

Acid and Base Titrations

Chemistry 101: *General Chemistry*

Post-Lab & Lab Report #6



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January 25, 2020

Acid and Base Titrations

Purpose:

Titration is a commonly used analytical technique to determine the amount of chemical in a sample by using a standardized reagent solution (titrant). The point using a titration is called end point of analyte solution by balanced equation. In part III & part IV help us determine the molarity of HCl and standardizing the sodium hydroxide solution by using titration process. To determine the chemical amount of reacted in chemical reaction.

Procedures:

Part I: Preparing titrant Solutions. .25 M Sodium hydroxide 500 mL and about 300 mL of approximately 0.35 M HCl from the 6 M solution on the lab bench. We need 20.83 ml of NaOH from the 6 M bench top to dilute to 0.25 M NaOH then add water up to 500 mL to its solution. Then we prepare 0.35 M of HCl by using 6 M top bench to dilute it down to 0.35 M of HCl for 300 ml. So we need 17.5 mL of HCl from the top bench to dilute in down then add the amount the water to reach up 300 mL, so that is the end of part I.

Part III: from pre-lab question: Weigh out .2363 gram of $\text{H}_2\text{C}_2\text{O}_4$ then prepare buret with your dilute titrant (NaOH) to titrate the solution of above then add 50 mL deionized water to the flask which you put the substance from the beginning. Then wait it to dissolve in the water or boiling it if it is not dissolving. Used phenolphthalein as the indicator to determine maximum of neutralization of solution. Then titrate it and record initial buret volume then final when it turns pink. Repeat it for 3 times then do calculation.

Part IV: use a buret to put an amount of 10 ml of HCl to each 3 flask to titrate in the solution. Then used indicator phenolphthalein added 4 drop then titrate with NaOH to determine the molarity of HCl by the balanced equation by the mole ratio and molarity from part I which you can get the number from.

Part V: get a sample of unknown substance and divided as 4 trial with equal amount of substance you get. Then add a water then titrate it with NaOH. Measure the buret and then do calculation.

Part VI: get a sample of unknown substance and divided as 4 trial with equal amount of substance you get. Then up about 20 mL of your dilute HCl then put in

the hot plate to heat it up to release a bubble of carbon dioxide. Then wait it cool down and titrate with NaOH.

Data:

Part III: Morality of NaOH

	Trial 1	Trial 2	Trial 2
Mass of empty vial (g)	6.1908g	6.1914g	6.2515g
Mass of vial + acid	6.5213g	6.4608g	6.4695g
Mass empty vial after transfer(g)	6.1913g	6.1913g	6.2513g
Mass of oxalic acid used (g)	.3300g	.2695 g	.2180g
Base: Initial buret reading	0.0 mL	0.0 ml	0.0 ml
Base: final buret reading	22.5 mL	18.9mL	15.5 mL
NaOH: total volume added (mL)	22.5 mL	18.9 mL	15.5 mL
NaOH Concentration (m/L)	0.2326 mol/Liter	.2257 mol/L	.2229 mol/L
Average NaOH concentration	.22705 mol/L	.22705 mol/L	.22705 mol/L
Deviation from average	0.00557	0.00145	.00415
Relative deviation (ppt)	24.4	6.386	18.27
Average Relative Deviation (Ppt)	16.35	16.35	16.35
Difference from Average of relative Devaition	8.048	9.966	19.2

Part II & IV: Morality of HCl

	Trial 1	Trial 2	Trial 2
Acid initial reading	0.0 mL	9.9mL	20.2mL
Acid final reading	9.9mL	20.0 mL	30.1mL
Total acid added	9.9mL	10.1mL	9.9mL
Base: Initial buret reading	0.1 mL	15.4 ml	8.5 ml
Base: final buret reading	15.4 mL	30.9mL	23.8 mL
Total base added	15.3	15.5mL	15.3 mL
HCl Concentration (m/L)	0.3509 mol/Liter	.3584 mol/L	.3509 mol/L
Average HCl concentration	0.35007 mol/L	0.35007 mol/L	0.35007 mol/L
Deviation from average	0.000815	0.00167	.000815
Relative deviation (ppt)	2.33	4.77	2.33
Average Relative Deviation (Ppt)	3.143	3.143	3.143
Difference from Average of relative Devaition	.813	1.627	.0813

We can calculate the morality of HCl by using mol ratio between of mole of HCl and NaOH 1:1 by using morality of what we get from part #3 the average morality of NaOH times with Litter measure of NaOH then we get a mole of HCl then using the mole / liter equation of ratio of HCl which is 9.9 to 10.1 mL then convert that to liter. You divide with mole you got then with liter you put. So you will get the morality of HCl

