Procedure

Safety

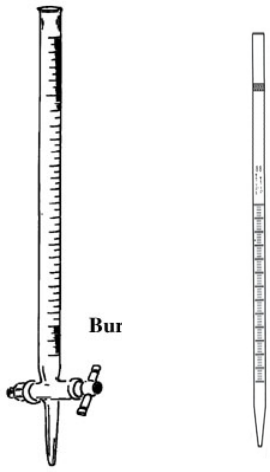
Be especially careful when handling the sodium hydroxide base (NaOH), as it is corrosive and can cause chemical burns to the skin. If any NaOH spills on you, rinse immediately under running water for up to 15 minutes and report the accident to your instructor.

Materials and Equipment

50-mL EXUHW, 5-mL PRKU pipet bulb*, ~ 0.1 M NaOH (*aq*), vinegar, phenolphthalein, buret stand, two 250-mL (or 125 mL) Erlenmeyer flasks, wash bottle with distilled water, funnel

Titration Procedure

Your instructor will demonstrate the correct use of the mohr pipet and buret at the beginning of the lab session. Detailed instructions on how to use a pipet are also found on the last page of this handout. Note that <u>three</u> titrations must be performed.



1. Obtain a 50-mL buret, 10-mL PRKU SLSHW, and a SLSHW pump from the front.

Setting up the EXUHW and prepa ring the NaOH

Rinse the inside of the EXUHW with distilled water. Allow the distilled water to drain out through the tip in order to ensure that the tip is also rinsed.

0DNH P/RI 01D2+ 7HQ rinse the EXUHW with a small amount of NaOH (*aq*). To do this, add ab out 5-mL of NaOH (*aq*) to the EXUHW, then twirl the EXUHW on its side (over the sink) to rinse its entire inner surface. Then allow the NaOH (*aq*) to drain out through the tip.

Fill the EXUHW with NaOH (*aq*) up to the top, between 0-mL and 5-mL. Use a funnel to do this carefully, below eye-level, and preferably over the sink. After this you will need to flush the tip of the EXUHW – your instructor will sho you how to do this. Now measure the volume at the level of the NaOH precisely, and record it as the "Initial buret Reading" on your report. Also record the exact molarity of the NaOH (*aq*), which is labeled on the stock bottle.

Preparing the vinegar sample

5. The mohr pipet used in this lab is designed to measure and transfer exactly 5.00 mL of solution. First, rinse the inside of the mohr pipet with distilled water. Using the pipet pump, draw the water into the pipet up above the 5-mL mark, then allow it to drain out through the tip. You may want to do this several times for practice. Then perform a final rinse, but this time use vinegar.

6. Now use the mohr pipet to transfer 5.00-mL of vinegar into a clean 250-mL Erlenmeyer flask (see instructions on page 4). Record this volume of vinegar (precise to two decimal places) on your report. Then add about 20-mL of distilled water and 5 drops of phenolphthalein to this Erlenmeyer flask.

