I’m Drinking Acid?! Lab

Objectives:

- Find the endpoint of common beverages.
- Compare the milligrams of citric acid within various beverages.

Materials (Bench):

- Buret and buret clamp.
- Various beverages (juice, soda, etc.)
- Standardized solution of sodium hydroxide
- Citric Acid solution (approximately 3.300 mg/mL)
- Phenolphthalein indicator

Materials (Drawer):

- 3 250-mL beaker
- 100-mL beaker
- 400 or 600 mL beaker (waste)
- 3 250-mL Erlenmeyer Flasks
- Funnel

Safety:

- Sodium hydroxide is caustic; handle it carefully.
- Wear safety goggles while performing the experiment.

Waste Disposal:

- After the titration, return the unused NaOH in your beaker and buret to the TA.
- The remaining solutions may go down the drain with additional water.

Introduction

Many of the beverages you commonly consume contain acids. In this lab you will measure the pH of some common beverages through titration.

When an acid reacts with a base, the hydrogen ion from the acid reacts with the hydrogen ion from the base in accordance with the following chemical equation:

$$HA + NaOH \rightarrow NaA + H_2O$$

In this representation of an acid-base reaction, the acid (HA) reacts with the base, sodium hydroxide (NaOH), to produce a salt (NaA) and water. The products of an acid-base reaction are commonly salt and water.

The **pH** is a measure of the concentration of hydrogen ions in an acid or a base. The pH scale ranges from 0 to 14. Acidic pHs include values below 7, while bases have pH values above 7. Neutral substances have a pH within a close range to 7.

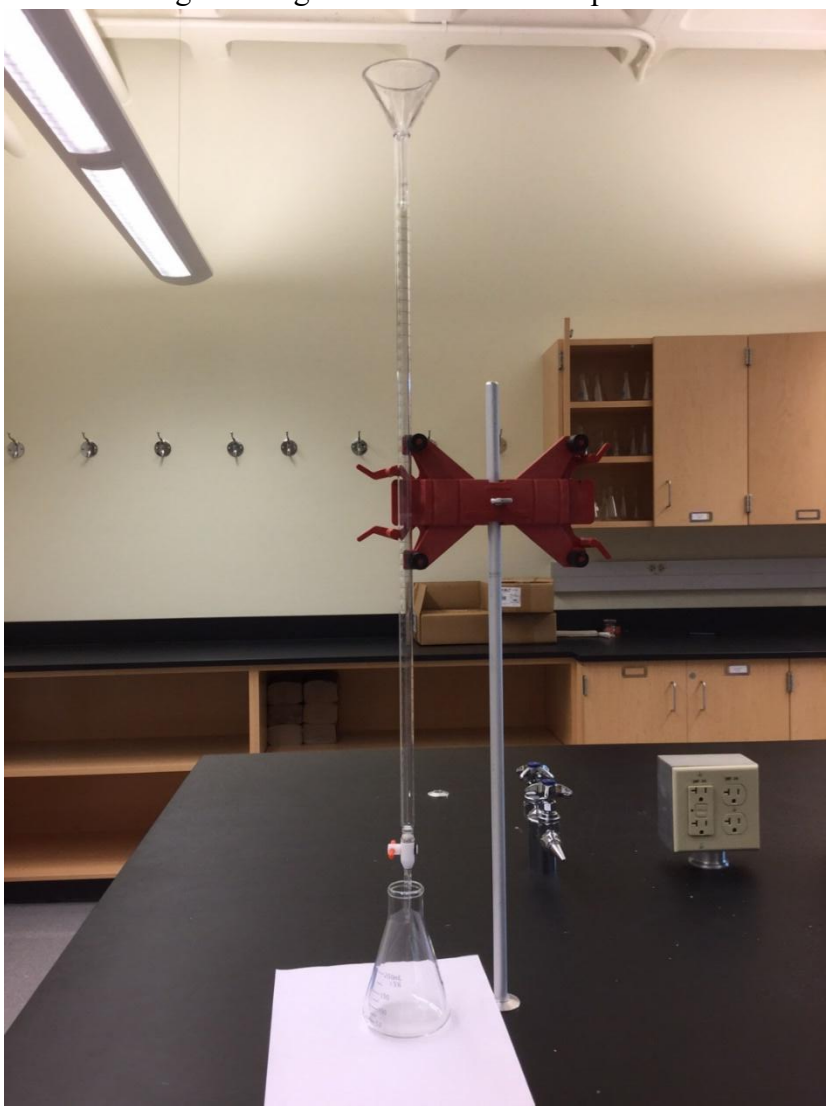
A **titration** is a process commonly used to determine the unknown concentration of a solution of an acid. In this lab, we will be titrating various acidic beverages that contain citric acid.

The **equivalence point** is the point at which enough titrant is added to neutralize the acid within the acidic beverage. The **endpoint** of a titration occurs when the used indicator (in this case, phenolphthalein) causes the solution to change color. The endpoint is a physical indicator of neutralization, but it is not always exactly the same as the equivalence point.

