Ascorbic Acid Titration of Vitamin C Tablets

Part A. Preparation of Vitamin C Tablet Solutions

1. Obtain two vitamin C tablets. Place a plastic weighing boat on the balance, and press zero to tare the balance. Break the first tablet into two pieces so it will dissolve faster, place the pieces in the tared weighing boat, and record the exact mass of the tablet in your **LAB NOTEBOOK**. MAKE SURE TO RECORD **ALL** OF THE DIGITS! Repeat this procedure for the second tablet in a separate plastic weighing boat.

2. Transfer the tablets to separate, labeled 250 mL Erlenmeyer flasks. Add 40-50 mL of deionized water to each sample. Crush each tablet with a stirring rod. Use a hotplate at your lab bench to heat the flasks (heat setting between 3-4). Heat gently to dissolve the vitamin C tablets. The binder in the tablet will not completely dissolve, leaving some residue. Set these solutions to the side to cool to room temperature while you complete the titrations in Part B.

CAUTION: Sodium hydroxide, NaOH, can cause chemical burns and damage eyes very quickly. Any NaOH spilled on your skin must be rinsed immediately with water for 15 minutes. Any NaOH spilled on the lab benches should be neutralized, and the area rinsed with water and wiped clean. Inform your instructor of any NaOH spills.

CAUTION: Sulfuric acid, H_2SO_4(aq), is corrosive and can cause chemical burns and damage clothing. Any H_2SO_4(aq) spilled on skin must be rinsed immediately with water for 15 minutes. Any acid spilled on your work area must be neutralized, the area rinsed with water and wiped clean.

WEAR GOGGLES AT ALL TIMES, even when you are washing the glassware to avoid exposing your eyes to NaOH solution. Wash your hands completely with soap and water before leaving the lab.

Part B. Standardization of the NaOH Solution

LAB NOTEBOOK

You will need to make a data table which contains the following information:

- Initial buret reading, final buret reading, and total volumes (in mL) for *each* titration trial.
- Calculated molarity of NaOH for *each* trial

Save room under your table to show calculations

1. Prepare a data table in your lab notebook to record volume and concentration data as suggested above.

2. Use the NaOH pump dispenser to deliver 100 mL of NaOH into a clean, labeled 250 mL beaker. Clean, rinse, and *condition* a 25.00 mL buret with a few mL of the NaOH solution, then fill the buret with the

NaOH solution. Drain a small amount of the NaOH solution into your waste beaker so it fills the buret tip (with no air bubbles present). Record the exact initial buret reading. (Save the rest of the NaOH solution in the beaker to refill the buret later.)

3. Use the H_2SO_4 pump dispenser to dispense 40 mL of H_2SO_4 into a clean labeled 150 mL beaker. **Record the exact concentration of H_2SO_4 from the label on the dispenser in your LAB NOTEBOOK either directly above or below your data table**.

4. **Review how to properly use a pipet found in the Background Section before continuing.** Using the 10.00 mL pipet and a rubber bulb (or other device such as a pipet pump), pipet 10.00 mL of the standard H_2SO_4 solution into a *clean* 250 mL Erlenmeyer flask. Only gravity should be used to deliver the acid solution from the pipet to the flask. In other words, don't use the bulb or pump to force the solution out of the pipet. Also remember that the pipets are *designed* to leave a small amount of liquid in the tip (do not blow it out!). Add about 10 mL of deionized water with a 10 mL graduated cylinder. Then add 2 drops of phenolphthalein indicator to the acid. Repeat the process using two more empty Erlenmeyer flasks.

5. Place a teflon magnetic stir bar in the Erlenmeyer flask. Place the flask on a cool stir plate. Adjust the stir setting so that your solution is contiuously being mixed without splashing the solution on the insides of the flask.

6. Slowly add the NaOH from the buret to the acid solution in the flask, while swirling the flask to get homogeneous solutions. When you begin seeing flashes of pink, add the base dropwise, occasionally rinsing the sides of the flask with deionized water from a wash bottle. (*Note: The slower the NaOH is added near the end of the titration, the more accurately you can catch the endpoint. The closer you stop the titration at the endpoint, the less likely you will have to redo a trial.*) Stop adding base when one drop causes a permanent (>1 minute) **faint pink** coloration of the solution in the flask. Record the reading on the buret at this endpoint ***to the nearest 0.01 mL***.

7. Refill your buret with the NaOH solution. Repeat steps 4-6 to titrate the other two H_2SO_4 samples with the NaOH solution. Record the exact initial and final buret readings in your data table. When titrations are performed, a minimum of three trials should be completed to ensure accuracy. More trials should be completed if any volume of NaOH used differs by more than 1 mL.

Part C. Analysis of Ascorbic Acid in Vitamin C Tablets

LAB NOTEBOOK

You will need to make a data table which contains the following information:

- Initial buret reading, final buret reading, and total volumes (in mL) for *each* titration trial.
- Calculated mass of ascorbic acid (in mg) from the titration data for each tablet
- Calculated % by mass of ascorbic acid in each vitamin C tablet

Add 2 drops of phenolphthalein solution to each flask containing a Vitamin C tablet. Titrate each sample (i.e., 2 trials) with the NaOH solution to the pink phenolphthalein endpoints similarly as done in Part B (use a teflon stir bar, slowly add NaOH, etc.). Below the data table you will need to calculate the average mass of Ascorbic acid (in mg) and the average mass % of Ascorbic acid from both trials. In the interest of time, you will only titrate two samples of Vitamin C tablets. For accuracy, it would be ideal to perform 3 titrations in this step as well, but time constraints don't allow this.

