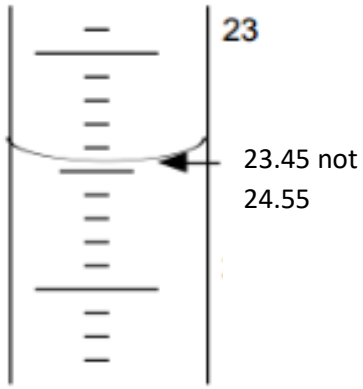
Honors Chemistry Lab #21-Introductory Titration Lab

Question: How can I determine the molarity of an analyte (e.g., sodium hydroxide solution) by performing a titration using a titrant of known concentration and volume?



1. Dilute an appropriate volume of 0.150 M HCl solution. This will be your titrant. You will need to make this from a stock solution of HCl using $C_1V_1 = C_2V_2$ in the appropriately sized beaker. Use a volumetric wheel or bulb pipette for accuracy when measuring. Read through entire investigation to determine an "appropriate volume".

2. Place an appropriate volume of the 0.150 M HCl into a new clean beaker and add 2 drops of phenolphthalein. Place this beaker under the burette for titration. Phenolphthalein is a colorless, weak acid that is used to indicate the endpoint of the titration. The endpoint for phenolphthalein is a pH of 8.2. The solution should remain clear and will turn pink at its endpoint.

3. Pipette an appropriate volume of the "? NaOH" solution, which is the analyte, into another clean beaker. Add this to the burette and note the starting volume on the burette. You may want to practice reading the burette using the figure above. It is crucial to know exact volumes before and after the titration.

5. Open the stopcock to allow approximately 5-8 mL of the NaOH to flow into the flask while continuously swirling the flask. Observe the color changes occurring. Continue to add the NaOH **slowly** while swirling the flask. When a faint pink color appears and persists for 10 seconds or more of swirling of the flask, you have reached your endpoint. *Note*: It is important to realize that if you accidentally pass your endpoint, you can add more HCl to the flask which will cause the solution to become clear again. You can then add the NaOH slowly to the flask again and attempt once more to carefully reach the endpoint. This is known as "back-titrating."

6. When you have reached the endpoint, record the NaOH final burette readings and the starting HCL amount in an appropriate data table. This is your evidence.

7. Calculate the molarity of the NaOH solution. Obtain the pH of the titrated solution using LabQuest probes.

8. Pour the solution out of the flask (into the sink) and repeat the titration again. You should estimate how much NaOH you will need for this titration based on the information that you gathered from the first titration. Adjust your volumes appropriately to minimize wasting reagents.

9. Calculate the molarity of the NaOH solution from the second trial. It should be very close to the molarity you got for the first trial. Then calculate your average and percentage difference. You will be graded on your accuracy, so do a careful job. Obtain the pH of the titrated solution using LabQuest probes.

MOLARITY OF NaOH: Trial #1: _____ Trial #2: _____ Average: _____

10. Calculate the concentrations of hydroxide ions and hydronium ions in solution based on your LabQuest probe pH values.

11. Sketch a titration curve for this reaction placing the pH on the y-axis and volume of NaOH on the x-axis. Label the endpoint and equivalence point.

Make your claim and write your summary for this investigation.

Optional problems:

1. You are given a solution of 0.100 M HCl as was used for this lab and are again told to find the unknown molarity of a different NaOH solution. You start with 10.54 mL of HCl and need 13.17 mL of NaOH to reach the endpoint. What is the molarity of this NaOH solution?

2. You are now given a solution of 0.170 M NaOH and are told to find the molarity of an unknown HBr solution. You start with 11.29 mL of NaOH and need 38.55 mL of HBr to reach the endpoint. What is the molarity of the HBr?

3. How many mL of 0.340 M HCl would be needed to titrate 14.91 mL of 0.265 M NaOH?

4. How many mL of 0.340 M HCl would be needed to titrate 14.91 mL of 0.265 M Ca(OH)2?