ACID-BASE TITRATION

Introduction

Titration is the addition of a solution with an unknown concentration (the **analyte**) to a solution with a known concentration (the **titrant**). It allows for the determination of the molarity of the unknown in the given sample. The reaction between strong acids and bases is often used when it comes to performing a titration.

In this experiment, you will be performing a neutralisation with hydrochloric acid (HCl) as the titrant and sodium hydroxide (NaOH) as the analyte:

$$\mathbf{HCl_{(aq)} + NaOH_{(aq)} \rightarrow H_2O_{(l)} + NaCl_{(aq)}}$$

The acid-base titration continues until **neutralization** has occurred. To determine when the moles of acid are equivalent to the moles of base, an indicator is used. When the solution has a permanent colour change, this indicates the **end-point** of the titration has been reached.

In this case, the sodium hydroxide will be gradually added to the hydrochloric acid drop by drop using a burette. A **burette** is a device that allows for precise delivery of known volumes of solutions. The NaOH will be added to the HCl until the solution is neutralized.

This technique requires a great deal of precision. In order to accurately determine the concentration of the sodium hydroxide, several trials are to be done.

Purpose

To determine the unknown concentration of NaOH through titration using HCl.

Hypothesis

What is your hypothesis concerning the volume of the solutions?

_____

_____

Materials

- 50mL Burette + clamp
- Stand
- 125mL or 250mL Erlenmeyer Flask
- 2 x 50mL beaker
- 2 x 10mL graduated cylinder
- Funnel
- Distilled water
- HCl, 0.2M
- NaOH, unknown concentration
- Phenolphthalein indicator

Notes on Materials

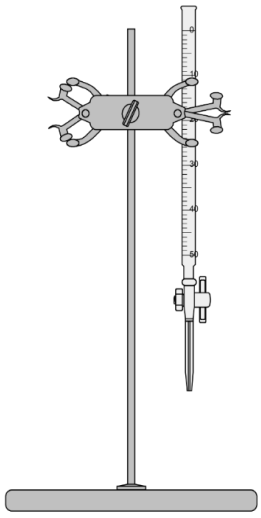
Different concentrations of acid and base can be used depending on what is in stock but the concentrations should **not** be higher than 0.5M. The unknown concentration of NaOH will be up to the teacher or lab technician to decide. It should be relatively close to that of the HCl used in the experiment.

If one wishes to take the lab further in the future, the students can look for an unknown concentration of HCl while using a known NaOH and methyl orange as the indicator.

Procedure

1. To clean the burette: close the stopcock, pour a small amount of distilled water into the top via one of the beakers. Carefully tip and roll the burette so that the water has come in contact with the whole of the interior surface. Open the stopcock and allow the water to drain into a beaker.

2. Carefully clamp burette to the stand with the burette clamp. Do not clamp too tight so as to not damage the burette. Make sure it is perfectly vertical.



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3. Clean glassware with distilled water and dry.

4. Label 50mL beaker NaOH and one 50mL beaker cleaning.

5. From the stock solution using a graduated cylinder, pour 10mL of NaOH into the beaker.

6. From the stock solution using a graduated cylinder, pour 10mL of HCl into the Erlenmeyer flask.

7. Clean burette with the base solution: funnel a small amount of NaOH into the burette. Follow the same steps as step 1 minus the tip and roll. Drain into clean 50mL cleaning beaker. Make sure the stopcock is closed at the end of this step.

8. Fill the burette to the 0 mL with an unknown concentration of NaOH using the funnel.

9. Add 5 drops of phenolphthalein to the HCl in the Erlenmeyer flask.

10. Place Erlenmeyer flask under the tip of the burette.

11. Record initial volume of NaOH in the burette.

12. Add NaOH drop by drop into the flask. After every drop, swirl the flask. Continue adding base until the end-point has been reached.

13. Record the final volume of the NaOH in the burette.

14. Repeat titration for a total of 3 trials.

15. Make sure there is less than a 1% difference between the volumes of each trial. If not, discard the result.

Results

Trials	**Initial Burette Volume (mL)**	**Final Burette Volume (mL)**	**Volume of NaOH (aq) used (mL)**
Trial #1			
Trial #2			
Trial #3			

Calculate the average volume of NaOH used in the titration:

Ans: _____

Conclusion

Determine the concentration of the NaOH using the following equation:

$$M_{HCl} \times V_{HCL} = M_{NaOH} \times V_{NaOH}$$

Ans: _____

Where are some possible sources of error?

_____

_____