

Data Tables

NOTE: Data from this lab including logger pro data tables were obtained from Ashley Wong - 8173905 and her partner Dominique Lalonde – 7804245. Calculations were done separately.

Table 1. Formation of a stock solution of NaOH

Volume of concentrated NaOH solution (mL)	5.00 ml
Concentration of concentrated NaOH solution (M)	6.0 M
Volume of stock solution after dilution (mL)	255.0 ml
Approximate concentration of stock solution (M)	0.1176 M

Table 2. Standardization of Stock Solution of NaOH

Data	Trial 1	Trial 2
Concentration of Standard Acid solution (M)	0.1000 M	0.1000 M
Volume of Standard Acid solution (mL)	$V_i = 4.21$ ml $V_f = 14.18$ ml $V_t = 9.97$ ml	$V_i = 14.18$ ml $V_f = 24.20$ ml $V_t = 10.02$ ml
Volume of stock solution of NaOH (mL)	9.387 ml	9.953 ml
Concentration of stock solution of NaOH (M)	Observed: 0.106 M Logger Pro: 0.103 M	Observed: 0.101 M Logger Pro: 0.0979 M
Average Concentration of stock solution of NaOH (M)	0.100425 M	

Table 3. Determination of the Concentration of an Unknown Acid

Data	Trial 1	Trial 2
Sample Number of Unknown Acid	1	1
Volume of Unknown Acid solution (mL)	$V_i = 5.89 \text{ ml}$ $V_f = 15.90 \text{ ml}$ $V_t = 10.01 \text{ ml}$	$V_i = 3.39 \text{ ml}$ $V_f = 13.45 \text{ ml}$ $V_t = 10.06 \text{ ml}$
Volume of stock solution of NaOH (mL)	10.802 ml	10.802 ml
Concentration of stock solution of NaOH (M)	0.100425 M	0.100425 M
Concentration of Unknown Acid Solution (M)	Observed: 0.0542 M Logger Pro: 0.0552 M	Observed: 0.0539 M Logger Pro: 0.0532 M
Average Concentration of Unknown Acid solution (M)	$= 0.054167845\text{M}$ $\approx 0.0542 \text{ M}$	

Observations (all parts of the experiment):

- NaOH is a clear and colorless liquid with no smell.
- Addition of water to dilute NaOH made no physical change
- Phenolphthalein is clear and colorless.
- There was no color or odor change to the unknown acid when Phenolphthalein was added.
- Once a specific amount of NaOH was added to the acid, the solution started to turn light pink.
- Addition of more NaOH to the acid continued to darken the pink colored solution.
- No smell. Translucent dark pink color.

Table 4. Determination of the Mass Percentage of Acid in a Juice

Data	Trial 1	Trial 2
Sample Number of Juice	1	1
Volume of Juice (mL)	$V_i = 4.49$ ml $V_f = 14.51$ ml $V_t = 10.02$ ml	$V_i = 9.870$ ml $V_f = 19.72$ ml $V_t = 10.02$ ml
Volume of stock solution of NaOH (mL)	8.679 ml	8.443 ml
Concentration of stock solution of NaOH (M)	0.100425 M	0.100425 M
Concentration of acid in Juice (M)	Observed: 0.0290 Logger Pro: 0.0296	Observed: 0.0282 M Logger Pro: 0.0290 M
Average Concentration of Acid in Juice (M)	= 0.02931067M ≈ 0.0293 M	
Density of Juice (g/mL)	0.9974 g/ml	
Molar Mass of acid in Juice (g/mol)	192.124 g/mol	
Mass Percent of Acid in Juice (%)	0.564%	

GRAPHS: Attach Logger Pro data tables AND graphs (at least 6 [2 per part]) to this form!!

Table 1: pH & Derivative of Diluted NaOH Solution and standard acid – Trial 1 and Trial 2

Trial 1			Trial 2		
Volume (ml)	pH	FD	Volume (ml)	pH	FD
0.000	2.08	0.000	0.000	1.86	0.006
0.047	2.08	0.000	0.047	1.86	0.012
0.094	2.08	0.000	0.094	1.86	0.027
0.142	2.08	0.000	0.142	1.86	0.000
0.189	2.08	0.003	0.189	1.86	-0.024

0.236	2.08	0.013	0.236	1.86	0.003
0.283	2.08	0.041	0.283	1.86	0.036
0.330	2.08	0.041	0.330	1.86	0.042
0.377	2.08	0.013	0.377	1.86	0.024
0.425	2.08	0.003	0.425	1.86	0.042
0.472	2.08	0.000	0.472	1.87	0.042
0.519	2.08	0.000	0.519	1.87	0.021
0.566	2.08	0.000	0.566	1.87	0.035
0.613	2.08	0.000	0.613	1.87	0.013
0.660	2.08	0.000	0.660	1.87	0.013
0.708	2.08	0.003	0.708	1.87	0.032
0.755	2.08	0.012	0.755	1.87	0.009
0.802	2.08	0.039	0.802	1.87	0.003
0.849	2.09	0.042	0.849	1.87	0.003
0.896	2.09	0.024	0.896	1.87	0.012
0.943	2.09	0.042	0.943	1.87	0.042
0.991	2.09	0.042	0.991	1.88	0.054
1.038	2.09	0.028	1.038	1.88	0.066
1.085	2.09	0.056	1.085	1.88	0.095
1.132	2.10	0.080	1.132	1.89	0.092
1.179	2.10	0.054	1.179	1.89	0.054
1.226	2.10	0.027	1.226	1.89	0.018

**Table 2: pH & Derivative of Diluted NaOH Solution and unknown acid –
Trial 3 and Trial 4**

Trial 3			Trial 4		
Volume (ml)	pH	FD	Volume (ml)	pH	FD
0.000	1.915	0.019	0.000	1.982	-0.130
0.047	1.915	0.033	0.047	1.977	-0.137
0.094	1.920	0.013	0.094	1.967	-0.105
0.142	1.915	0.013	0.142	1.967	-0.068
0.189	1.920	0.032	0.189	1.961	-0.047
0.236	1.920	0.009	0.236	1.961	-0.013
0.283	1.920	0.003	0.283	1.961	-0.003
0.330	1.920	0.000	0.330	1.961	-0.003
0.377	1.920	0.000	0.377	1.961	-0.012
0.425	1.920	0.000	0.425	1.961	-0.039
0.472	1.920	0.000	0.472	1.956	-0.039
0.519	1.920	0.003	0.519	1.956	-0.012
0.566	1.920	0.012	0.566	1.956	-0.006
0.613	1.920	0.039	0.613	1.956	-0.012
0.660	1.925	0.039	0.660	1.956	-0.039
0.708	1.925	0.015	0.708	1.951	-0.036
0.755	1.925	0.015	0.755	1.951	0.000
0.802	1.925	0.042	0.802	1.951	0.036
0.849	1.930	0.051	0.849	1.956	0.039
0.896	1.930	0.053	0.896	1.956	0.012
0.943	1.936	0.044	0.943	1.956	0.003

0.991	1.936	0.013	0.991	1.956	0.003
1.038	1.936	0.003	1.038	1.956	0.012
1.085	1.936	0.000	1.085	1.956	0.039
1.132	1.936	0.003	1.132	1.961	0.039
1.179	1.936	0.015	1.179	1.961	0.012
1.226	1.936	0.054	1.226	1.961	0.003

**Table 3: pH & Derivative of Diluted NaOH Solution and unknown juice –
Trial 5 and Trial 6**

Trial 5			Trial 6		
Volume (ml)	pH	FD	Volume (ml)	pH	FD
0.000	2.798	-0.028	0.000	2.834	0.006
0.047	2.793	0.046	0.047	2.834	0.016
0.094	2.803	0.072	0.094	2.834	0.039
0.142	2.803	0.034	0.142	2.840	0.045
0.189	2.803	0.051	0.189	2.840	0.042
0.236	2.809	0.069	0.236	2.840	0.113
0.283	2.809	0.122	0.283	2.850	0.191
0.330	2.819	0.191	0.330	2.860	0.221
0.377	2.829	0.216	0.377	2.871	0.250
0.425	2.840	0.235	0.425	2.886	0.237
0.472	2.850	0.272	0.472	2.891	0.249
0.519	2.865	0.298	0.519	2.907	0.305
0.566	2.881	0.279	0.566	2.927	0.235
0.613	2.891	0.267	0.613	2.927	0.194
0.660	2.902	0.332	0.660	2.938	0.295
0.708	2.927	0.311	0.708	2.958	0.341
0.755	2.933	0.258	0.755	2.974	0.318
0.802	2.948	0.271	0.802	2.989	0.267
0.849	2.958	0.286	0.849	2.995	0.291
0.896	2.974	0.321	0.896	3.020	0.270
0.943	2.989	0.343	0.943	3.020	0.249
0.991	3.010	0.304	0.991	3.036	0.381
1.038	3.015	0.316	1.038	3.062	0.415
1.085	3.036	0.408	1.085	3.072	0.487
1.132	3.056	0.445	1.132	3.113	0.435
1.179	3.077	0.471	1.179	3.118	0.287
1.226	3.108	0.368	1.226	3.134	0.252

