Names _____

Workshop: Titration Curves

A pH titration is performed by adding small amounts of a titrant (usually a strong base) to a solution (usually a weak acid) and simultaneously monitoring the changes in the solution's pH. A typical titration would be to add small amounts of sodium hydroxide solution to a weak acid solution. In this case, the pH during the titration is related to the pK_a of the weak acid.

During the titration, acid is being converted to its conjugate base, and a buffer solution is formed. Eventually, the quantity of base added is such that all of the acid has been converted to its conjugate base, and the equivalence point of the titration has been reached. The solution is no longer a buffer at the equivalence point.

1. When a strong base is gradually added dropwise to a weak acid, the pH changes at each addition. When the appropriate quantity of base has been added to react with all of the acid, the pH changes sharply, indicating the endpoint of the titration. A plot of pH versus volume of base added gives what is known as a titration curve.

   Consider the titration of 25.00 mL of 0.1000 M benzoic acid with 0.1000 M NaOH,.

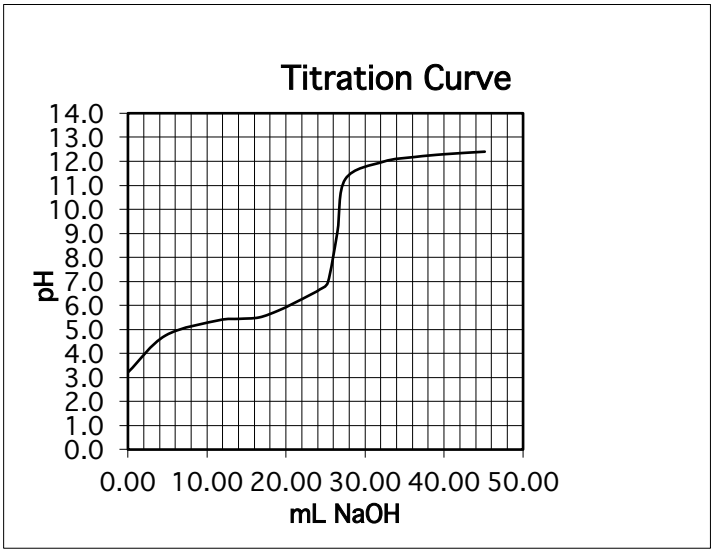
   (a) Write a balanced chemical equation for the titration reaction using C_6H_5COOH for benzoic acid's formula.

   (b) Determine the volume of NaOH solution required to reach the endpoint.

2. The chart below has entries for several steps along the titration curve. To calculate the pH at each step, you first must understand the chemistry at that step, and then you can decide the appropriate method to calculate the pH. For each volume listed, (i) list the major species in solution, (ii) determine whether the K_a equation, K_b equation, buffer equation, or solution equilibrium equation is appropriate for the calculation of the solution $[H_3O^+]$ and pH, and (iii) complete the calculations.

Volume NaOH Added (mL)	Major Species	Appropriate Equation	$[H_3O^+]$	pH
0.00				
5.00				
12.50				
20.00				
25.00				
30.00				

3. A scientist from a team of chemists and clinical oncologists extracted, separated, and purified a natural product from a plant of the *datura sp.,* which was collected in the Amazon Basin. Initial data indicated that the structurally complicated compound likely contained a weak monoprotic carboxylic acid function. The scientist weighed 252.8 mg of the purified compound. She then used it to prepare 250.00 mL of aqueous solution, and then titrated the solution with 0.01000 M NaOH. Her titration curve is shown below. Answer the accompanying questions; show your calculations and attach to the Worksheet.



How many moles of the compound were in the sample?

What is the molar mass of the compound?

What is the pK_a of the compound?