

Lab #19: Determination of Vinegar Concentration by Titration Lab Exercise Name: \_\_\_\_\_

Chemistry II Partner: \_\_\_\_\_

10 points

**USE BLUE/BLACK INK!!!!**

Date: \_\_\_\_\_ Hour: \_\_\_\_\_

Goal:

The goal of this lab is to determine the molarity of acetic acid in a bottle of vinegar.

Background:

In this experiment, a standard solution of sodium hydroxide will be used to neutralize a sample of vinegar containing an unknown concentration of acetic acid. From the amount of sodium hydroxide solution needed, the molarity of the vinegar will be calculated.

Research questions (answers may be continued on a separate sheet):

1) What is meant by *a standard solution of sodium hydroxide*? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2) What are the formulas of:

sodium hydroxide \_\_\_\_\_ acetic acid \_\_\_\_\_

3) What is a strong base? \_\_\_\_\_

\_\_\_\_\_

What is a weak base? \_\_\_\_\_

\_\_\_\_\_

Is sodium hydroxide a strong or weak base? Explain your answer. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

4) What is a strong acid? \_\_\_\_\_

\_\_\_\_\_

What is a weak acid? \_\_\_\_\_

\_\_\_\_\_

Is acetic acid a strong or weak acid? Explain your answer. \_\_\_\_\_

\_\_\_\_\_

5) Will the equivalence point for this titration be at, above, or below a pH of 7? Explain your answer.

---

---

---

Materials:

- |                            |   |
|----------------------------|---|
| 1 pH meter                 | 1 buret                                   |
| 4 30 mL beakers            | 10 mL pH 7 buffer solution                |
| 10 mL pH 4 buffer solution | 10 mL pH 10 buffer solution               |
| 1 100 mL beaker            | 100 mL standard sodium hydroxide solution |
| 3 250 mL beakers           | 1 10 mL graduated cylinder                |
| 15 mL vinegar              | 1 mL 1% phenolphthalein solution          |
| 1 test tube brush          | 1 permanent marker                        |
| 1 magnetic stir bar        | 1 magnetic stir plate                     |
| 1 ringstand                | 1 test tube clamp                         |
| 1 double buret clamp       | 1 100 mL graduated cylinder               |

---

---

---

Hazards:

---

---

---

---

---

---

---

---

---

---

Procedure:

- 1) Physically and chemically clean the glassware.
- 2) Carefully set up the pH meter using the ring stand and clamp.
- 3) Obtain pH buffer solutions for calibration in labeled 30 mL beakers
- 4) Calibrate the pH meter
- 5) Prepare the buret
  - a) Carefully set up the buret using the double buret clamp
  - b) Rinse the buret with the standard sodium hydroxide solution





Post-Lab Calculations, Analysis, and Questions (no need for a separate conclusion):

1. Graph the pH vs. volume of sodium hydroxide solution added for the three trials.
2. Calculate the molarity of the vinegar for each trial.
3. Calculate the average molarity of the vinegar.
4. Use the molar mass of acetic acid and the density of vinegar (1.01 g/mL) to calculate the mass percent of acetic acid in the vinegar.
5. Commercial vinegar is generally  $5.0 \pm 0.5$  % acetic acid by mass. Assuming that was the true value for the vinegar, what was your percent error?
6. Discuss any problems that occurred during the lab, how you handled them, and how the lab could be changed or improved.

Lab handout based on the experiments “Acid-Base Titrations” in Experimental Chemistry (Seventh Edition) by James F. Hall (Houghton Mifflin, 2007) and “Acid-Base Titrations” in Laboratory Manual: Prentice Hall Chemistry by Antony C. Wilbraham, Dennis D. Staley, and Michael S. Matta (Pearson Prentice Hall)