



Westminster College

## ACID DISSOCIATION CONSTANT, $K_a$

In this experiment you will:

- Gain experience mixing solutions of specified concentration.
- Experimentally determine the dissociation constant,  $K_a$ , of an acid.
- Investigate the effect of initial solution concentration on the equilibrium constant.

The acid to be used is acetic acid,  $\text{HC}_2\text{H}_3\text{O}_2$ , and its dissociation equation is:

### MATERIALS:

Labquest	wash bottle
Labquest Application	distilled water
pH sensor	100 mL volumetric flask
100 mL beaker	pipets
2.00 M $\text{HC}_2\text{H}_3\text{O}_2$	pipet bulb

### PRE-LAB

1. Write the equilibrium constant expression,  $K_a$ , for the dissociation of acetic acid,  $\text{HC}_2\text{H}_3\text{O}_2$ . (Use box 2 in the Data and Calculations table of this experiment.)
2. You have been assigned two different  $\text{HC}_2\text{H}_3\text{O}_2$  solution concentrations by your teacher. Determine the volume, in mL, of 2.00 M  $\text{HC}_2\text{H}_3\text{O}_2$  required to prepare each. (Show your calculations and answers in Space 4 of the Data and Calculations table.)

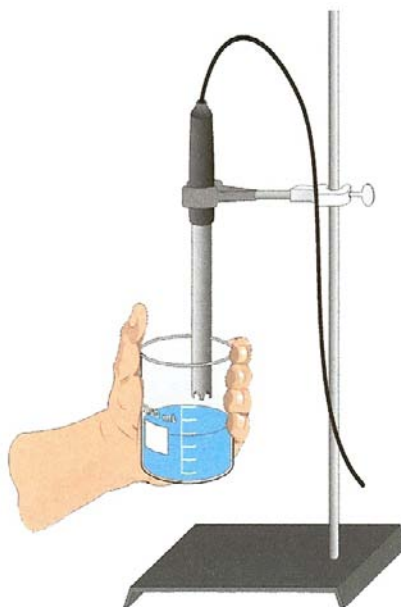


Figure 1

## PROCEDURE:

1. Obtain and wear safety goggles.
2. 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.
3. Put approximately 50 mL of distilled water into a 100 mL volumetric flask.
4. Use a pipet bulb (or pipet pump) to pipet the required volume of 2.00 M acetic acid (calculated in Pre-Lab Step 2) into the volumetric flask. **CAUTION:** *Use care when handling the acetic acid. It can cause painful burns if it comes into contact with your skin or gets into your eyes.* Fill the flask with distilled water to the 100 mL mark. To prevent overshooting the mark, use a wash bottle filled with distilled water for the last few mL. Mix thoroughly.
5. Use a utility clamp to secure the pH Sensor to a ring stand as shown in Figure 1.
6. Determine the pH of your solution as follows:
  - a. Use about 40 mL of distilled water in a 100 mL beaker to rinse the electrode.
  - b. Pour about 30 mL of your solution into a clean 100 mL beaker and use it to thoroughly rinse the electrode.
  - c. Repeat the previous step by rinsing with a second 30 mL portion of your solution.
  - d. Use the remaining 40 mL portion to determine pH. Swirl the solution vigorously. **Note:** Readings may drift without proper swirling! When the pH reading stabilizes, record the pH value displayed on the Meter screen.
  - e. When done, place the pH Sensor in distilled water.
  - f. Discard the acetic acid solution as directed by your teacher.
7. Repeat Steps 3-6 for your second assigned solution.
8. When you are finished, rinse the probe with distilled water and return it to the sensor soaking solution.

## PROCESSING THE DATA:

1. Use the calculator on LabQuest to determine the  $[H^+]_{eq}$  from the pH values for each solution.
2. Use the obtained value for  $[H^+]_{eq}$  and the equation:  
  
to determine  $[C_2H_3O_2]_{eq}$  and  $[HC_2H_3O_2]_{eq}$ .
3. Substitute these calculated concentrations into the  $K_a$  expression you wrote in Step 1 of the Pre-Lab.

4. Compare your results with those of other students. What effect does initial  $\text{HC}_2\text{H}_3\text{O}_2$  concentration seem to have on  $K_a$ ?

**OBSERVATIONS:****DATA TABLE:**

1. Assigned concentration	M	M
2. Measured pH		
3. $K_a$ expression		
4. Volume of 2M acetic acid	mL	mL
5. $[\text{H}^+]_{\text{eq}}$	M	M
6. $[\text{C}_2\text{H}_3\text{O}_2^-]_{\text{eq}}$	M	M
7. $[\text{HC}_2\text{H}_3\text{O}_2]_{\text{eq}}$	M	M
8. $K_a$ calculation		