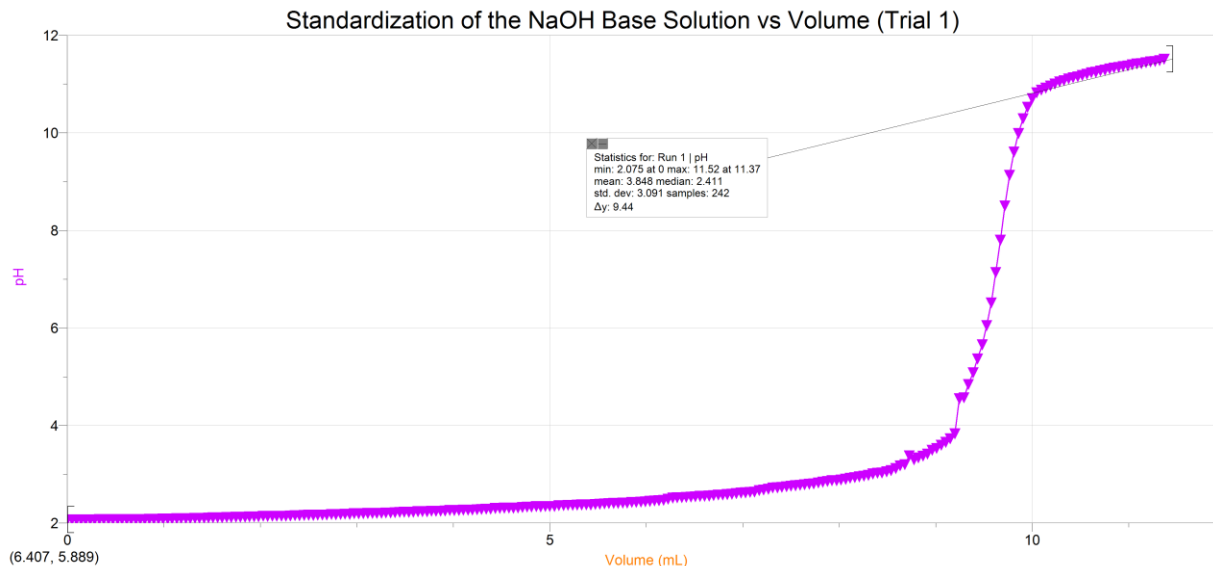


Figure 1: Run 1 of Standardizing the diluted NaOH solution. Trial 1 of the experiment, this graph is a representation of the pH increase as diluted NaOH is added to standard 0.1M HCl acid.

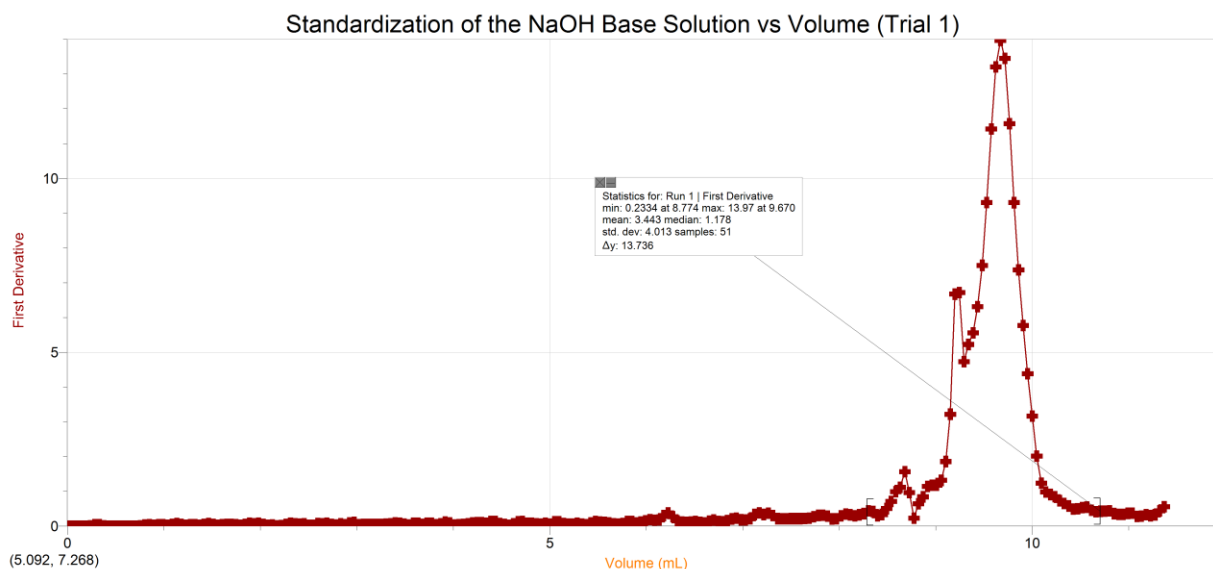


Figure 2: This graph is a representation of the First Derivative of the pH graph for trial 1. This graph shows us the equivalence point of when there is an equal amount of acid and base present in the solution, the equivalence point is reached at 9.670ml of added base.

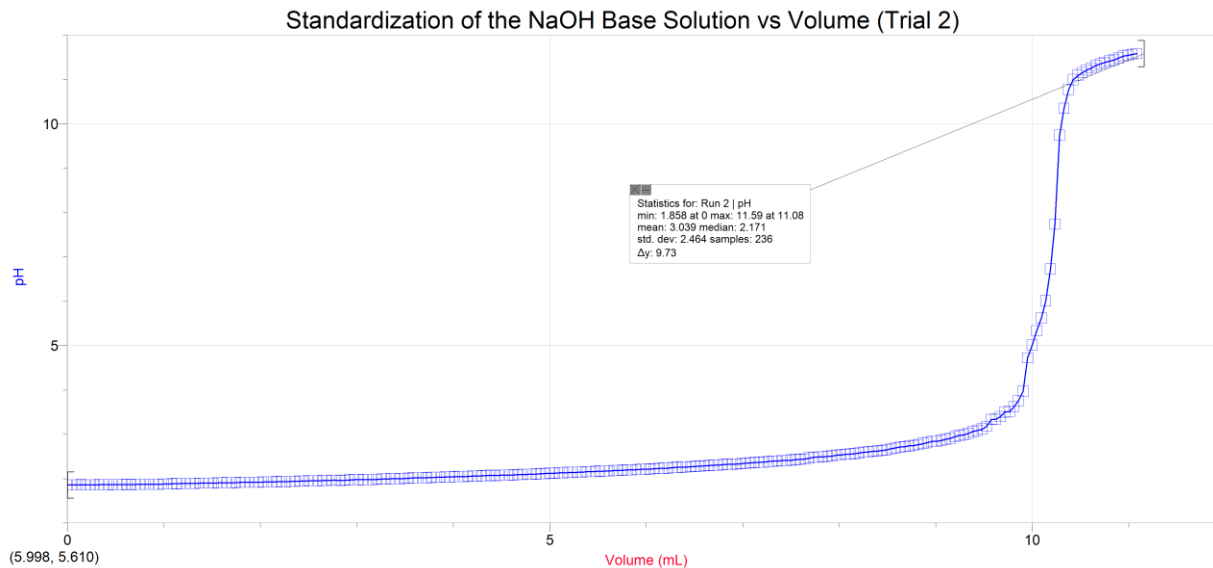


Figure 3: Run 2 of Standardizing the diluted NaOH solution. Trial 2 the experiment, this graph is a representation of the pH increase as diluted NaOH is added to standard 0.1M HCl acid.

