colors at the endpoint. (e) In the Experimental Results section, record the initial and final volumes of HCl to determine the total volume of HCl delivered for the titration. Record this total volume in the Experimental Results section, also. (f) Repeat procedures (c) through (e) 3 to 4 times with the remaining aliquots. Be sure the indicator dye has been added to each aliquot before titrating.

II. EXPERIMENTAL RESULTS FOR HCL TITRATION LAB

Mass of THAM used: 2.1003 g (+/- 0.0002 g)

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Mass of THAM used: 2.1003 g (+/- 0.0002 g)

Volume of THAM solution: 250 mL (+/- 0.12 mL)

Molarity of THAM solution: 0.0694 M (+/- 0.000034 M)

Volume of THAM aliquots: 50 mL (+/- 0.05 mL)

Measured volumes of HCl for the titrations are recorded in the following Microsoft Excel spreadsheet:

[CHM 326- Volume of HCl Delivered Data](#)

****NOTE: All uncertainty calculations can be found in the Results section of the Lab Report.****

III. LAB REPORT: HCL TITRATION LAB - K. SMITH, CHM 326 LAB B, 1/25/10

ABSTRACT

The molarity of a hydrochloric acid (HCl) solution was determined by titrating a prepared solution of Tris(hydroxymethyl)aminomethane (THAM). By knowing the volume and molarity of the THAM solution, the concentration of the HCl solution could easily be calculated using the fundamental equation $M_a V_a = M_b V_b$. Measuring the volume of HCl (V_a) that was needed to titrate 50 mL of approximately 0.0694 M THAM left only one unknown variable in the fundamental equation--the molarity of the acid (M_a). The concentration of the acid was calculated to be approximately 0.0925 M, which was relatively close to 0.1 M, the concentration of the HCl that was supposed to be used for this experiment. Uncertainties in all measurements were also calculated for this lab.

INTRODUCTION

Preparing solutions is an extremely important part of chemistry. Every chemist must be able to prepare solutions, determine concentrations of solutions, or even dilute concentrated solutions. This lab uses a fundamental equation $M_a V_a = M_b V_b$ to calculate the molarity of a hydrochloric acid (HCl) solution. By titrating a prepared solution of Tris(hydroxymethyl)aminomethane (THAM) of known concentration (M_b) and volume (V_b) with HCl, the molarity of the acid (M_a) can easily be determined using the equation. Another important aspect of chemistry, especially in the field of analytical chemistry, is calculating the uncertainties in measurements. Almost all measurements have uncertainty, and those uncertainties cannot be ignored. This lab also focuses on calculating the uncertainties of the many measurements required to find the molarity of the HCl solution.

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PROCEDURE

PREPARING THE THAM SOLUTION-

An analytical balance (uncertainty: ± 0.0002 g) was used to measure the mass of THAM. The THAM was placed in a 250 mL volumetric flask (uncertainty: ± 0.12 mL) which was then filled with de-ionized water. The flask was inverted to dissolve all of the THAM. The molarity of the THAM solution was determined using the equation $M_{THAM} = n_{THAM} / V_{H_2O}$. Values of mass, volume, and molarity were recorded in the Experimental Results section.

PERFORMING THE TITRATION-

The stock solution of THAM was divided into four 50 mL aliquots using a 50 mL pipet (uncertainty: ± 0.05 mL). Four drops of indicator dye (bromocresol green) were added to the Erlenmeyer flasks containing the THAM solution. HCl was dispensed through a 50 mL buret (uncertainty: ± 0.05 mL) to titrate the THAM solution. HCl was added until the solution changed from blue to yellow at the endpoint. The titration was repeated three more times on the remaining aliquots, and the volumes of HCl dispensed were recorded in a spreadsheet.

