# Abstract:

Abstract: Introduction: Materials: * Chemicals: Buffer solution, pH 7. 0, 50 mL Phenolphthalein indicator solution, 1. 0 %, 1 mL Potassium hydrogen phthalate, KHC8H4O4, 2 g sodium hydroxide solution, NaOH, 0. 1 M, 150 mL Unknown weak acid, 1. 5g Water, distilled or deionized * Equipment: Balance Stir bar Beaker, 250mL Oven Buret, 50 mL pH sensor Desiccator Rising stand and buret clamp Erlenmeyer flask, 125mL Wash bottle with distilled water Funnel Weighing dishes, 2 Procedure: Part 1: Standardization of a Sodium Hydroxide Solution 1. Obtain a sample of potassium hydrogen phthalate that has been previously dried in oven and stored in a desiccator. 2. On an analytical balance, accurately weigh 0. 4 g of KHP in a previously tared weighing dish. Record the precise mass in the table. 3. Transfer the KHP into an Erlenmeyer flask. Use water from a wash bottle to rinse the entire remaining solid from weighing dish to flask. 4. Add 45mL of distilled water into the flask and dissolve the KHP. 5. Obtain 75mL of NaOH solution. 6. Clean a 50mL buret and rinse it with NaOH solution. 7. Fill the buret to the above zero mark with the NaOH solution. 8. Open the stopcock to remove the air and then measure the remaining solution in the buret and record it. 9. Position the buret over the Erlenmeyer flask so the tip of buret is 2cm above the liquid. 10. Add three drops of phenolphthalein solution to the KHP solution in the flask. 11. Begin the titration by adding 1. 0 mL of NaOH solution to the flask and swirl the flask to mix the content. 12. Repeat this step until 15mL of NaOH has been added to the flask. 13. Reduce the incremental volumes of NaOH to 0. 5 mL until pink color persists. Reduce the rate of addition of NaOH drop by drop until the pink color starts to persist for 15 seconds. Remember to continuously swirl the flask. 14. Measure the volume of remaining NaOH in the buret. Record this volume as the final

volume in the table. 15. Repeat the standardized titration two more times. Rinse the flask thoroughly between the trials. Part 2: Determination of the equivalent Mass of an unknown acid 1. Weigh about 0. 4g of a sample of an unknown acid in a weighing dish and record the mass in the table 2. 2. Dissolve the acid in the 40 mL of distilled water and titrate the phenolphthalein endpoint as above in steps 5-16 3. Record the initial and final volumes of NaOH solution in the data table2. 4. Repeat once more. Choose a mass for the second sample so that the volume of NaOH needed will be about 45mL if using a 50mL buret. Part 3: Determination of the pKa of the unknown acid 1. Set up the pH meter and the electrode. Calibrate the pH meter using a pH 7 buffer solution. Rinse the electrode with the distilled water. 2. Weigh a sample of the unknown acid that will require approximately 20mL of titrant. 3. Dissolve the acid in approximately 100mL distilled water in a 250mL beaker. 4. Fill the buret with the standardized NaOH solution used in part 1. Record the initial volume as the “ initial buret reading" in the table 3. 5. Set the beaker containing the unknown acid solution on a magnetic stirrer. Clamp the pH electrode so it is submerged in the acid solution. Be sure the stir bar does not hit the electrode. Set the stir bar gently spinning. 6. When the pH reading has stabilized, record the initial pH of the solution in the table 3. 7. Add about 1 mL of NaOH solution to the beaker. Record the exact buret reading in the table 3. 8. Record the pH of the solution next to the buret reading in data table 3. 9. Add another 1mL increment of NaOH solution. Record both the buret reading and the pH in data table 3. 10. Continue adding NaOH in 1 mL portions. Record both pH and the buret reading for each addition. 11. When the pH begins to increase more than 0. 3 units decrease the amount of NaOH added to about 0. 2 mL.

12. Continue adding sodium hydroxide in about 0. 2-mL increments. Record both the buret reading and the pH after each addition. 13. When the pH change is again about 0. 3 pH units, resume adding the sodium hydroxide in 1mL increments. Continue to record both the buret reading and the pH after each addition. 14. Stop the titration when the pH of solution is greater than 12. Record the final volume of solution in the buret and final pH. 15. Graph the data, with pH on the vertical axis and the volume of NaOH on the horizontal axis. Make the graph large enough to reflect the care taken with the pH and volume measurements. Data Data Table 1 | Trial 1 | Trial 2 | Trial3 | Mass KHP, g | 0. 5 | | | Final volume, mL | 15. 1 | | | Initial volume, mL | . 1 | | | Volume of NaOH added, ml | 15. 0 | | | Data Table 2 | Trial 1 | Trial 2 | Mass of unknown acid, g | . 41 | . 42 | Final volume, mL | | | Initial volume, mL | 15. 1 | . 1 | Volume of NaOH added , mL | 35. 0 | 22. 2 | Data Table 3 Mass of unknown acid | . 42 | Standard NaOH concentration | | Initial buret reading | 0123. 4 | Initial pH | 3. 75 | Buret reading (mL) | pH | Buret reading (mL) | pH | 1 | 3. 86 | 12 | 5. 45 | 2 | 3. 95 | 13 | 6. 10 | 3 | 4. 03 | 14 | 10. 81 | 4 | 4. 15 | 15 | 11. 33 | 5 | 4. 25 | 16 | 11. 55 | 6 | 4. 35 | 17 | 11. 67 | 7 | 4. 45 | 18 | 11. 72 | 8 | 4. 58 | 19 | 11. 81 | 9 | 4. 73 | 20 | 11. 86 | 10 | 4. 88 | 21 | 11. 93 | 11 | 5. 15 | 22 | 12. 01 | Discussion: Questions: 1. From the standardized data in part 1. Calculate the molarity of the sodium hydroxide solution for each trial. Average the values and enter the average in data table 1. 2. From the equivalent mass data in part 2, calculate the equivalent mass of the unknown acid for each trial. Average the values and enter the average in data table 2. 3. Why is the answer obtained in question #2 the equivalent mass of the acid rather than the molar mass? 4. Why must KHP and the acid samples be dried, would the calculated molarity of the NaOH be higher or

lower than the actual value? Explain. 5. Why must NaOH be standardized? Why can’t an exact solution of NaOH be prepared? 6. From the titration curve of pH versus volume of NaOH added in part3, determine the pKa of the unknown acid. Calculate the value of Ka for unknown acid. 7. Why is the equivalence point in the titration of the unknown acid with sodium hydroxide not at pH 7?