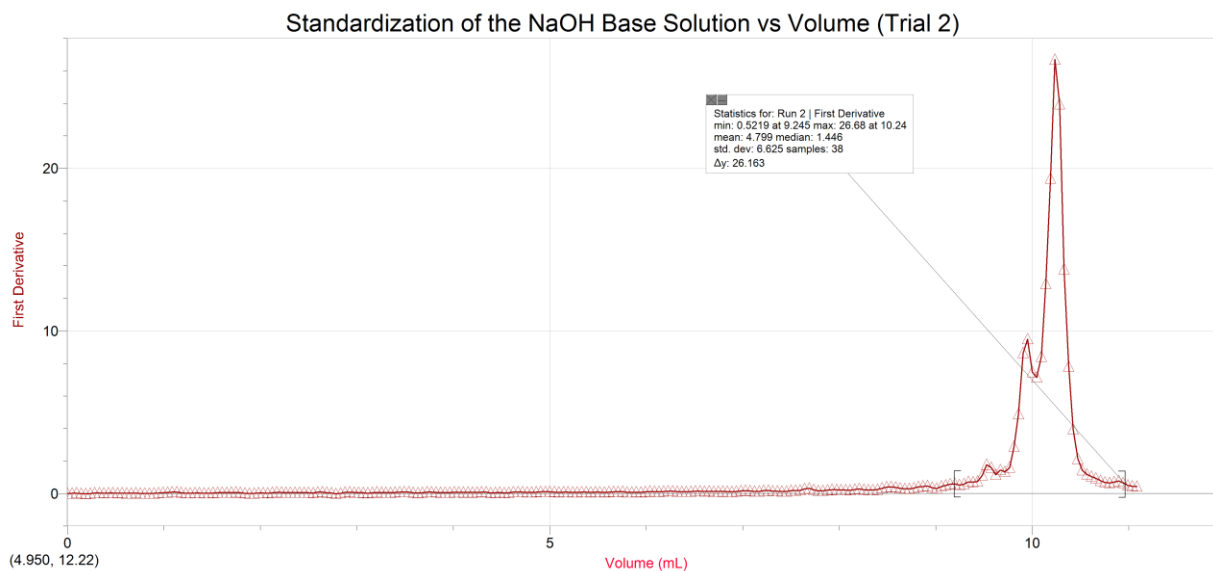


Figure 4: This graph is a representation of the First Derivative of the pH graph for trial 2. This graph shows us the equivalence point of when there is an equal amount of acid and base present in the solution, the equivalence point is reached at 10.24ml of added base.

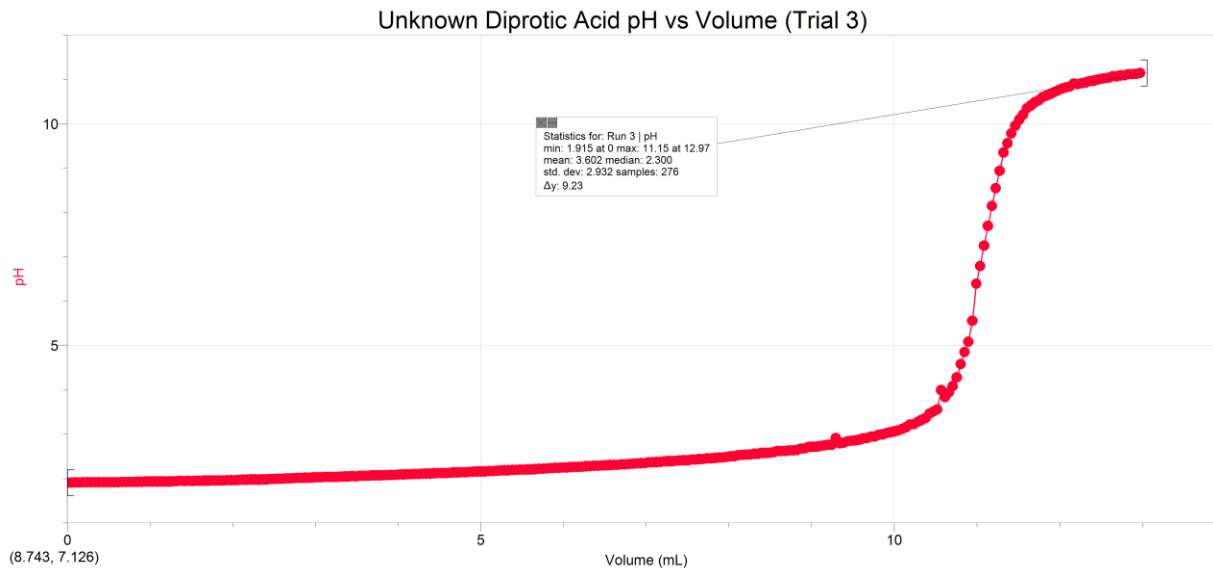


Figure 5: Run 1 of determining the concentration of an unknown acid. Trial 3 of the experiment, this graph is a representation of the pH increase as diluted NaOH is added to the unknown diprotic acid #1

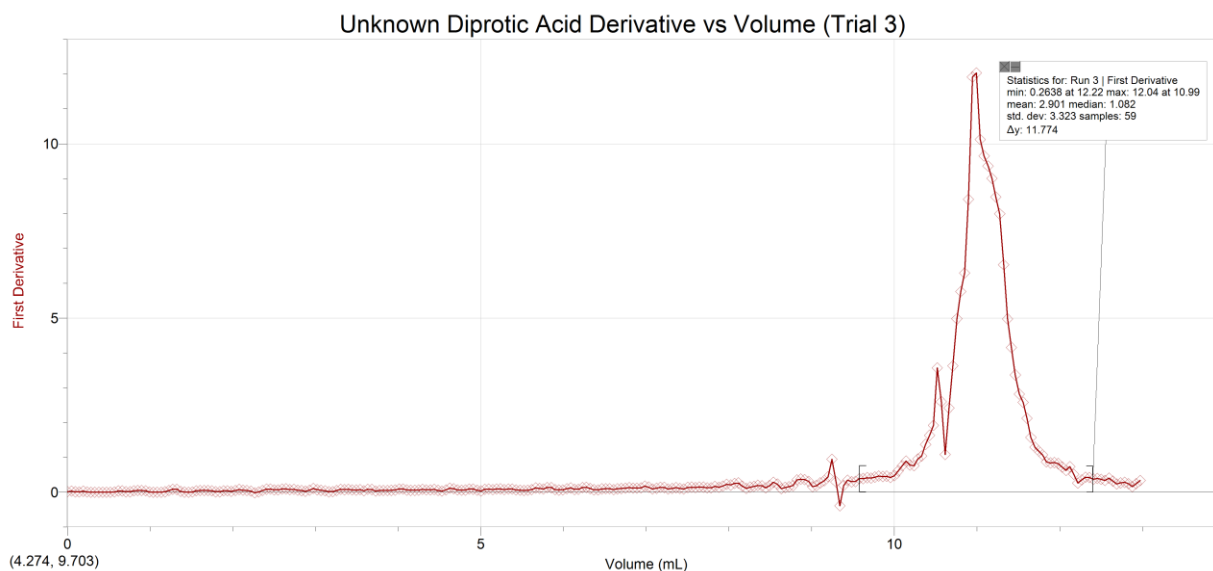


Figure 6: This graph is a representation of the First Derivative of the pH graph for trial 3. This graph shows us the equivalence point of when there is an equal amount of acid and base present in the solution, the equivalence point is reached at 10.99ml of added base.