Waste Disposal: Combine all solutions in your waste beaker and dispose in waste container in the hood.

BE SURE TO WASH AND DRY YOUR LAB BENCH AFTER COMPLETING THE EXPERIMENT TO REMOVE ALL TRACES OF ANY SPILLED CHEMICALS

Calculations to be Completed in LAB NOTEBOOK

Part B. Standardization of the NaOH Solution

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

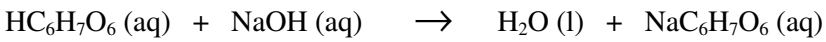
2. Calculate the molarity of the NaOH from the data for each titration of H_2SO_4(aq). Don't forget to take into account the mole to mole ratio of the two substances from the balanced chemical equation. Make sure to label each calculation such that it can be graded.

3. Calculate the average molarity of the NaOH(aq).

4. After completing the calculations, be sure to complete your data table.

Part C. Determining the Amount of Ascorbic Acid in Vitamin C

1. Use the average molarity of the NaOH from part B to calculate the moles of ascorbic acid present in your flasks. Then convert moles of ascorbic acid to grams and then milligrams. The equation for this reaction is shown here (as always, check to see if the equation is balanced):



$$HC_6H_7O_6\,(aq) + NaOH\,(aq) \longrightarrow H_2O\,(l) + NaC_6H_7O_6\,(aq)$$

(Write this chemical reaction equation in your lab notebook)

2. Calculate the average, in milligrams, of ascorbic acid in your two tablets.
3. Use the mass of the tablet from Part A and the milligrams of ascorbic acid calculated in part C to calculate the mass percentage of ascorbic acid in each tablet.
4. Calculate the average mass percentage of ascorbic acid for a tablet of Vitamin C.
5. Be sure to label each calculation, and complete your data table.

For Your Lab Report:

Attach the yellow copies of your lab notebook and the Postlab Questions, pages 4-5, and submit as your report.

Ascorbic Acid in Vitamin C Tablets: Lab Report

Name: _____

Section Number:_____

Turn in pp. 4 and 5 with the copies from your lab notebook

Post-Lab Questions

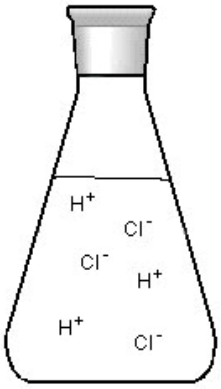
1. In acidic solutions, phenolphthalein is: (Circle one) pink colorless

   In basic solutions, phenolphthalein is: (Circle one) pink colorless

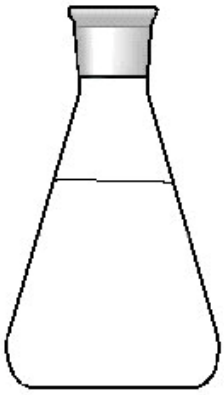
2. Acidic solutions contain what ions, specifically? _____

   Basic solutions contain what ions, specifically? _____

3. Hydrochloric acid can also be titrated with sodium hydroxide using phenolphthalein indicator to determine the endpoint. The Erlenmeyer flask on the left below shows that the only ions present at the start of the titration are $H^+(aq)$ and $Cl^-(aq)$. Indicate the color of the solution at the start. For the second flask, write the chemical formulas for the substances present (other than water) at the endpoint of the titration between hydrochloric acid and sodium hydroxide. Also indicate (by circling) the color of the solution at the endpoint.



Before any NaOH(aq) is added, the solution is: **pink colorless**



At the endpoint of the titration, the solution is: **pink colorless**

4. In Procedure B, Step 2 (where you add approximately 10mL of water to the acid), why wasn't it necessary to record the exact volume of water added to the flask?

6. Explain, in terms of substances present, why the solution in the flask, after a few milliliters of NaOH(aq) have been added, turns pink for a few seconds then becomes clear again.

7. Explain, in terms of substances present, why the solution in the flask turns pink and stays pink at the endpoint.

8. a) How does the average milligrams of ascorbic acid that you calculated (refer to Part C calculations above) compare with the manufacturer's claim of 500 mg of ascorbic acid per tablet?

   b) Describe at least three sources of error <u>in your lab techniques</u> that could have resulted in different amounts of ascorbic acid than the manufacturer's claim.

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9. How would the ***calculated*** **molarity for NaOH** be affected (higher, lower, or no change) if the following procedural errors occurred? Explain why in each case.

   a. While pipetting the H_2SO_4 solution, several drops of H_2SO_4 drip out of your pipet onto the bench top and miss the Erlenmeyer flask.
      - NaOH molarity (circle one): high or low
      - Why?

   b. The buret tip is not filled with NaOH at the beginning of the titration.
      - NaOH molarity (circle one) : high or low
      - Why?

9. Predict the products (including phases) and balance the equation for each of the following sets of reactants:

a.	HNO_3 (aq) + $Ba(OH)_2$ (aq) →
b.	HBr (aq) + LiOH (aq) →
c.	$HC_2H_3O_2$ (aq) + $Ca(OH)_2$ (aq) →
d.	H_3PO_4 (aq) + KOH (aq) →