Student Name: Iannick Leclerc

Student Number: 8316404

Partner's Name and Student #: samantha lalonde 822061

Demonstrator's Name: Tom Lacelle

PLEASE NOTE: If ANY of the above information is UNCLEAR or not provided, your grade will NOT be recorded!!

Lab Day (circle): Tues aft Tues night Wed Thurs aft Thurs night Fri

Lab Week (circle): 1 2

Laboratory Report Form

Experiment 5.

Acid/Base Titrations

Checklist:

- **Raw Data Sheet written in pen, signed by TA AND Raw data from LabQuest attached**
- **Data tables and graphs (6 minimum!) made in Logger Pro attached**
- **Report Form attached**

Student's Initials __IL__

Data Tables

	run 1		run 2		run 3		run 4		run 5		run 6	
	volume (ml)	PH	volume (ml)	PH	volume (ml)	PH	volume (ml)	PH	volume (ml)	PH	volume (ml)	PH
1	0	2.599	0	2.216	0	2.436	0	2.355	0	3.251	0	3.093
2	0.03647	2.594	0.03647	2.211	0.03647	2.432	0.03647	2.345	0.03647	3.251	0.03647	3.088
3	0.07294	2.599	0.07294	2.211	0.07294	2.427	0.07294	2.345	0.07294	3.251	0.07294	3.083
4	0.1094	2.599	0.1094	2.211	0.1094	2.422	0.1094	2.331	0.1094	3.251	0.1094	3.083
5	0.1459	2.599	0.1459	2.211	0.1459	2.417	0.1459	2.326	0.1459	3.251	0.1459	3.083
6	0.1823	2.599	0.1823	2.211	0.1823	2.408	0.1823	2.326	0.1823	3.251	0.1823	3.083
7	0.2188	2.599	0.2188	2.216	0.2188	2.408	0.2188	2.326	0.2188	3.251	0.2188	3.083
8	0.2553	2.594	0.2553	2.211	0.2553	2.403	0.2553	2.317	0.2553	3.251	0.2553	3.083
9	0.2918	2.599	0.2918	2.216	0.2918	2.403	0.2918	2.317	0.2918	3.251	0.2918	3.088
10	0.3282	2.599	0.3282	2.216	0.3282	2.403	0.3282	2.317	0.3282	3.251	0.3282	3.088
11	0.3647	2.594	0.3647	2.216	0.3647	2.403	0.3647	2.317	0.3647	3.251	0.3647	3.088
12	0.4012	2.561	0.4012	2.216	0.4012	2.398	0.4012	2.307	0.4012	3.246	0.4012	3.093
13	0.4376	2.561	0.4376	2.216	0.4376	2.398	0.4376	2.307	0.4376	3.246	0.4376	3.093
14	0.4741	2.580	0.4741	2.216	0.4741	2.398	0.4741	2.312	0.4741	3.246	0.4741	3.088
15	0.5106	2.561	0.5106	2.221	0.5106	2.393	0.5106	2.317	0.5106	3.246	0.5106	3.093
16	0.5470	2.556	0.5470	2.221	0.5470	2.393	0.5470	2.312	0.5470	3.246	0.5470	3.093
17	0.5835	2.556	0.5835	2.225	0.5835	2.393	0.5835	2.312	0.5835	3.246	0.5835	3.093
18	0.6200	2.556	0.6200	2.221	0.6200	2.393	0.6200	2.317	0.6200	3.246	0.6200	3.097
19	0.6565	2.556	0.6565	2.225	0.6565	2.398	0.6565	2.317	0.6565	3.246	0.6565	3.097
20	0.6929	2.556	0.6929	2.225	0.6929	2.393	0.6929	2.312	0.6929	3.246	0.6929	3.102
21	0.7294	2.556	0.7294	2.230	0.7294	2.393	0.7294	2.317	0.7294	3.255	0.7294	3.102
22	0.7659	2.556	0.7659	2.230	0.7659	2.393	0.7659	2.317	0.7659	3.260	0.7659	3.097
23	0.8023	2.561	0.8023	2.230	0.8023	2.398	0.8023	2.317	0.8023	3.270	0.8023	3.097
24	0.8388	2.561	0.8388	2.230	0.8388	2.403	0.8388	2.312	0.8388	3.274	0.8388	3.097
25	0.8753	2.561	0.8753	2.235	0.8753	2.398	0.8753	2.317	0.8753	3.289	0.8753	3.097
26	0.9117	2.561	0.9117	2.235	0.9117	2.403	0.9117	2.317	0.9117	3.298	0.9117	3.097
27	0.9482	2.566	0.9482	2.235	0.9482	2.398	0.9482	2.317	0.9482	3.317	0.9482	3.097
28	0.9847	2.570	0.9847	2.235	0.9847	2.403	0.9847	2.317	0.9847	3.322	0.9847	3.097
29	1.021	2.570	1.021	2.240	1.021	2.403	1.021	2.321	1.021	3.337	1.021	3.097
30	1.058	2.570	1.058	2.240	1.058	2.403	1.058	2.317	1.058	3.346	1.058	3.093
31	1.094	2.570	1.094	2.240	1.094	2.403	1.094	2.317	1.094	3.346	1.094	3.097