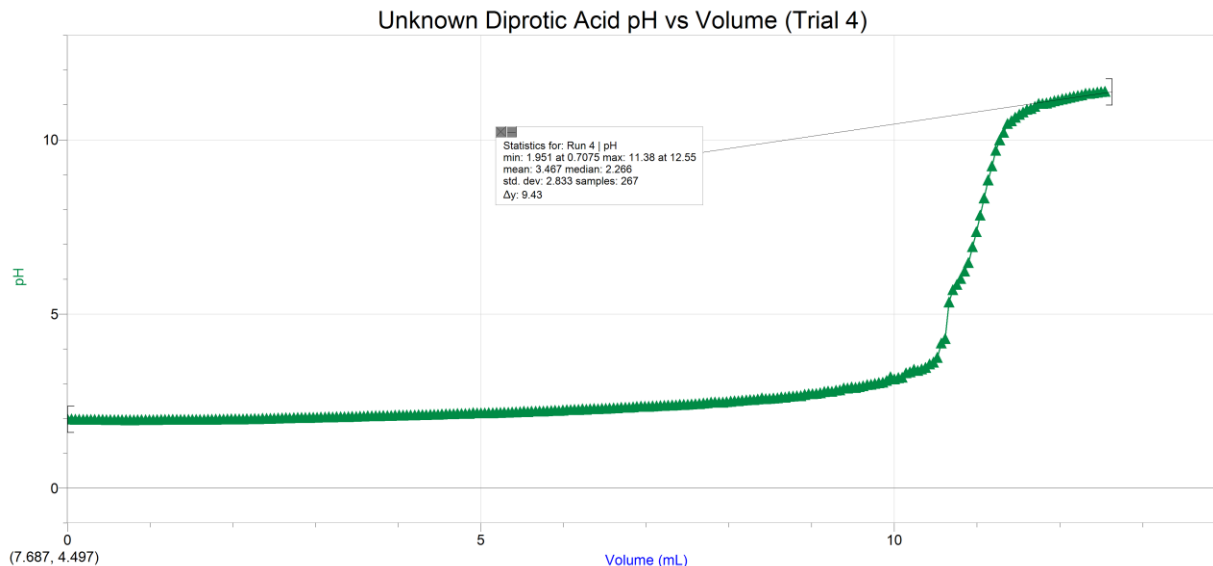


Figure 7: Run 2 of determining the concentration of an unknown acid. Trial 4 of the experiment, this graph is a representation of the pH increase as diluted NaOH is added to the unknown diprotic acid #1

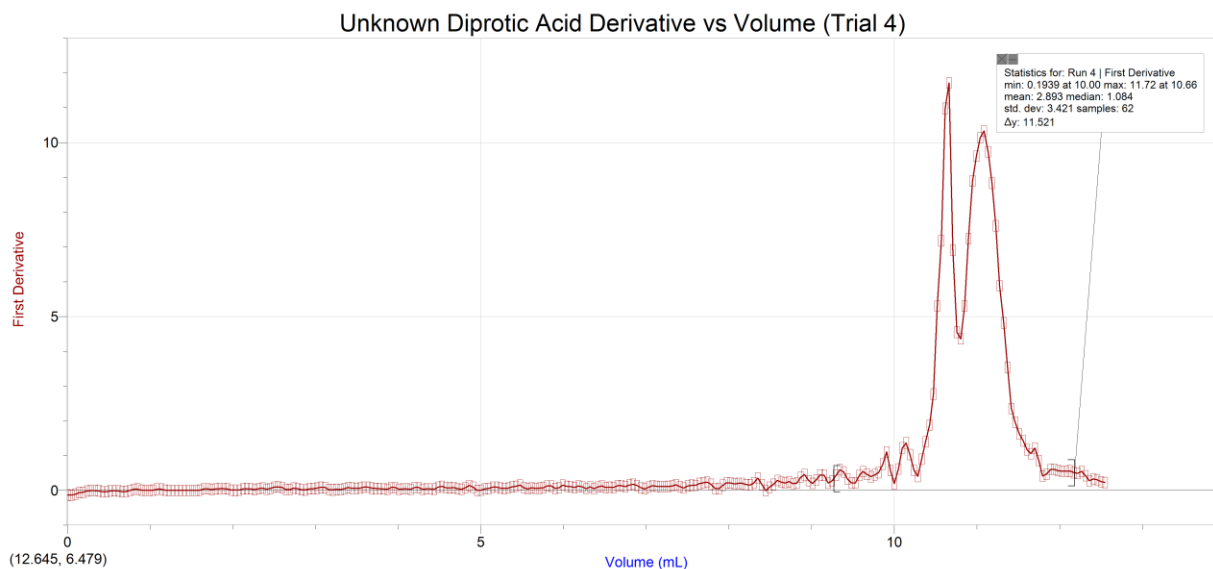


Figure 8: This graph is a representation of the First Derivative of the pH graph for trial 4. This graph shows us the equivalence point of when there is an equal amount of acid and base present in the solution, the equivalence point is reached at 10.66ml of added base.

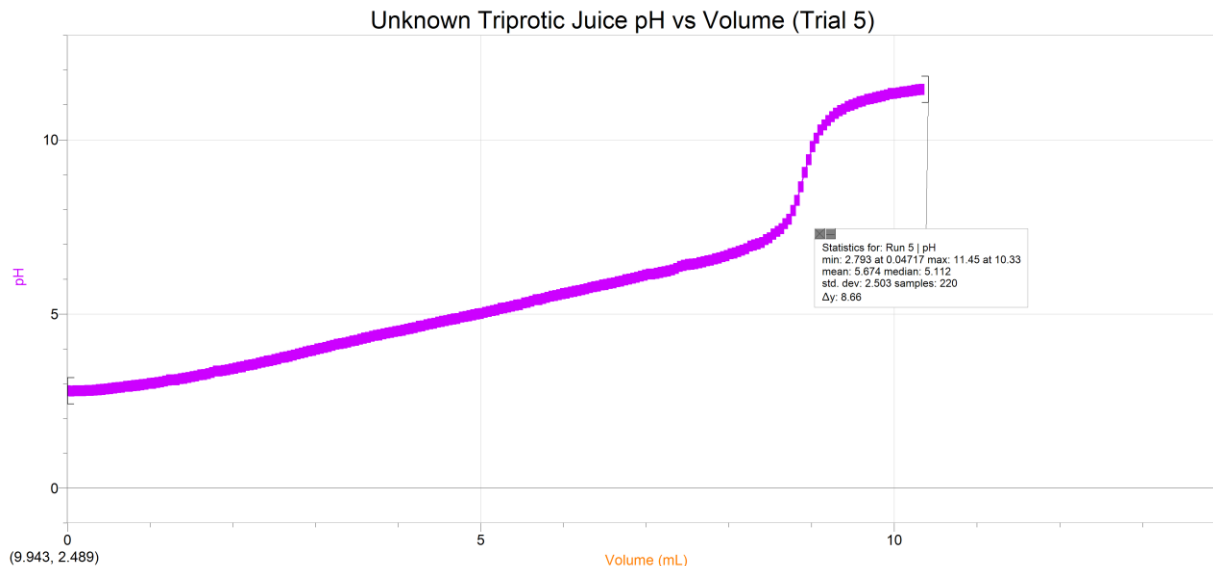


Figure 9: Run 1 of determining the mass percentage of acid in a juice sample. Trial 5 of the experiment, this graph is a representation of the pH increase as diluted NaOH is added to the unknown triprotic juice #1

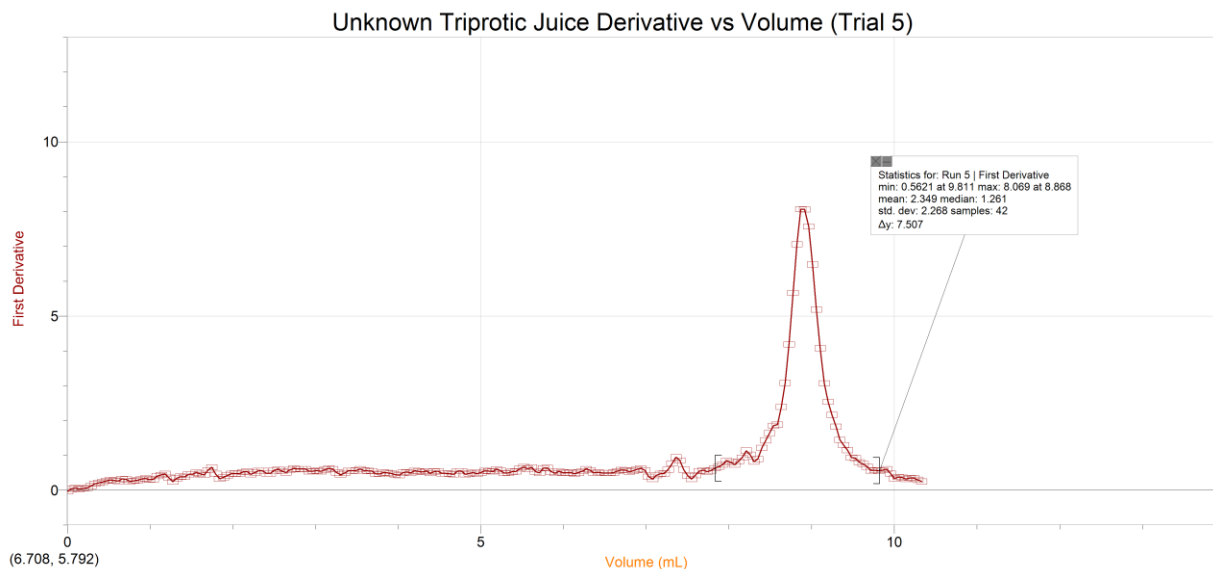


Figure 10: This graph is a representation of the First Derivative of the pH graph for trial 5. This graph shows us the equivalence point of when there is an equal amount of acid and base present in the solution, the equivalence point is reached at 8.868ml of added base.

