

Colorado State University
CHEM 431
Instrumental Analysis Chemistry Laboratory

Notes for
Measurement of the pKa of a Weak Acid

The following is a set of short notes to outline the experiment in question and to provide helpful guidance to those executing the experiment.

- A. It is now well known that the dissociation constant (K_a) of acetic acid is roughly 2×10^{-5} M at 25° C. How do we know the numerical value of this constant?
- B. Fundamentally, the degree of dissociation of the acetic acid molecule must be measured (perhaps at a number of initial concentrations of acetic acid). The concentrations of hydronium ion, acetate ion and acetic acid must be measured and the equilibrium equation for the dissociation solved.
- C. Use a pH probe and meter to measure the concentration of hydronium ions in a series of solutions of acetic acid. Start with a 1.0 M concentration (make no more than 250 mL of this solution). Decide how much solution is required to complete a pH determination (including rinsing out of glassware, the pH probe, etc.). Prepare a series of solutions of various concentrations of acetic acid from the initial solution and measure their pH values. Use a logarithmic scale of acetic acid concentrations to span a range of at least four decades of concentration. (What the heck does this mean?) Also, prepare enough solutions so that you have at least two concentrations in each decade.
- D. Analyze your data to determine how much the pKa of acetic acid varies with initial concentration.
- E. Repeat this process using three chlorinated acetic acids (monochloroacetic acid, dichloroacetic acid and trichloroacetic acid). Use the *minimum* amount of each of these three compounds – be green.
- F. Analyzed these data and present the results on a single, unified figure.