Table 1. Formation of a stock solution of NaOH

Volume of concentrated NaOH solution (mL)	**4ml**
Concentration of concentrated NaOH solution (M)	**6.0M**
Volume of stock solution after dilution (mL)	**249ml**
Approximate concentration of stock solution (M)	**.096386**

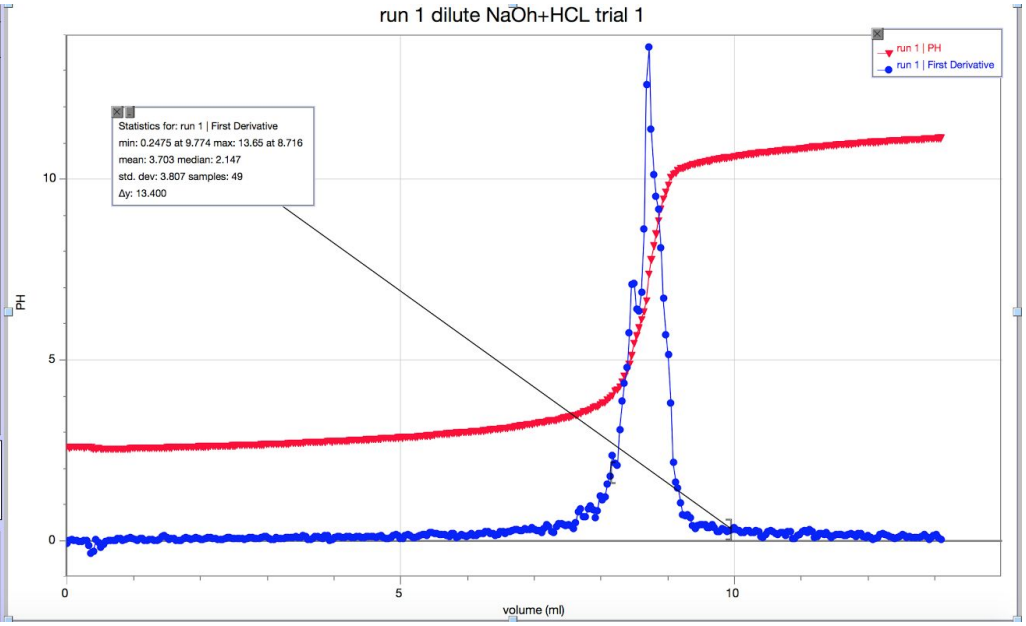
Table 2. Standardization of Stock Solution of NaOH

Data	Trial 1	Trial 2	Trial 3
Concentration of Standard Acid solution (M)	HCL .1M	HCL .1M	
Volume of Standard Acid solution (mL)	10ml	10ml	
Volume of stock solution of NaOH (mL)	8.716ml	8.352ml	
Concentration of stock solution of NaOH (M)	6.0M	6.0M	
Concentration of stock solution of NaOH (M)	.114732M	.119732M	
Average Concentration of stock solution of NaOH (M)	.116232M		

	run 1		
	volume (ml)	PH	FD
207	7.513	3.442	0.435
208	7.549	3.461	0.409
209	7.586	3.476	0.328
210	7.622	3.476	0.488
211	7.659	3.504	0.791
212	7.695	3.543	0.875
213	7.732	3.581	0.660
214	7.768	3.581	0.660
215	7.805	3.619	0.891
216	7.841	3.653	0.952
217	7.877	3.696	0.846
218	7.914	3.720	0.638
219	7.950	3.725	0.835
220	7.987	3.773	1.240
221	8.023	3.840	1.117
222	8.060	3.845	1.196
223	8.096	3.916	1.560
224	8.133	3.964	1.795
225	8.169	4.031	2.353
226	8.206	4.170	2.147

PH

volume ml



	run 2		
	volume (ml)	PH	FD
157	5.689	2.652	0.115
158	5.726	2.656	0.211
159	5.762	2.671	0.223
160	5.799	2.676	0.162
161	5.835	2.680	0.147
162	5.872	2.685	0.161
163	5.908	2.690	0.225
164	5.945	2.704	0.232
165	5.981	2.709	0.190
166	6.018	2.714	0.234
167	6.054	2.728	0.229
168	6.090	2.733	0.179
169	6.127	2.738	0.196
170	6.163	2.747	0.218
171	6.200	2.757	0.175
172	6.236	2.757	0.201
173	6.273	2.771	0.234
174	6.309	2.776	0.222
175	6.346	2.786	0.251
176	6.382	2.795	0.260

