Unit 10: Acids & Bases
#10 High Standards Titration Laboratory Experiment

Objective: Determine the concentration of a standard solution of NaOH.

Safety: Wear goggles at all times, NaOH and HCl are corrosive, rinse with water. HCl is toxic by ingestion or inhalation.

Materials:

50.00 mL buret
Buret clamp
Ring stand
250 mL Erlenmeyer flask
50.0 mL Graduated cylinder
0.15M HCl
NaOH (unknown molarity)
Phenolphthalein

Procedure:

1. Fill the buret with NaOH. Record initial reading of NaOH in the buret.
2. Measure 25.0 mL of 0.15 M HCl into a 250 ml Erlenmeyer flask and record exact volume.
3. Add 2-3 drops of phenolphthalein indicator.
4. Gradually dispense the NaOH into the titration flask. Continuously swirl the flask.
5. As the equivalence point is approached, the solution will temporarily turn pink and back to colorless. Now add NaOH drop by drop. Stop the titration when the addition of a single drop causes the solution to remain pink for 30 seconds.
6. Record the final buret reading of NaOH needed to reach the equivalence point.
7. Pour the solution down the sink with plenty of water.
8. Repeat the titration using a second 25.0 mL sample of HCl.

Rough Data

	Trial #1	Trial #2
Volume of HCl		
Initial buret reading of NaOH		
Final buret reading of NaOH		

Let's Concentrate...

Objective: Determine the concentration of acetic acid in vinegar.

Safety: Wear goggles at all times, NaOH and HCl are corrosive, rinse with water. HCl is toxic by ingestion or inhalation.

Materials:

50.00 mL buret
Buret clamp
Ring stand
125 mL Erlenmeyer flask
10.0 mL Graduated cylinder
vinegar
NaOH (unknown molarity)
Phenolphthalein

Procedure:

1. Fill the buret with NaOH. Record initial reading of NaOH in the buret.
2. Measure 10.0 mL of white vinegar into a 250.0 ml Erlenmeyer flask. Record the initial volume.
3. Add 10.0 mL of distilled water to the flask.
4. Add 2-3 drops of phenolphthalein to the flask.
5. Gradually dispense the NaOH into the titration flask. Continuously swirl the flask.
6. As the equivalence point is approached, the solution will temporarily turn pink and back to colorless. Now add NaOH drop by drop. Stop the titration when the addition of a single drop causes the solution to remain pink for 30 seconds.
7. Record the final buret reading of NaOH needed to reach the equivalence point.
8. Pour the solution down the sink with plenty of water.
9. Repeat the titration using a second 10.0 mL sample of white vinegar and 10.0 mL water.

Rough Data

	Trial #1	Trial #2
Volume of vinegar		
Initial buret reading of NaOH		
Final buret reading of NaOH		

Back to the Base-ics...

Objective: Determine the amount of calcium carbonate in a tablet of Tums using the process of **back titration**.

Safety: Wear goggles at all times, NaOH and HCl are corrosive, rinse with water. HCl is toxic by ingestion or inhalation.

Materials:

50.00 mL buret
Buret clamp
Ring stand
125 mL Erlenmeyer flask
100.0 mL Graduated cylinder
0.15 M HCl
NaOH (unknown molarity)
Phenolphthalein
Tums tablet

Procedure:

1. Fill the buret with NaOH. Record initial reading of NaOH in the buret.
2. Measure exactly 75.00 mL of 0.15 M HCl into a 125 mL Erlenmeyer flask.
3. Crush 1 tablet of tums up into small pieces with a mortar and pestle.
4. Dissolve the Tums in the acid in the Erlenmeyer flask and gently heat this solution for 2 minutes to drive off any excess dissolved carbon dioxide.
5. After heating, add 2-3 drops of phenolphthalein indicator to the Erlenmeyer flask.
6. Gradually dispense the NaOH into the titration flask. Continuously swirl the flask.
7. As the equivalence point is approached, the solution will temporarily turn pink and back to colorless. Now add NaOH drop by drop. Stop the titration when the addition of a single drop causes the solution to remain pink for 30 seconds.
8. Record the final buret reading of NaOH needed to reach the equivalence point.
9. Pour the solution down the sink with plenty of water.
10. Run a second trial to confirm a precise result.

Rough Data:

	Trial 1	Trial 2
Amount of HCl added		
Initial buret reading of NaOH		
Final buret reading of NaOH		

Name: _____ date: _____ period: _____

Acid Base Titration Lab Sheet

Data-PART I

	Trial #1	Trial #2
Volume of HCl		
Molarity of HCl	0.15M	0.15M
Initial buret reading of NaOH		
Final buret reading of NaOH		
Volume of NaOH reacted		

Calculations-PART I

1. Write the balanced equation for the reaction between hydrochloric acid and sodium hydroxide.

2. Calculate the molarity of NaOH.	
Trial 1	Trial 2

3. Calculate the average molarity of NaOH. This will be needed for parts II & III.

Data-PART II

	Trial #1	Trial #2
Volume of vinegar		
Initial buret reading of NaOH		
Final buret reading of NaOH		
Volume of NaOH reacted		
Molarity of NaOH (from part I calc. 3)		

Calculations-PART II

4. Write the balanced equation for the reaction between acetic acid (vinegar) and sodium hydroxide.

5. Calculate the molarity of the acetic acid in vinegar.	
Trial 1	Trial 2

6. Calculate the average molarity of acetic acid in vinegar.

Data-PART III

	Trial #1	Trial #2
Volume of HCl added		
Molarity of HCl	0.15M	0.15M
Initial buret reading of NaOH		
Final buret reading of NaOH		
Volume of NaOH reacted		
Molarity of NaOH (from part I calc. 3)		

Calculations-PART III

7. Write the balanced equation for the reaction between hydrochloric acid and sodium hydroxide.

8. Calculate the volume of HCl that was neutralized in the titration (hint...stoichiometry!)	
Trial 1	Trial 2

9. Calculate the volume of HCl that reacted with the calcium carbonate (hint...what did you start with and what did you have left at the end??)	
Trial 1	Trial 2

10. Write the balanced equation for the reaction between hydrochloric acid and calcium carbonate.

11. Calculate the grams of calcium carbonate in the Tums tablet (assuming that is the only substance that reacts in the tablet).	
Trial 1	Trial 2

12. Average the two trials and compare this value to the known value on the antacid container. Calculate your percent error.

13. If the molarity of stomach acid is approximately 0.11 M, calculate the liters of stomach acid that could be neutralized by 1 tablet of Tums (assuming that calcium carbonate is the only substance that reacts with acid).