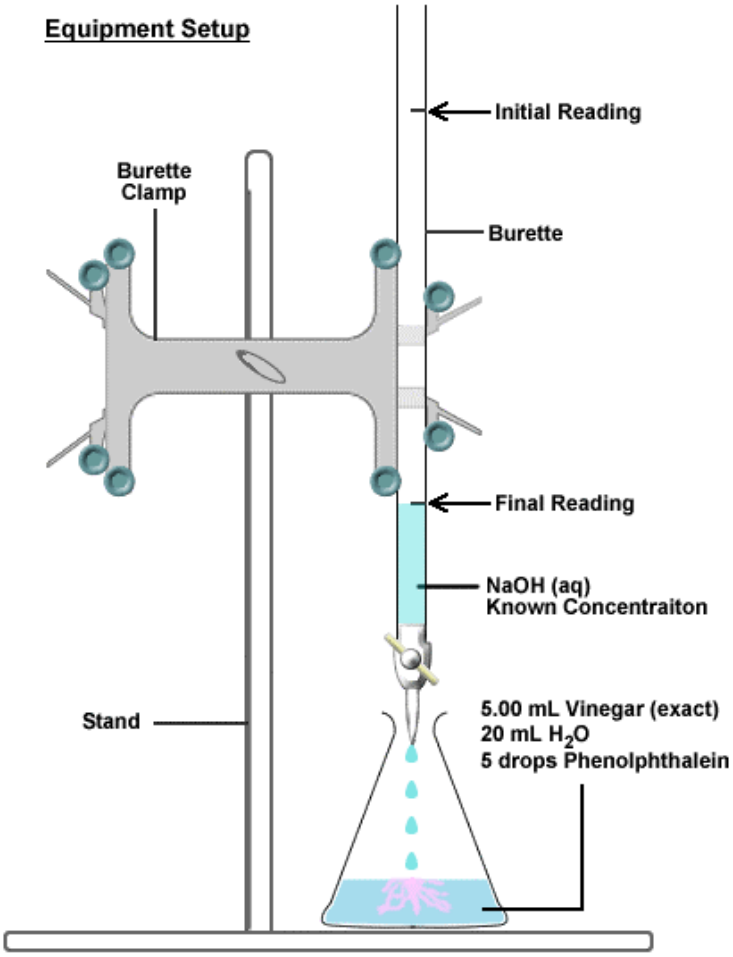
Performing the titration

7. Begin the titration by slowly adding NaOH (*aq*) from the buret to the vinegar in the Erlenmeyer flask. Swirl Erlenmeyer flask as you add the base in order to efficiently mix the chemicals. Some pinkness may appear briefly in the flask as the base is added, but it will quickly disappear as the flask is swirled.

8. As the equivalence point is approached, the pink color will become more pervasive and will take longer to disappear. When this occurs, start to add the NaOH (*aq*) ***drop by drop***. Eventually the addition of just one drop of NaOH (*aq*) will turn the solution in the Erlenmeyer flask a pale pink color that does not disappear when swirled. This indicates that the equivalence point has been reached. ***Do not add any more NaOH (aq) at this point***. Measure this volume of NaOH (*aq*) precisely, and record it as the "Final buret Reading" on your report. Then show the resulting solution in the flask to your instructor so s/he can record the final color on your report form.

9. Refill your buret with NaOH (*aq*), and then repeat this procedure for a second sample of vinegar, and then a third sample of vinegar. You do not need to flush the tip of the buret again. Note that if you use less than 25-mL of NaOH (*aq*) for the second titration, you do not need to refill the buret for the third titration; also that you will need to clean out and re-use one of your Erlenmeyer flasks for the third titration. You and your partner should take turns performing these titrations.

10. When finished, dispose of your chemical waste as instructed.



Pipetting Instructions

a. Get the appropriate amount of the solution you wish to pipet in a clean, dry beaker. Never pipet directly out of the stock bottles of solution. This creates a contamination risk.

b. Insert the tip of the pipet into the beaker of solution so that it is about a quarter inch from the bottom. Be sure not to press the tip against the bottom of the container.

c. If you are right handed, hold the pipet in your left hand, leaving your right hand free to place over the top of the pipet. With your right hand, put the pump onto the pipet. Press it firmly over the top of the pipet, but DO NOT INSERT THE PIPET DEEP INTO THE PUMP!

d. Insert the pipet into the solution and roll the wheel down to draw up the solution. Do not allow the solution to be sucked into the pump itself.

e. Make sure not to press on the bar of the pipet pump. This will cause the solution to come out.

f. Slowly roll the wheel to allow the liquid to drain until the bottom of the meniscus is aligned with the desired volume mark. With practice you will be able to lower the liquid very, very slowly.

g. When the bottom of the meniscus is even with the desired volume mark, remove the pipet from the solution. Touch the tip once to the side of the beaker to remove any hanging drops.

h. To transfer the solution, place the tip of the pipet against the wall of the receiving container at a slight angle. Then press the bar or roll the wheel up to allow the liquid to drain from the pipet.

i. When the solution stops flowing, touch the pipet once to the side of the receiving container to remove any hanging drops. DO NOT blow out the remaining solution. The pipet has been calibrated to deliver the appropriate amount of solution with some remaining in the tip.

Calculations

Molarity of Acetic Acid in Vinegar

- First, using the known molarity of the NaOH (*aq*) and the volume of NaOH (*aq*) required to reach the equivalence point, calculate the moles of NaOH used in the titration.
- From this mole value (of NaOH), obtain the moles of $HC_2H_3O_2$ in the vinegar sample, using the mole-to-mole ratio in the balanced equation.
- Finally, calculate the molarity of acetic acid in vinegar from the moles of $HC_2H_3O_2$ and the volume of the vinegar sample used.

Mass Percent of Acetic Acid in Vinegar

- First, convert the moles of $HC_2H_3O_2$ in the vinegar sample (previously calculated) to a mass of $HC_2H_3O_2$, via its molar mass.
- Then determine the total mass of the vinegar sample from the vinegar volume and the vinegar density. Assume that the vinegar density is 1.000 g/mL (= to the density of water).
- Finally, calculate the mass percent of acetic acid in vinegar from the mass of $HC_2H_3O_2$ and the mass of vinegar.