

unknown		of unknown	
Molar Mass of unknown	9.5590g/mol	Mol of NaOH	13.47mL

Vol	pH	Vol	pH
1/4	7.000868	13.47	7.6028
1/2	7.3019	15.47	7.6630
3/4	7.4779		

II. Discussion

In the identification of the unknown the molecular weight had to be determined by converting the volume of NaOH to moles of acid, which was divided to the weight of the unknown acid. The result was 128.76g/mol and the nearest molecular weight from the chart given was anilinium hydrochloride, which was 129.59g/mol. The pH was derived from the equation from the graph as x was substituted by the volume of NaOH, 13.47mL, at equivalence point giving a pH of 4.06. This, however, is not close to the pH of anilinium hydrochloride as given in the chart. The volume of NaOH, 13.47mL, was determined from the equation of the graph by using the Quadratic Formula $[(-b \pm \sqrt{b^2 - 4ac}) \div 2a]$, where it is the average of the two points from the equation.

The theoretical curve determined by getting 1/4, 1/2, 3/4, 5/4, 3/2 of the volume at equivalence point, as well as the equivalence point itself. These were then multiplied with the Molarity of NaOH 0.1012 to get the moles. The values were used in the equation to get the pH with 4.60 as the pKa value. The results were then plotted in a graph. The theoretical curve was relatively close to the actual curve with possible errors, although this could mean the unknown acid should be different but if the molecular weight is to be followed, anilinium hydrochloride is the closest to the result. The molar mass of the unknown acid was also computed to be 5.990g/mol using the moles of the acid, volume of NaOH at equivalence point and weight of the unknown acid.

III. Conclusion

The unknown acid was determined to be anilinium hydrochloride as it had the closest molecular weight to the result, which was 128.76g/mol with a molar mass of 5.990g/mol. The theoretical and actual curves are relatively similar to each other but not relatively close as seen in the graph. This could be due to incorrect unknown acid used, though their molecular weights are close, which served as the basis for using this unknown acid. The equivalence point of the graph is also the volume of NaOH, which is 13.47mL. The pKa of the unknown acid was 4.06, which is also its pH.

IV. Calculations

$$M \text{ NaOH} = 0.1012 \quad pK_a = pH - \log \frac{[A^-]}{[HA]}$$

$$1. \ y = 0.1997 - \frac{(0.514)^2}{4 - (0.0012)} = 0.3507$$

$$0.3507 = -0.0012x^2 + 0.0514x - 0.1997 \quad \rightarrow \quad x = 21.33 \quad y = 0.3507 \text{ 1}^{\text{st}} \text{ derivative}$$

2. From 1st graph:

$$y = -0.0024x^3 + 0.097x^2 - 0.6564x + 4.8108 \\ = -0.0072x^2 + 0.194x - 0.6564$$

$$\frac{-(0.194 \pm \sqrt{(0.194)^2 - 4(-0.0072)(-0.6564)}}{2(-0.0072)} = (3.968, 22.977) = 13.47\text{mL NaOH}$$

$$13.7\text{mL NaOH} \times \frac{0.1092 \text{ mol NaOH}}{1 \text{ L}} \times \frac{1 \text{ L}}{1000\text{mL}} \times \frac{1 \text{ mol acid}}{1 \text{ mol NaOH}} = 0.001363 \text{ mol acid}$$