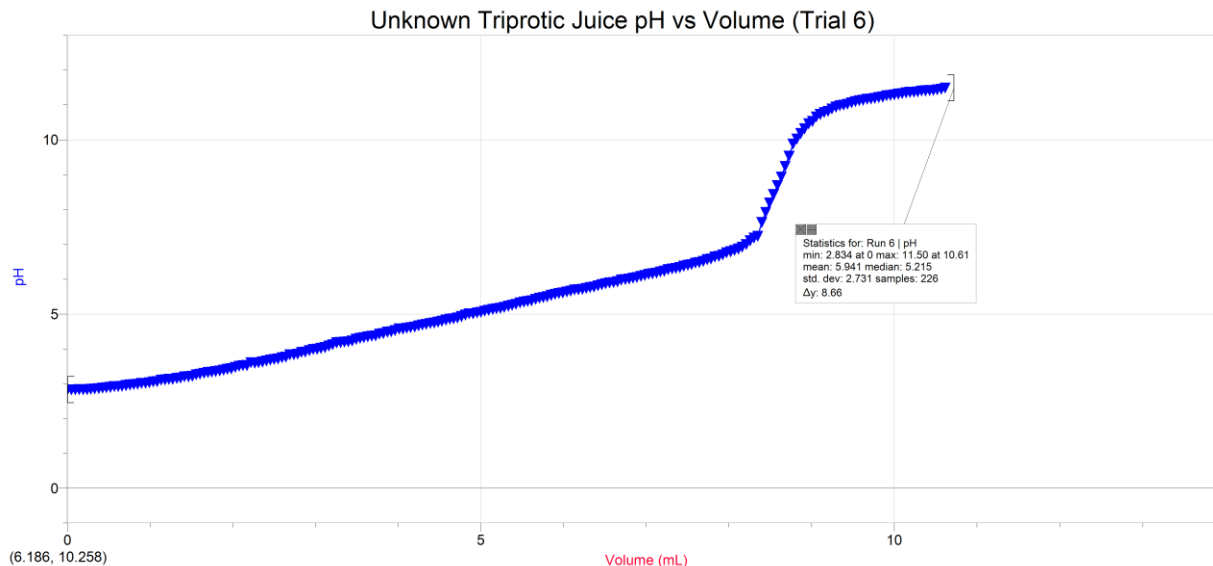


Figure 11: Run 2 of determining the mass percentage of acid in a juice sample. Trial 6 of the experiment, this graph is a representation of the pH increase as diluted NaOH is added to the unknown triprotic juice #1

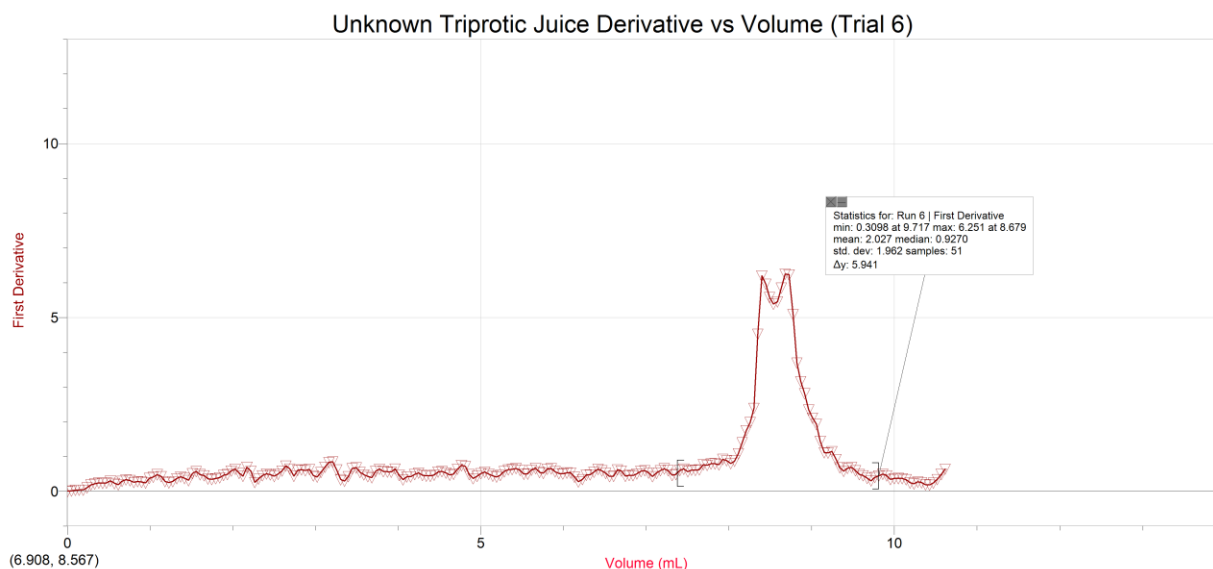


Figure 12: This graph is a representation of the First Derivative of the pH graph for trial 6. This graph shows us the equivalence point of when there is an equal amount of acid and base present in the solution, the equivalence point is reached at 8.679ml of added base.

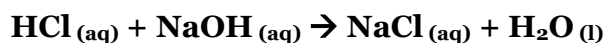
Sample Calculation: (Part 1)

1. Approximate concentration of stock solution

$$\begin{aligned}C_1V_1 &= C_2V_2 \\C_2 &= C_1V_1/V_2 \\C_2 &= (6.0M \times 0.00500L) / (0.2550L) \\C_2 &\approx 0.1176 M \\C_2 &\approx 0.1 M\end{aligned}$$

Sample Calculation: (Part 2)

2. Exact concentration of stock solution (from visual endpoint and cV calculations AND by first derivative from titration curve using LabQuest 2 data):



$$\begin{aligned}{}^1\text{Observed } V_{\text{NaOH}} &= 9.953\text{ml} \\&= 0.009953 \text{ L}\end{aligned}$$

$$\begin{aligned}{}^2\text{Logger Pro } V_{\text{NaOH}} &= 10.24\text{ml} \\&= 0.01024 \text{ L}\end{aligned}$$

$$\begin{aligned}V_{\text{acid}} &= 24.20\text{ml} - 14.18\text{ml} \\&= 10.02\text{ml}\end{aligned}$$

$$= 0.01002 \text{ L}$$

$$C_{\text{acid}} = 0.1000 \text{ M}$$

$$n_{\text{acid}} = CV$$

$$= (0.1000M \times 0.01002L)$$

$$= 0.001002 \text{ mol}$$

$$n_{\text{NaOH}} = n_{\text{acid}}(1 \text{ mol NaOH}/1 \text{ mol Acid})$$

$$C_{\text{NaOH}} = ?$$

TRIAL 2

$$C_{\text{NaOH}}V_{\text{NaOH}} = (b \div a)(C_{\text{acid}} \times V_{\text{acid}})$$

$$\begin{aligned}C_{\text{NaOH}} &= (b \div a)(C_{\text{acid}} \times V_{\text{acid}})/V_{\text{NaOH}} \\&= (1 \div 1)(0.1000M \times 0.01002L)/(0.009953L) \\&= 0.100673164 \text{ M} \\&\approx 0.101 \text{ M}\end{aligned}$$

$${}^2C_{\text{NaOH}}V_{\text{NaOH}} = (b \div a)(C_{\text{acid}} \times V_{\text{acid}})$$

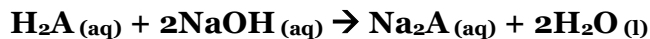
$$\begin{aligned}C_{\text{NaOH}} &= (b \div a)(C_{\text{acid}} \times V_{\text{acid}})/V_{\text{NaOH}} \\&= (1 \div 1)(0.1000M \times 0.01002L)/(0.01024L) \\&= 0.097851563 \text{ M} \\&\approx 0.100 \text{ M}\end{aligned}$$

