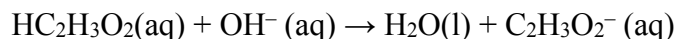


Acid-Base Titration

A titration is a process used to determine the volume of a solution that is needed to react with a given amount of another substance. In this experiment, your goal is to determine the molar concentration of an acid solution by conducting titrations with a base of known concentration. You will be testing a weak acid, $\text{HC}_2\text{H}_3\text{O}_2$, solution. You will use the sodium hydroxide, NaOH , solution that you standardized in Lab 6 as your base of known concentration. The reaction equation is shown below in net ionic form.



In this experiment, you will use a handheld device to monitor pH as you titrate. The region of most rapid pH change will then be used to determine the equivalence point. The volume of NaOH titrant used at the equivalence point will be used to determine the molarity of the acid solutions.

OBJECTIVES

In this experiment, you will

- Accurately conduct acid-base titrations.
- Determine the equivalence point of a weak acid-strong base titration.
- Calculate the molar concentrations of a weak acid solution.

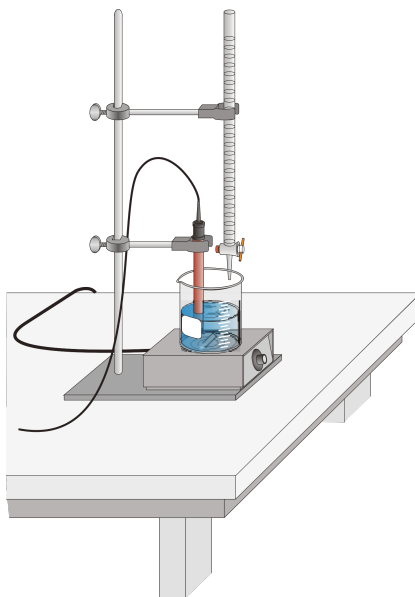


Figure 1

LabQuest 7

CHOOSING A METHOD

You will deliver volumes of NaOH titrant from a buret. You will enter the buret readings manually to store and graph each pH-volume data pair.

MATERIALS

LabQuest	wash bottle
LabQuest App	distilled water
Vernier pH Sensor	ring stand
0.100 M NaOH solution	utility clamp
50 mL buret	250 mL beaker
acetic acid, HC ₂ H ₃ O ₂ , solution, unknown molarity	10 mL pipet with pump
buret clamp	50 mL graduated cylinder
10 mL pipet	

Measuring Volume Using a Buret

1. Obtain and wear goggles.
2. Obtain about 25 mL of an acetic acid solution of unknown concentration. Add 50 mL of distilled water into a separate 250 mL beaker. Use a pipet bulb with a pipet to transfer 10 mL of the HC₂H₃O₂ solution into the beaker.
3. Stir the reaction mixture with a stirring rod during the titration.
4. Connect the pH Sensor to LabQuest and choose New from the File menu. If you have an older sensor that does not auto-ID, manually set up the sensor.
5. Set up a ring stand, buret clamp, and 50.0 mL buret to conduct the titration (see Figure 1). Rinse and fill the buret with 0.100 M NaOH solution. **CAUTION:** *Sodium hydroxide solution is caustic. Avoid spilling it on your skin or clothing.*
6. Use a utility clamp to suspend the pH Sensor on the ring stand, as shown in Figure 1. Position the pH Sensor so that its tip is immersed in the HC₂H₃O₂ solution but is not struck by the stirring bar. Gently stir the beaker of acid solution.
7. On the Meter screen, tap Mode. Change the data-collection mode to Events with Entry. Enter the Name (Volume) and Unit (mL) and select OK.
8. Conduct the titration carefully, as described below.
 - a. Start data collection.
 - b. Before you have added any NaOH solution, tap Keep and enter **0** as the buret volume in mL. Select OK to store the first data pair.
 - c. Add the next increment of NaOH titrant. When the pH stabilizes, tap Keep, and enter the current buret reading as precisely as possible. Select OK to save the second data pair. Enter a new buret reading after each increment.
 - d. Continue adding NaOH solution until the pH value remains constant.

9. Stop data collection to view a graph of pH vs. volume.
10. Dispose of the reaction mixture as directed. Rinse the pH Sensor with distilled water in preparation for the second titration.
11. Examine your titration data to identify the equivalence point.
 - a. To examine the data pairs on the displayed graph, select any data point.
 - b. As you move the examine line, the pH and volume values of each data point are displayed to the right of the graph.
 - c. Identify the equivalence point as precisely as possible and record this information.
 - d. Store the data from the first run by tapping the File Cabinet icon.
12. Repeat the titration with a second and third $\text{HC}_2\text{H}_3\text{O}_2$ solution. Analyze the titration results in a manner similar to your first trial and record the equivalence point in your data table.

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DATA TABLE: Create your own!!!

DATA ANALYSIS

1. What is the molar amount of NaOH used in the reaction with the HC₂H₃O₂ solution.
2. Calculate the molar concentration (molarity) of the HC₂H₃O₂ solution.
3. Compare the actual molar concentration of your acid solution with your calculated molarity. Were the calculated molarity of your acid solution within a reasonable range (about 5%) of the actual values? If not, suggest reasons for the inaccuracy.
4. The equivalence points of this titration is not the same as a the equivalence point when a strong base is titrated to a strong acid. Explain.