Part V: Equivalent Mass of an Unknown Solid Acid : 115 R

	Trial 1	Trial 2	Trial 2
Mass of empty vial (g)	6.1940g	6.2726g	6.2591g
Mass of vial + acid	6.3080g	6.3922g	6.3770g
Mass empty vial after transfer(g)	6.2200g	6.2726g	6.2508g
Mass of unknown acid used (g)	.088g	.1196 g	.1262g
Base: Initial buret reading	11.5 mL	16.1 ml	22.7 ml
Base: final buret reading	16.1 mL	22.7mL	29.6 mL
NaOH: total volume added (mL)	4.6 mL	6.6 mL	6.9 mL
Molar mass of unknown (g/mol)	82.5 g/mol	82.1 g/mol	80.55g/mol
Average molar of mass of	81.72g/mol	81.72g/mol	81.72g/mol
Deviation from average	.78	.38	1.17
Relative deviation (ppt)	9.54	4.65	14.3
Average Relative Deviation (Ppt)	9.50	9.50	9.50
Difference from Average of relative Devaition	.04	4.85	4.8

By using mole morality of NaOH so we can find the mole of Acid but we are not actually know the mole ratio between acid and NaOH but we can consider it as 1:1 we got grams we measure divide by the mole we got so we will get the molar mass of each trial. Then we find the deviation and relative deviation of each trial.

Part VI: Percent Carbonate in Unknown Salt

	Trial 1	Trial 2	Trial 2
Mass of empty vial (g)	6.1917g	6.2487g	6.1953g
Mass of vial + acid	6.3215g	6.3753g	6.3220g
Mass empty vial after transfer(g)	6.1957g	6.2500g	6.1938g
Mass of unknown acid used (g)	.1258g	.1253 g	.1282g
Acid initial reading	0.0 mL	20.0mL	28.0mL
Acid final reading	20.0mL	40.0 mL	48.0mL
Total acid added	20.0mL	20.0mL	20.0mL
Base: Initial buret reading	0.0 mL	15.5 ml	24.0 ml
Base: final buret reading	15.5 mL	31.3mL	39.8 mL
Total base added	15.5	15.8mL	15.8mL
Average NaOH concentration	.22705 mol/L	.22705 mol/L	.22705 mol/L
Average HCl concentration	0.35007 mol/L	0.35007 mol/L	0.35007 mol/L
Mole of HCl added initially	.0070014 mol	.0070014 mol	.0070014 mol
Mole of Excess NaOH reacted with HCl	.0035912 mol	.00358739 mol	.00358739 mol
Mole of HCl reacted with Carbonate Ion	.0034102 mol	.00341401 mol	.00341401 mol
Mole of Carbonate ion	.0017051 mol	.001707005 mol	.001707005 mol
Gram of Carbonate produced	.102323051g	.1024373701 g	.1024373701 g
Percent carbonate in	81.33 %	81.75 %	79.90 %

Unknown			
Average Percent carbonate in Unknown	80.99%	80.99%	80.99%
Deviation from average	.34	.76	1.09
Relative deviation (ppt)	4.07	9.38	13.53
Average Relative Deviation (Ppt)	8.99	8.99	8.99
Difference from Average of relative Devaition	4.92	.039	4.54

We find the mole react from HCl and mole excess of HCl from NaOH then we will find the mole reacted from subtracting the mole of both then we use mole ratio of $\text{H}:\text{CO}_3^{2-}$ which is 2:1 so we divide by 2 then we get the mole CO_3^{2-} carbonate produced in the reaction then we will find the gram to using the molar mass of carbonate is equate 60.01 gram/mol. Then you will get the number then we divide by g we used in the experiment *100 we will get the percent of carbonate in the solution.

Results:

	Average value	Average Relative Deviation (ppt)
Average NaOH concentration	.22705 mol/L	16.35
Average HCl concentration	0.35007 mol/L	3.143
Unknown number part V	115R	
Average molar of mass of	81.72g/mol	9.50
Unknown number part VI	220R	
Average Percent carbonate in Unknown	80.99%	8.99

Conclusion:

Part III: An average relative deviation on part III is relatively high because masses we measure are relatively wide of precision, but the average of molarity is relatively close to the experiment we want it to be. If we measure the masses and volumes accurately, we can find the relatively small deviation between the average and the molarity itself. It is hard to do because the mass and weighting scale relative inaccurate with the result.

The result from part II & IV is pretty precise and accurate because we just measure the buret only, regardless measure the mass at the scale, and it will be relatively small number of relative deviation of the experiment.

Part V the number of molar is in range and relatively close to what we want to see. Its accuracy and average are relatively small. By doing so many experiment in this part so we got the resolution for the experiment.

Part VI: the experiment went pretty well by measuring masses in vial and relatively close to each other and the amount acid we put is the same, so it would be calculated precisely. Percent of carbon is relatively close to each other by considering it. The number from part VI is pretty good, I guess.

Part I : just preparing the solutions for experiments