3. Average concentration of stock solution:

$$\begin{aligned}\text{Average concentration}_{\text{NaOH}} &= (\text{Concentration}_{\text{Trial1}} + \text{Concentration}_{\text{Trial2}})/2 \\&= (0.103M + 0.09785M)/2 \\&= 0.100425M \\&\approx 0.100 \text{ M}\end{aligned}$$

Sample Calculation: (Part 3)

4. Concentration of Unknown Acid (from visual endpoint and cV calculations AND by second derivative from titration curve using LabQuest data):



$$\begin{aligned} {}^1\text{Observed } V_{\text{NaOH}} &= 10.802 \text{ ml} \\ &= 0.010802 \text{ L} \end{aligned}$$

$$\begin{aligned} {}^2\text{Logger Pro } V_{\text{NaOH}} &= 10.66 \text{ ml} \\ &= 0.01066 \text{ L} \end{aligned}$$

$$C_{\text{NaOH}} = 0.100425\text{M}$$

$$\begin{aligned} n_{\text{NaOH}} &= CV \\ &= 0.100425\text{M} \times 0.010802\text{L} \\ &= 0.001084791 \text{ mol} \end{aligned}$$

$$\begin{aligned} V_{\text{acid}} &= 13.45\text{ml} - 3.39\text{ml} \\ &= 10.06\text{ml} \\ &= 0.01006 \text{ L} \end{aligned}$$

$$\begin{aligned} n_{\text{acid}} &= n_{\text{NaOH}}(1 \text{ mol Acid}/2 \text{ mol NaOH}) \\ &= 0.001084791\text{mol} \times (1 \text{ mol}_{\text{Acid}}/2 \text{ mol}_{\text{NaOH}}) \\ &= 0.000542396 \text{ mol} \\ &= 0.000542 \text{ mol} \end{aligned}$$

$$C_{\text{acid}} = ?$$

TRIAL 4

$${}^1C_{\text{Acid}}V_{\text{Acid}} = (\mathbf{a \div b})(C_{\text{base}} \times V_{\text{base}})$$

$$\begin{aligned} C_{\text{Acid}} &= (\mathbf{a \div b})(C_{\text{base}} \times V_{\text{base}})/V_{\text{acid}} \\ &= (1 \div 2)(0.100425\text{M} \times 0.010802\text{L})/(0.01006\text{L}) \\ &= 0.053916046\text{M} \\ &\approx 0.0539 \text{ M} \end{aligned}$$

$${}^2C_{\text{Acid}}V_{\text{Acid}} = (\mathbf{a \div b})(C_{\text{base}} \times V_{\text{base}})$$

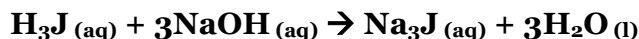
$$\begin{aligned} C_{\text{Acid}} &= (\mathbf{a \div b})(C_{\text{Base}} \times V_{\text{Base}})/V_{\text{Acid}} \\ &= (1 \div 2)(0.100425\text{M} \times 0.01066\text{L})/(0.01006\text{L}) \\ &= 0.053207281 \text{ M} \\ &\approx 0.0532 \text{ M} \end{aligned}$$

5. Average concentration of unknown acid:

$$\begin{aligned} \text{Average concentration}_{\text{Acid}} &= (\text{Concentration}_{\text{Trial1}} + \text{Concentration}_{\text{Trial2}})/2 \\ &= (0.055128409\text{M} + 0.053207281\text{M})/2 \\ &= 0.054167845\text{M} \\ &\approx 0.0542 \text{ M} \end{aligned}$$

Sample Calculation: (Part 4)

6. Concentration of acid in juice (from visual endpoint and cV calculations AND by second derivative from titration curve using LabQuest data):



$$\begin{aligned} {}^1\text{Observed } V_{\text{NaOH}} &= 8.443 \text{ ml} \\ &= 0.008443 \text{ L} \\ {}^2\text{Logger Pro } V_{\text{NaOH}} &= 8.679 \text{ ml} \\ &= 0.008679 \text{ L} \\ C_{\text{NaOH}} &= 0.100425 \text{ M} \\ n_{\text{NaOH}} &= CV \\ &= 0.100425 \text{ M} \times 0.008679 \text{ L} \\ &= 0.000871589 \text{ mol} \\ V_{\text{Acid}} &= 19.72 \text{ ml} - 9.870 \text{ ml} \\ &= 10.02 \text{ ml} \\ &= 0.01002 \text{ L} \\ n_{\text{Acid}} &= n_{\text{NaOH}} (1 \text{ mol Acid} / 3 \text{ mol NaOH}) \\ &= 0.000871589 \text{ mol} \times (1 \text{ mol Acid} / 3 \text{ mol NaOH}) \\ &= 0.00029053 \text{ mol} \\ &= 0.000291 \text{ mol} \\ C_{\text{Acid}} &=? \end{aligned}$$

TRIAL 6

$$\begin{aligned} {}^1C_{\text{Acid}}V_{\text{Acid}} &= (\mathbf{a \div b})(C_{\text{base}} \times V_{\text{base}}) \\ C_{\text{Acid}} &= (\mathbf{a \div b})(C_{\text{base}} \times V_{\text{base}}) / V_{\text{Acid}} \\ &= (1 \div 3)(0.100425 \text{ M} \times \\ &0.008443 \text{ L}) / (0.01002 \text{ L}) \\ &= 0.028206529 \text{ M} \\ &\approx 0.0282 \text{ M} \end{aligned}$$

$$\begin{aligned} {}^2C_{\text{Acid}}V_{\text{Acid}} &= (\mathbf{a \div b})(C_{\text{base}} \times V_{\text{base}}) \\ C_{\text{Acid}} &= (\mathbf{a \div b})(C_{\text{Base}} \times V_{\text{Base}}) / V_{\text{Acid}} \\ &= (1 \div 3)(0.100425 \text{ M} \times \\ &0.008679 \text{ L}) / (0.01002 \text{ L}) \\ &= 0.028994963 \text{ M} \\ &\approx 0.0290 \text{ M} \end{aligned}$$

7. Average concentration of acid in juice:

$$\begin{aligned} \text{Average concentration}_{\text{Acid}} &= (\text{Concentration}_{\text{Trial1}} + \text{Concentration}_{\text{Trial2}}) / 2 \\ &= (0.029626377 \text{ M} + 0.028994963 \text{ M}) / 2 \\ &= 0.02931067 \text{ M} \\ &\approx 0.0293 \text{ M} \end{aligned}$$

8. Mass percentage of acid in juice:

$$\begin{aligned} \text{Mass \% of Acid in Juice} &= [(C_{\text{Acid}} \times MM_{\text{Acid}}) / (\text{density}_{\text{juice}} \times 1000)] \times 100\% \\ &= [(0.0293 \text{ M} \times 192.124 \text{ g/mol}) / (0.9974 \text{ g/ml} \times 1000)] \times 100\% \\ &= 0.564390736\% \\ &= 0.564\% \end{aligned}$$

Discussion (in space provided):

This acid base titration experiment was performed to determine the concentrations of unknown acids and juices. The main reaction in acid-base titrations is a neutralization reaction. During neutralization, the acid and base react to form a salt and water. As all the solutions are clear and colorless, phenolphthalein is added to the solution as an indicator that changes color once the reaction reaches the equivalence point. Distilled water was used for this reaction instead of tap water because acid-base titrations are pH sensitive reactions and distilled water is completely pH neutral and would not affect the results of our titration. Since every step taken while doing the experiment has to be done precisely, that opens us up to many possible errors that can change our final concentration and pH from the desired amount. Starting with the beginning of the lab, certain containers that held acid were contaminated with another type of acid which could have reacted and altered our results. Also, although we were asked to take down the precise volumes of the solutions that we measured, there may have been error in our volume readings that would have caused less precision in the final results. Other factors that would affect the accuracy of the results include making sure there were no air bubbles in our burette while titrating, the proper mixing of our solutions and the constant rate at which the drops of base were added to the solution throughout the whole experiment from start to finish. The volumes at equivalence point determined by Logger Pro and the volumes observed were very much similar. For example, trial 2, the observed and Logger Pro values were .101M and .100M respectively. For trial 4, the observed and Logger Pro values were 0.0539M and 0.0532M respectively. And lastly for trial 6, the observed and Logger Pro values were 0.0282M and 0.0290M respectively. With these values we are able to choose which value seems most accurate, then take an average of the 2 or more runs done for that specific procedure, to get closer to the required result.

