

Diprotic Acid Lab and Easy Data

Name _____

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A diprotic acid is an acid that yields two H^+ ions per acid molecule. Examples of diprotic acids are sulfuric acid, H_2SO_4 , and carbonic acid, H_2CO_3 . A diprotic acid dissociates in water in two stages.

The primary purpose of this experiment is to identify an unknown diprotic acid by finding its molecular weight. A diprotic acid is titrated with NaOH solution of known concentration. Molecular weight (or molar mass) is found in g/mole of the diprotic acid. Weighing the original sample of acid will tell you its mass in grams. Moles can be determined from the volume of NaOH titrant needed to reach the first equivalence point. The volume and the concentration of NaOH titrant are used to calculate moles of NaOH. Moles of unknown acid equal moles of NaOH at the first equivalence point. Once *grams* and *moles* of the diprotic acid are known, molecular weight can be calculated, in g/mole. Molecular weight determination is a common way of identifying an unknown substance in chemistry. A TI-84 calculator running Easy Data with a Easy Link and pH sensor is an excellent way to complete this experiment.

You may use the first or second equivalence point to calculate molecular weight.

Safety

Goggles must be worn at all times.

Procedure

1. Weigh out about 0.120 g of the unknown diprotic acid on a piece of weighing paper. Record the mass to the nearest 0.001 g in the Data and Calculations table. Transfer the unknown acid to a 250-mL beaker and dissolve in 100mL of distilled water. **CAUTION:** *Handle the solid acid and its solution with care. Acids can harm your eyes, skin, and respiratory tract.*
2. Place the beaker on a magnetic stirrer and add a stirring bar.
3. Use a utility clamp to suspend a pH electrode on a ring stand. Position the pH electrode in the diprotic acid solution and adjust its position toward the outside of the beaker so that it is not struck by the stirring bar. You may wish to use a new electrode support clamp available from Vernier Software and Technology.
4. Obtain a 50-mL buret and rinse the buret with a few mL of the 0.10 M NaOH solution. Record the precise concentration of the NaOH solution in the Data and Calculations table. Use a clamp to attach the buret to the ring stand. Fill the buret a little above the 0.00 mL level. Drain a small amount of NaOH solution so it fills the buret tip *and* leaves the NaOH at the 0.00-mL level.
5. Prepare the TI-84 calculator by attaching an Easylink and pH sensor to the system. Easy Data will run automatically. Set the mode to “events with entry” and begin collection data points.
6. This process goes faster if one person manipulates and read the buret while another person operates the computer and enters buret readings.
 - Before adding NaOH titrant, click "Start" and monitor pH for 5-10 seconds. Once the pH has stabilized, click "Keep", and type "0" (for 0 drops added). You may then press “Keep” each time you wish to enter a data point. Data points should be recorded in milliliters of NaOH added.
 - Add enough NaOH to raise the pH by about 0.20 units. When the pH stabilizes, again click "Keep". and type the current buret reading, to the nearest 0.01 mL. After entering each data point you will need to press “OK” to continue. You have now saved the second data pair for the experiment.
 - Continue adding NaOH solution in increments that raise the pH about 0.20 units and enter the buret reading after each addition. Proceed in this manner until the pH is 3.5.
 - When pH 3.5 is reached, change to 2-drop increments. Enter the buret reading after each increment.
 - After pH 4.5 is reached, again add larger increments that raise the pH by about 0.20 units and enter the buret reading after each addition. Continue in this manner until the pH of 7.5 is reached.
 - When pH 7.5 is reached, change to 2-drop increments. Enter the buret reading after each increment.

- When pH 10 is reached, again add larger increments that raise the pH by 0.20 units. Enter the buret reading after each increment. Continue in this manner until you reach a pH of 11.
7. When you have finished collecting data, click "Stop". Dispose of the beaker contents as directed.
 8. You may link the data to Graphical Analysis program and print the results. A sample graph below show how that data will appear in Graphical Analysis.

Data and Calculations

Mass of diprotic acid	_____ g
Concentration of NaOH	_____ M
1. Equivalence point (indicate the one you will use in the calculations below)	first equivalence point _____ or second equivalence point _____
2. NaOH volume added before and after largest pH increase	_____ mL _____ mL
3. Volume of NaOH added at the equivalence point	_____ mL
4. Moles NaOH	_____ mol
5. Moles of diprotic acid, H ₂ X	_____ mol
6. Molecular weight of the diprotic acid	_____ g/mol
7. Name, formula, and accepted molecular weight of the diprotic acid	_____ g/mol
8. Percent error	_____ %

