Titration of Acetic Acid in Vinegar: Is it really 5%? Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Introduction**

Acid/base indicators change colors depending upon two factors: the amount of acid in the solution and the amount of base in the solution. Phenolphthalein is the indicator commonly using in neutralization titrations. The indicator is colorless in acid solutions like vinegar, when an excess of base (like sodium hydroxide) is added, the phenolphthalein will turn pink.

In an acid/base titration, generally, the amount of base needed to neutralize a given amount of acid is determined by completing an experiment (titration). In this experiment, a weak acid (acetic acid, vinegar) is titrated with a strong base (sodium hydroxide). The number of drops of sodium hydroxide is counted until all the acid is neutralized and the indicator will turn pink. Most vinegar solutions purchased at the store are a 5% solution of acetic acid.

The point at which the solution turns and stays pink is called the endpoint. At this point enough base has been added to neutralize the acid. Any base added after this point will not have acid to react with and will therefore stay in solution, causing the indicator to stay pink.

**Objectives**

(1) To perform a titration of a weak acid with a strong base using phenolphthalein as the indicator.

(2) To determine experimentally the percentage of acetic acid in vinegar.

**Safety**

Sodium hydroxide solution can cause burns to skin and eyes. If exposure occurs, rinse thoroughly with water.

**Materials and Equipment**

Pipets with 0.20 M sodium hydroxide One 24-well reaction plate

Pipet with phenolphthalein Toothpicks (use to stir solution)

Pipet with commercial vinegar (acetic acid) Piece of white paper

**Pre-Lab Questions**

1) Write the balanced equation for the neutralization reaction that will take place in this lab.

2) Acid/base indicators, like phenolphthalein, change colors depending upon what two factors?

3) What color is phenolphthalein in acid solutions like vinegar ? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4) What color is phenolphthalein when an excess of base has been added to a solution ? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5) What color was the phenolphthalein when all the acid had been neutralized ? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6) What does the term "endpoint" mean ?

7) Why does the solution stay pink after reaching the endpoint ? Use complete sentences.

8) What is the percentage of acetic acid in a solution of vinegar purchases at the grocery store?

**Procedures**

1. Check to ensure that your reaction plate is clean. If not notify the instructor.
2. Place the 24-well reaction plate on a piece of white paper.
3. Find the pipet labeled “vinegar”. Hold in upright and carefully dispense 10 drops of vinegar in one of the well on the reaction plate.
4. Find the pipet labeled “phenolphthalein”. Hold in upright and carefully dispense 1 drop into the well with the vinegar. Stir with a toothpick. The solution should be colorless (Why?). If it is not colorless, notify the instructor.
5. **READ THIS ENTIRE STEP BEFORE BEGINNING.** Find the pipets labeled “sodium hydroxide”. To the well with the vinegar and indicator, add **ONE DROP OF SODIUM HYDROXIDE AND STIR.** Continue to add sodium hydroxide one drop at a time with stirring in between additions until the colorless solution turns pink and stays pink for at least one minute. Count the total number of drops of sodium hydroxide. You must stir the solution after each drop of sodium hydroxide added to obtain the proper results. As you approach the endpoint, you will notice an increase in the amount of stirring necessary to return the solution to its colorless state.
6. Record the number of drops of sodium hydroxide required to reach the end point in the “Trial 1” blank below. Repeat the titration four more times in separate and clean wells.

Trial 1 \_\_\_\_\_\_\_\_\_\_ drops Trial 2 \_\_\_\_\_\_\_\_\_\_ drops

Trial 3 \_\_\_\_\_\_\_\_\_\_ drops Trial 4 \_\_\_\_\_\_\_\_\_\_ drops

Trial 5 \_\_\_\_\_\_\_\_\_\_ drops

1. Show your reaction well plate to the instructor to obtain an instructor’s check.
2. Clean up your lab:
   1. Use tap water to rinse all solutions in the well-reaction plate down the sink.
   2. Rinse out well several times with tap water.
   3. Place well upside-down on a paper towel at your lab station.
   4. Throw all used toothpicks in the trash. Leave un-used toothpicks at your station.
   5. Place all pipets in the plastic cup **WITH THE TIPS POINT UPWARD.** Leave the cup at your lab station.
   6. Wash your hands with soap and water.
   7. Wipe your lab station clean and dry.

**Calculations:**

1. Average the number of drops for the 5 trials. Round to a whole number. Record your average below”

Average drops of sodium hydroxide = \_\_\_\_\_\_\_\_\_\_\_\_\_ drops

1. Enter the average number of drops in the equation below to obtain the percentage of acetic acid in vinegar.

For the Calculations:

Concentration of NaOH = 0.20 M

Number of drops of vinegar = 10 drops

Molar mass of acetic acid = \_\_\_\_\_\_\_\_\_\_

Mass of acidic acid in 1 liter of solution = 1000 g

Number of drops of NaOH = \_\_\_\_\_\_\_\_\_\_

Percentage of acetic acid in vinegar =

( \_\_\_\_\_\_\_\_\_\_\_ drops of NaOH) (0.20 M NaOH) ( \_\_\_\_\_\_g/mol) (100%) =

( 10 drops vinegar) 1000g/L acetic acid)

% acetic acid in vinegar = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Round to the tenths place