My partner Haneen and I had the tip of our burette pop off while our reaction was happening which altered drop count and volume of base recorder, in addition the tap that controls the rate at which the drops fell was slightly moved when the tip had to be put back on the burette, this lead to our whole experiment being off. As we did not have sufficient time to restart the experiment from the beginning, we had to take data from another group; Ashley Wong - 8173905 and her partner Dominique Lalonde – 7804245.

Conclusion: (2 sentences. Please note that the values you state as your results in this section will be used to determine your grade out of 5 for the results. Please include your unknown acid number and your juice name in this section.)

In conclusion, from this experiment we were able to determine the average concentration of unknown acid #1 which was 0.0542M and the average mass % of acid in juice #1 which was 0.564%.

RAW DATA

Data Tables

Table 1. Formation of a stock solution of NaOH

Volume of concentrated NaOH solution (mL)	5.0
Concentration of concentrated NaOH solution (M)	6.0
Volume of stock solution after dilution (mL)	255
Approximate concentration of stock solution (M)	

Table 2. Standardization of Stock Solution of NaOH

Data	Trial 1	Trial 2	Trial 3
Concentration of Standard Acid solution (M)	0.1000	0.1000	
Volume of Standard Acid solution (mL)	$V_i = 4.21$ $V_f = 14.48$ $V = 10.27$	$V_i = 14.18$ $V_f = 24.20$ $V = 10.02$	
Volume of stock solution of NaOH (mL)	9.987	9.953	
Concentration of stock solution of NaOH (M)			
Average Concentration of stock solution of NaOH (M)			

D. G. G.

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Table 3. Determination of the Concentration of an Unknown Acid

Data	Trial 1	Trial 2	Trial 3
Sample Number of Unknown Acid	1	1	
Volume of Unknown Acid solution (mL)	$V_i = 5.89$ $V_f = 15.90$ $V = 10.01$	$V_i = 13.39$ $V_f = 23.45$ $V = 10.06$	
Volume of stock solution of NaOH (mL)	10.802	10.802	
Concentration of stock solution of NaOH (M)			
Concentration of Unknown Acid Solution (M)			
Average Concentration of Unknown Acid solution (M)			

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Table 4. Determination of the Mass Percentage of Acid in a Juice

Data	Trial 1	Trial 2	Trial 3
Sample Number of Juice	1	1	
Volume of Juice (mL)	$V_1 = 4.49$ $V_2 = 14.51$ $V = 10.02$	$V_1 = 4.910$ $V_2 = 14.72$ $V = 10.02$	
Volume of stock solution of NaOH (mL)	8.679	8.413	
Concentration of stock solution of NaOH (M)			
Concentration of acid in Juice (M)			
Average Concentration of Acid in Juice (M)			
Density of Juice (g/mL)	0.9974	g/cm ³	
Molar Mass of acid in Juice (g/mol)			
Mass Percent of Acid in Juice (%)			

Ashley Wong

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The pictures shown above are the raw data from Ashley Wong - 8173905 and her partner Dominique Lalonde - 7804245.

DETERMINING THE CONCENTRATION OF UNKNOWN ACID

• Acid #6 Diprotic

DL

PREP A SOLUTION OF NaOH BY DILUTION

- CALCULATION 1
- ~~250~~ 250 ml of distilled water in 600 ml beaker
 - 4.2 ml of concentrated NaOH
 - 2.8 ml in graduated cylinder of distilled water
 - ~~6~~ 6 ml of 140 drops of dilute NaOH added to 2.8 ml of distilled water

- CALCULATION 2
- 2.8 ml of distilled water in graduated cylinder
 - 6 ml of 142 drops of dilute NaOH added to 2.8 ml of distilled water
 - NaOH is clear & colorless
 - NaOH & water made no change

STANDARDIZING DILUTED NaOH SOLUTION TRIAL #1

- Concentration of acid (HCl) \rightarrow 0.1000M MONOPROTIC
- Initial buret reading is 25 ml of acid. (25.00 ml)
 - Final buret reading is 15 ml of acid. (15.00 ml)
 - 10 ml of acid was transferred (10.00 ml)
 - 2 drops of phenolphthalein \rightarrow clear & colorless, no odor, no color change
 - Volume of added base @ which the color of the acid solution changes is 14.002 ml & pH \rightarrow light pink at first then became dark pink
- 20 ml of acid solution in 140 ml beaker

DATA FROM

ngld016@uottawa.ca
8317911

Nicholas Guddon
alath103@uottawa.ca
8386598
Adrian Latley

OK

	Run 1		Run 2		Run 3		Run 4		Run 5		Run 6		Run 7	
	Volume (mL)	pH	Volume (mL)	pH	Volume (mL)	pH	Volume (mL)	pH	Volume (mL)	pH	Volume (mL)	pH	Volume (mL)	pH
1	0.000	2.08	0.000	1.86	0.000	1.91	0.000	1.98	0.000	2.80	0.000	2.83		
2	0.047	2.08	0.047	1.86	0.047	1.91	0.047	1.98	0.047	2.79	0.047	2.83		
3	0.094	2.08	0.094	1.86	0.094	1.92	0.094	1.97	0.094	2.80	0.094	2.83		
4	0.142	2.08	0.142	1.86	0.142	1.91	0.142	1.97	0.142	2.80	0.142	2.84		
5	0.189	2.08	0.189	1.86	0.189	1.92	0.189	1.96	0.189	2.80	0.189	2.84		
6	0.236	2.08	0.236	1.86	0.236	1.92	0.236	1.96	0.236	2.81	0.236	2.84		
7	0.283	2.08	0.283	1.86	0.283	1.92	0.283	1.96	0.283	2.81	0.283	2.85		
8	0.330	2.08	0.330	1.86	0.330	1.92	0.330	1.96	0.330	2.82	0.330	2.86		
9	0.377	2.08	0.377	1.86	0.377	1.92	0.377	1.96	0.377	2.83	0.377	2.87		
10	0.425	2.08	0.425	1.86	0.425	1.92	0.425	1.96	0.425	2.84	0.425	2.89		
11	0.472	2.08	0.472	1.87	0.472	1.92	0.472	1.96	0.472	2.85	0.472	2.89		
12	0.519	2.08	0.519	1.87	0.519	1.92	0.519	1.96	0.519	2.87	0.519	2.91		
13	0.566	2.08	0.566	1.87	0.566	1.92	0.566	1.96	0.566	2.88	0.566	2.93		
14	0.613	2.08	0.613	1.87	0.613	1.92	0.613	1.96	0.613	2.89	0.613	2.93		
15	0.660	2.08	0.660	1.87	0.660	1.93	0.660	1.96	0.660	2.90	0.660	2.94		
16	0.708	2.08	0.708	1.87	0.708	1.93	0.708	1.95	0.708	2.93	0.708	2.96		
17	0.755	2.08	0.755	1.87	0.755	1.93	0.755	1.95	0.755	2.93	0.755	2.97		
18	0.802	2.08	0.802	1.87	0.802	1.93	0.802	1.95	0.802	2.95	0.802	2.99		
19	0.849	2.09	0.849	1.87	0.849	1.93	0.849	1.96	0.849	2.96	0.849	2.99		
20	0.896	2.09	0.896	1.87	0.896	1.93	0.896	1.96	0.896	2.97	0.896	3.02		
21	0.943	2.09	0.943	1.87	0.943	1.94	0.943	1.96	0.943	2.99	0.943	3.02		
22	0.991	2.09	0.991	1.88	0.991	1.94	0.991	1.96	0.991	3.01	0.991	3.04		
23	1.038	2.09	1.038	1.88	1.038	1.94	1.038	1.96	1.038	3.02	1.038	3.06		
24	1.085	2.09	1.085	1.88	1.085	1.94	1.085	1.96	1.085	3.04	1.085	3.07		
25	1.132	2.10	1.132	1.89	1.132	1.94	1.132	1.96	1.132	3.06	1.132	3.11		
26	1.179	2.10	1.179	1.89	1.179	1.94	1.179	1.96	1.179	3.08	1.179	3.12		
27	1.226	2.10	1.226	1.89	1.226	1.94	1.226	1.96	1.226	3.11	1.226	3.13		
28	1.274	2.10	1.274	1.89	1.274	1.94	1.274	1.96	1.274	3.11	1.274	3.14		

