Determination of an Equilibrium Constant with Spectrophotometry

Procedure

Accurately (to 3 sf) prepare 200 mL (or 250 mL) of a solution of bromocresol green, bromophenol blue or bromocresol purple (as assigned) indicator, from solid, which is about 0.0001 M. These indicators may require a significant amount of sodium hydroxide to aid dissolution. The pH may be adjusted later. Obtaining this concentration may require *serial dilution*. Only the final solution need have a volume of 200 mL.

To a 100 mL volumetric flask, add 25 mL of your indicator solution, add HCl until very acid (pH<2). Dilute to the mark and mix well. In another 100 mL volumetric flask, add 20 mL of indicator solution and NaOH until very basic (pH>10). Dilute to the mark and mix well. Use the indicator colors changes as pH guidelines then determine the pH with a glass electrode. Make a third solution with an intermediate pH. You should adjust the pH as necessary so that the intermediate solution also is of "intermediate" color. Do this carefully, dilution may affect the color of this solution. For each solution, it is important to know the pH (measure with glass electrode) and formal concentration of indicator (calculate from mass and with dilutions) as precisely as possible. Colors should be dilute enough to see through

You may do the dilutions using 10 mL aliquots and 50 mL of total solution instead.

Measure the entire spectrum of your intermediate solution compound, and determine the two values of λ_{max}. If the spectrophotometer goes off scale, dilute your solutions and try again. It may take several trials to find the best concentration for each solution. Hint: how dark were your standard addition samples? You should be able to see through the solutions you measure.

For all three solutions, measure the absorbance at BOTH values of λ_{max} determined with the intermediate solution. Make sure absorbance values for all three solutions are determined with the same instrument, however the λ_{max} values may be determined with a different one.

Calculate the K_a of the indicator using Beer's Law for mixtures. You may assume that in the acidic solution, essentially all the indicator is in its acidic form and that in the basic solution essentially all the indicator is present in its basic form.