Procedure

Standardization of NaOH:

1. Obtain a buret, ring stand, buret clamp and funnel. Use the clamp to attach the buret to the ring stand. Placing a piece of white paper below the buret will make it easier to observe the color changes during the titration. The setup of the buret is shown below.



2. Label your 250 mL beaker "citric acid." Record the concentration of the citric acid in your Lab Report. Using the volume marking of that beaker, pour about 100 mL of the citric acid solution into that beaker. This is all the citric acid you will need for the experiment. (**Never** pour solutions back into a reagent bottle. If you go over your volume slightly, that is ok.)

3. Transfer a small amount of the citric acid solution (~ 10 mL) into the buret and use the solution to rinse the buret. Open the stopcock and run the solution through the tip of the

buret into a large beaker. Label the beaker "waste" and use this to collect all waste generated during the experiment.

4. Close the stopcock and fill the buret with citric acid to near the "zero" mark. Record the initial volume to the nearest **0.01 mL**. You should not need to fill the buret again.
5. Label your 250 mL beaker "NaOH" and go to the hood to collect about 150 mL of the solution using the volume markers on your beaker.
6. Using a graduated cylinder measure 10.00 mL of the known NaOH solution from your beaker into a 250-mL Erlenmeyer flask labeled #1.
7. Using white-handled the D.I. water faucet, add about enough water to hit the 30 mL mark on the flask and swirl to combine. There is no need to be precise about the amount of water as it is not part of the overall reaction. Repeat this process with two additional 250 mL flask (label #2 and #3) so you now have three flasks.
8. Bring your three flasks to the hood and add a few drops of the phenolphthalein indicator to each flask and swirl to mix. Though the solution is brightly colored (pink) now in the basic solution, placing a piece of white paper under the flask will make it easier to observe the color changes during the titration.
9. Double check that you have recorded the starting volume of the citric acid in the buret. Begin the titration by slowly adding the citric acid from the buret to the flask #1 with NaOH. Swirl the flask constantly. Continue adding the citric acid until the solution just becomes colorless. Record the final volume in the buret to the nearest **0.01 mL.**
10. The titrated solution from the Erlenmeyer flask is neutralized so it can be dumped down the drain.
11. Rinse the 250-mL flask with tap water then D.I. water, discard all of the rinse down the drain.
12. Repeat the titration for flask #2 and flask #3. Any left-over citric acid solution should be collected in a waste beaker. Rinse the buret with distilled water and run distilled water through the tip.

Preparing Solution for Titration:

1. Using a 10-mL graduated cylinder, obtain 10 mL of the beverage (juice, soda, lemonade, etc.). Pour the 10 mL into a 250 mL beaker.
2. Add approximately 50 mL of distilled water to the beaker (this does not need to be exact).
3. Add 3-4 drops of phenolphthalein indicator. The solution should remain colorless. These solutions will have an endpoint (when the solution turns pink).
4. Swirl the solution to mix.
5. This process will be repeated for each beverage used.

Titration:

1. Rinse the buret with NaOH. Transfer a small amount of NaOH into the buret and use the solution to rinse the buret. Open the stopcock and run the solution through the tip of the buret into your waste beaker.
2. Record the initial volume of NaOH in the buret to the nearest **0.01mL** on the Lab Report.

3. Add NaOH drop by drop while swirling continuously until the solution begins to turn pink. ***You must watch for the indicator to change color*** (clear → pink), this will occur quickly.
4. Record the final volume to the nearest **0.01 mL** in the Lab Report table.
5. Put the beverage solution into your waste beaker, rinse the beaker and repeat the process for all four beverage solutions.
6. Add NaOH to the buret as needed. It does not need to be filled to 0.00 mL after each titration.
7. When all four titrations are complete, collect an extra NaOH from your beaker and buret and return to the TA. The solution in the waste beaker can be poured down the drain with extra water.

Titration Curve of Beverages Lab Report

Name: **Date:**

Standardization of Citric Acid

Concentration of Citric Acid (mg/mL):

Solution	**#1**	**#2**	**#3**
Initial Volume of Citric Acid (mL)			
Final Volume of Citric Acid (mL)			
Volume of Citric Acid Used (mL) final - initial			

Titration:

Beverage sample size:

Beverage	**Lemonade**	**7-UP**		
Initial Volume of NaOH (mL)				
Final Volume of NaOH (mL)				
Volume of NaOH used (mL) final - initial				

**the volume of NaOH used is equal to the endpoint of the titration*

Calculations

Standardization (Concentration of NaOH):

Using the known concentration of citric acid (mg/mL), determine the concentration of sodium hydroxide (mg citric acid/ mL NaOH). Do this for each of the 3 trials and average the resulting concentrations.

Average concentration of NaOH: _____ mg/mL

Determination of Milligrams of Citric Acid:

Using the determined average concentration of sodium hydroxide from the standardization and the endpoint volume of NaOH, calculate the milligrams of citric acid within each mL of beverage.

Post-Lab Exercises

1. Look up the beverages you used and determine which acid is present within each. Include your source.

2. Explain the difference between the equivalence point and endpoint.

3. Compare the amount of citric acid (mg) in each beverage. Rank the beverages from least to most acidic and explain.