	Run 1			Run 2			Run 3			Run 4			Run 5			Run 6		
	Volume (mL)	pH	FD	Volume (mL)	pH	FD	Volume (mL)	pH	FD	Volume (mL)	pH	FD	Volume (mL)	pH	FD	Volume (mL)	pH	FD
1	0.000	2.08	0.000	0.000	1.86	0.006	0.000	1.91	0.019	0.000	1.98	-0.130	0.000	2.80	-0.028	0.000	2.83	0.006
2	0.047	2.08	0.000	0.047	1.86	0.012	0.047	1.91	0.033	0.047	1.98	-0.137	0.047	2.79	0.046	0.047	2.83	0.016
3	0.094	2.08	0.000	0.094	1.86	0.027	0.094	1.92	0.013	0.094	1.97	-0.105	0.094	2.80	0.072	0.094	2.83	0.039
4	0.142	2.08	0.000	0.142	1.86	0.000	0.142	1.91	0.013	0.142	1.97	-0.068	0.142	2.80	0.034	0.142	2.84	0.045
5	0.189	2.08	0.003	0.189	1.86	-0.024	0.189	1.92	0.032	0.189	1.96	-0.047	0.189	2.80	0.051	0.189	2.84	0.042
6	0.236	2.08	0.013	0.236	1.86	0.003	0.236	1.92	0.009	0.236	1.96	-0.013	0.236	2.81	0.069	0.236	2.84	0.113
7	0.283	2.08	0.041	0.283	1.86	0.036	0.283	1.92	0.003	0.283	1.96	-0.003	0.283	2.81	0.122	0.283	2.85	0.191
8	0.330	2.08	0.041	0.330	1.86	0.042	0.330	1.92	0.000	0.330	1.96	-0.003	0.330	2.82	0.191	0.330	2.86	0.221
9	0.377	2.08	0.013	0.377	1.86	0.024	0.377	1.92	0.000	0.377	1.96	-0.012	0.377	2.83	0.216	0.377	2.87	0.250
10	0.425	2.08	0.003	0.425	1.86	0.042	0.425	1.92	0.000	0.425	1.96	-0.039	0.425	2.84	0.235	0.425	2.89	0.237
11	0.472	2.08	0.000	0.472	1.87	0.042	0.472	1.92	0.000	0.472	1.96	-0.039	0.472	2.85	0.272	0.472	2.89	0.249
12	0.519	2.08	0.000	0.519	1.87	0.021	0.519	1.92	0.003	0.519	1.96	-0.012	0.519	2.87	0.298	0.519	2.91	0.305
13	0.566	2.08	0.000	0.566	1.87	0.035	0.566	1.92	0.012	0.566	1.96	-0.006	0.566	2.88	0.279	0.566	2.93	0.235
14	0.613	2.08	0.000	0.613	1.87	0.013	0.613	1.92	0.039	0.613	1.96	-0.012	0.613	2.89	0.267	0.613	2.93	0.194
15	0.660	2.08	0.000	0.660	1.87	0.013	0.660	1.93	0.039	0.660	1.96	-0.039	0.660	2.90	0.332	0.660	2.94	0.295
16	0.708	2.08	0.003	0.708	1.87	0.032	0.708	1.93	0.015	0.708	1.95	-0.036	0.708	2.93	0.311	0.708	2.96	0.341
17	0.755	2.08	0.012	0.755	1.87	0.009	0.755	1.93	0.015	0.755	1.95	0.000	0.755	2.93	0.258	0.755	2.97	0.318
18	0.802	2.08	0.039	0.802	1.87	0.003	0.802	1.93	0.042	0.802	1.95	0.036	0.802	2.95	0.271	0.802	2.99	0.267
19	0.849	2.09	0.042	0.849	1.87	0.003	0.849	1.93	0.051	0.849	1.96	0.039	0.849	2.96	0.286	0.849	2.99	0.291
20	0.896	2.09	0.024	0.896	1.87	0.012	0.896	1.93	0.053	0.896	1.96	0.012	0.896	2.97	0.321	0.896	3.02	0.270
21	0.943	2.09	0.042	0.943	1.87	0.042	0.943	1.94	0.044	0.943	1.96	0.003	0.943	2.99	0.343	0.943	3.02	0.249
22	0.991	2.09	0.042	0.991	1.88	0.054	0.991	1.94	0.013	0.991	1.96	0.003	0.991	3.01	0.304	0.991	3.04	0.381
23	1.038	2.09	0.028	1.038	1.88	0.066	1.038	1.94	0.003	1.038	1.96	0.012	1.038	3.02	0.316	1.038	3.06	0.415
24	1.085	2.09	0.056	1.085	1.88	0.095	1.085	1.94	0.000	1.085	1.96	0.039	1.085	3.04	0.408	1.085	3.07	0.487
25	1.132	2.10	0.080	1.132	1.89	0.092	1.132	1.94	0.003	1.132	1.96	0.039	1.132	3.06	0.445	1.132	3.11	0.435
26	1.179	2.10	0.054	1.179	1.89	0.054	1.179	1.94	0.015	1.179	1.96	0.012	1.179	3.08	0.471	1.179	3.12	0.287
27	1.226	2.10	0.027	1.226	1.89	0.018	1.226	1.94	0.054	1.226	1.96	0.003	1.226	3.11	0.368	1.226	3.13	0.252
28	1.274	2.10	0.042	1.274	1.89	0.015	1.274	1.94	0.087	1.274	1.96	0.000	1.274	3.11	0.244	1.274	3.14	0.291

	Run 1		Run 2		Run 3		Run 4		Run 5		Run 6						
	pH	FD	Volume (mL)	pH	FD	Volume (mL)	pH	FD	Volume (mL)	pH	FD	Volume (mL)	pH	FD			
1	2.08	0.000	0.000	1.86	0.006	0.000	1.91	0.019	0.000	1.98	-0.130	0.000	2.80	-0.028	0.000	2.83	0.006
2	2.08	0.000	0.047	1.86	0.012	0.047	1.91	0.033	0.047	1.98	-0.137	0.047	2.79	0.046	0.047	2.83	0.016
3	2.08	0.000	0.094	1.86	0.027	0.094	1.92	0.013	0.094	1.97	-0.105	0.094	2.80	0.072	0.094	2.83	0.039
4	2.08	0.000	0.142	1.86	0.000	0.142	1.91	0.013	0.142	1.97	-0.068	0.142	2.80	0.034	0.142	2.84	0.045
5	2.08	0.003	0.189	1.86	-0.024	0.189	1.92	0.032	0.189	1.96	-0.047	0.189	2.80	0.051	0.189	2.84	0.042
6	2.08	0.013	0.236	1.86	0.003	0.236	1.92	0.009	0.236	1.96	-0.013	0.236	2.81	0.069	0.236	2.84	0.113
7	2.08	0.041	0.283	1.86	0.036	0.283	1.92	0.003	0.283	1.96	-0.003	0.283	2.81	0.122	0.283	2.85	0.191
8	2.08	0.041	0.330	1.86	0.042	0.330	1.92	0.000	0.330	1.96	-0.003	0.330	2.82	0.191	0.330	2.86	0.221
9	2.08	0.013	0.377	1.86	0.024	0.377	1.92	0.000	0.377	1.96	-0.012	0.377	2.83	0.216	0.377	2.87	0.250
10	2.08	0.003	0.425	1.86	0.042	0.425	1.92	0.000	0.425	1.96	-0.039	0.425	2.84	0.235	0.425	2.89	0.237
11	2.08	0.000	0.472	1.87	0.042	0.472	1.92	0.000	0.472	1.96	-0.039	0.472	2.85	0.272	0.472	2.89	0.249
12	2.08	0.000	0.519	1.87	0.021	0.519	1.92	0.003	0.519	1.96	-0.012	0.519	2.87	0.298	0.519	2.91	0.305
13	2.08	0.000	0.566	1.87	0.035	0.566	1.92	0.012	0.566	1.96	-0.006	0.566	2.88	0.279	0.566	2.93	0.235
14	2.08	0.000	0.613	1.87	0.013	0.613	1.92	0.039	0.613	1.96	-0.012	0.613	2.89	0.267	0.613	2.93	0.194
15	2.08	0.000	0.660	1.87	0.013	0.660	1.93	0.039	0.660	1.96	-0.039	0.660	2.90	0.332	0.660	2.94	