PH

volume ml

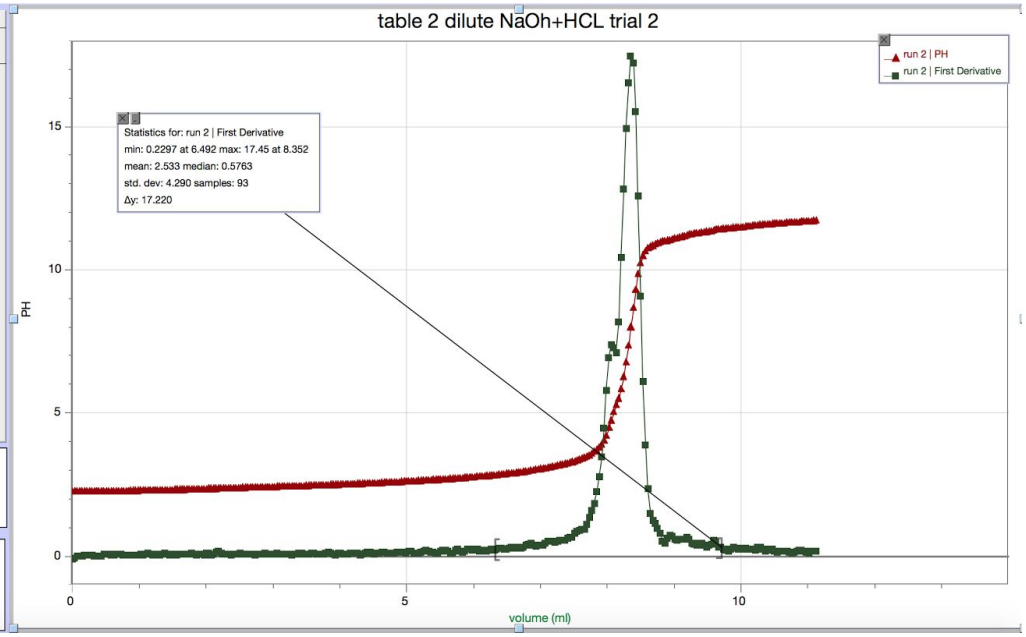


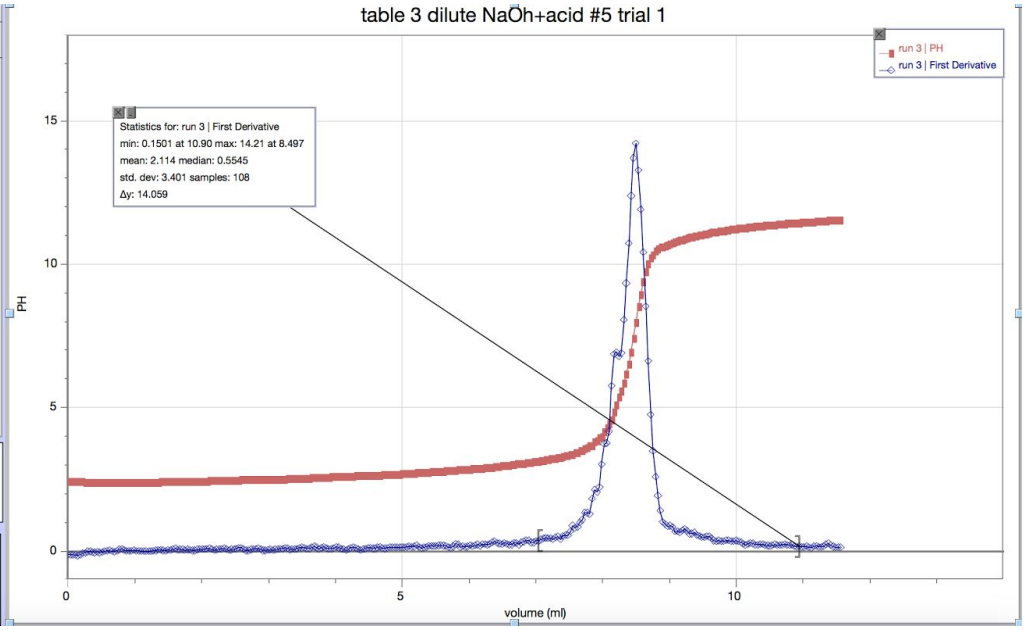
Table 3. Determination of the Concentration of an Unknown Acid