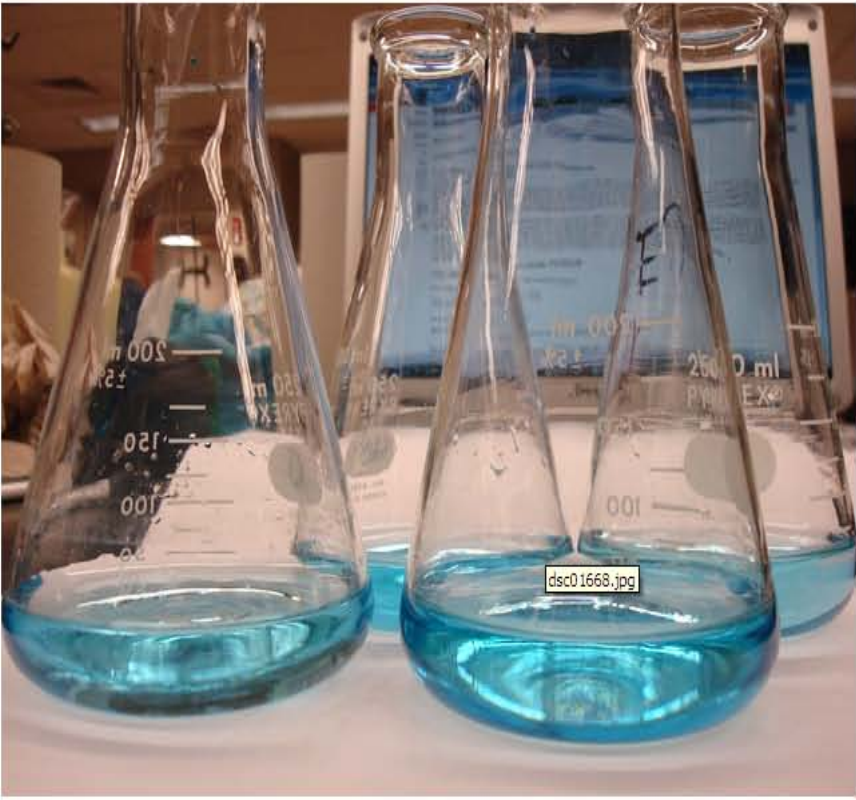




Picture 1: Titration apparatus



Picture 1: Titration apparatus



Picture 2: Aliquots of THAM solution with indicator dye before titration



Picture 2: Aliquots of THAM solution with indicator dye before titration



Picture 3: Aliquots of THAM solution with indicator dye after titration

RESULTS

This experiment set out to determine the concentration of an HCl solution that was used to titrate a prepared solution of THAM. However, in order to determine the molarity of HCl, many other measurements and calculations had to be done first. Moles, volumes, and molarity of different substances had to be calculated before the concentration of HCl was determined. Also, uncertainties in measurements for all those quantities also had to be calculated

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The calculated molarity of the THAM solution and the uncertainties for those measurements are recorded in the following Microsoft Word document:

[Link 1: Molarity and Uncertainty of THAM Solution](#)

The calculated volume of HCl delivered for each titration and the uncertainties for those measurements are recorded in the following Microsoft Word document:

[Link 2: Volume and Uncertainty of HCl Delivered for Each Titration](#)

The calculated molarity of the HCl solution, along with the uncertainties for those measurements are recorded in the following Microsoft Word document:

[Link 3: Molarity and Uncertainty of HCl Solution](#)

DISCUSSION

By using the fundamental equation $M_a V_a = M_b V_b$, the molarity of HCl was determined to be 0.0926 M (+/- 0.0002 M). This value was slightly lower than the expected concentration of HCl (0.1M). Random and systematic errors are possible contributors to the low molarity of HCl solution. No instruments were calibrated before the experiment, which could have produced systematic errors that were not detected. Random variations in the measurements taken during the lab could have produced random errors. Together these errors could have propagated and altered the results of the experiment. It is important to note that the difference in the observed molarity and expected molarity of HCl cannot be attributed to the equation $M_a V_a = M_b V_b$ itself, but to mistakes made in calculations using that equation and other equations during the experiment. Calculating uncertainties shows that most measurements are not exact, and even small fluctuations in measurements can produce results that will not always agree with the predicted results.

CONCLUSIONS

The concentration of HCl for this experiment came out to be 0.0926 M (+/- 0.0002 M) and not 0.1M, as was expected. Even considering the uncertainty of the measurement does not bring the value closer to the predicted concentration. However, this experiment shows that the equation $M_a V_a = M_b V_b$ is extremely important to chemists. This simple relationship allows scientists to prepare solutions and determine the concentrations of the solutions with ease. Because this experiment involved a titration, it is possible that poor eyesight and slow reaction time could have also been a cause of the differences observed in the concentration of HCl. Therefore, it is important in future experiments to concentrate more on the color of the indicator dye to avoid overshooting and undershooting the endpoint.

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