Data	Trial 1	Trial 2	Trial 3
Sample Number of Unknown Acid	#5	#5	
Volume of Unknown Acid solution (mL)	10ml	10ml	
Volume of stock solution of NaOH (mL)	8.497ml	9.701ml	
Concentration of stock solution of NaOH (M)	.116232M	.116232M	
Concentration of Unknown Acid Solution (M)	.049381M	.056378M	
average Volume of stock solution of NaOH (mL)	9.099ml		
Average Concentration of Unknown Acid solution (M)	.05288M		

	run 2		run 3
	FD	volume (ml)	PH
176	0.260	6.382	2.939
177	0.260	6.419	2.949
178	0.251	6.455	2.958
179	0.230	6.492	2.968
180	0.264	6.528	2.973
181	0.299	6.565	2.992
182	0.287	6.601	2.992
183	0.310	6.637	3.006
184	0.303	6.674	3.006
185	0.259	6.710	3.030
186	0.321	6.747	3.030
187	0.379	6.783	3.040
188	0.414	6.820	3.054
189	0.460	6.856	3.064
190	0.394	6.893	3.083
191	0.329	6.929	3.093
192	0.368	6.966	3.102
193	0.379	7.002	3.112
194	0.375	7.039	3.131
195	0.447	7.075	3.136

PH

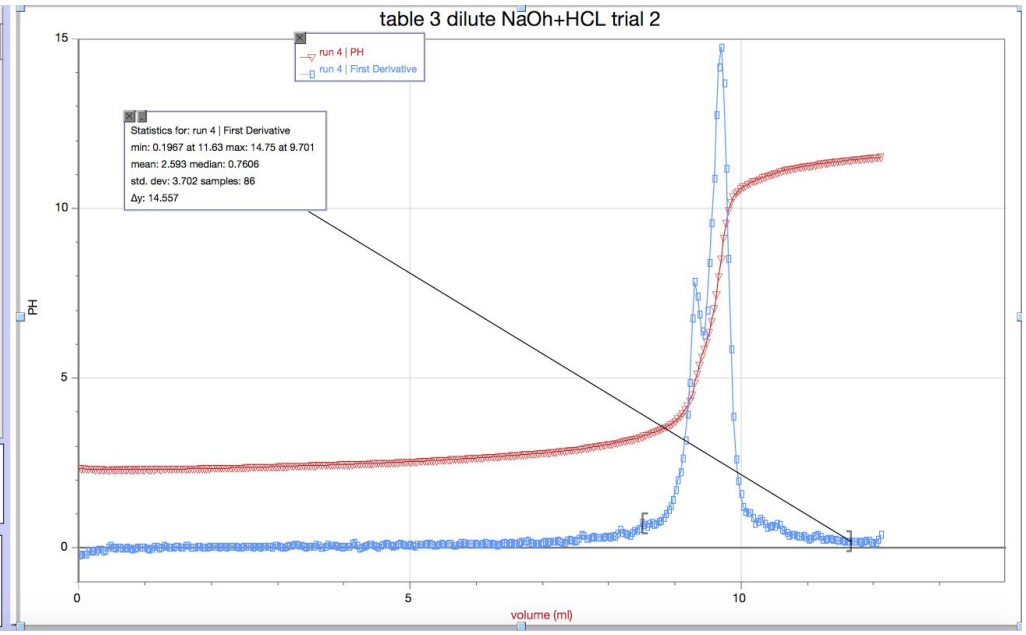
volume ml



	run 3		run 4
	FD	volume (ml)	PH
217	2.149	7.877	3.016
218	2.050	7.914	3.025
219	2.221	7.950	3.035
220	3.025	7.987	3.054
221	3.738	8.023	3.059
222	3.758	8.060	3.073
223	4.177	8.096	3.093
224	5.761	8.133	3.093
225	6.861	8.169	3.121
226	6.934	8.206	3.140
227	6.778	8.242	3.155
228	6.900	8.279	3.169
229	8.060	8.315	3.184
230	9.335	8.352	3.193
231	10.735	8.388	3.217
232	12.382	8.425	3.236
233	13.703	8.461	3.251
234	14.209	8.497	3.274
235	13.280	8.534	3.313
236	11.913	8.570	3.327

PH

volume ml



Observations (all parts of the experiment):

the NaOH was a clear colorless liquid with a strong and vial smell. all solutions appeared to be clear and see through with no smell to them. When we added the base nothing happened for a bit until the solution until the ph was about 4 then a large change in PH happened and was much quicker than before. The only acid that did not have such a change was the juice because from the start it increased in PH much faster than the other two acids and was pretty constant. A slight colour change occurred between the PH of 8-10 in all of our trials and the solution changed from clear to a light pinkish colour. The speed in which the color change varied depending on the acid used.

We observed that the juice had the most constant change out of the three acids, but HCl reached the maximum ph with the least amount of acid so we can conclude that the HCl is the most acidic.

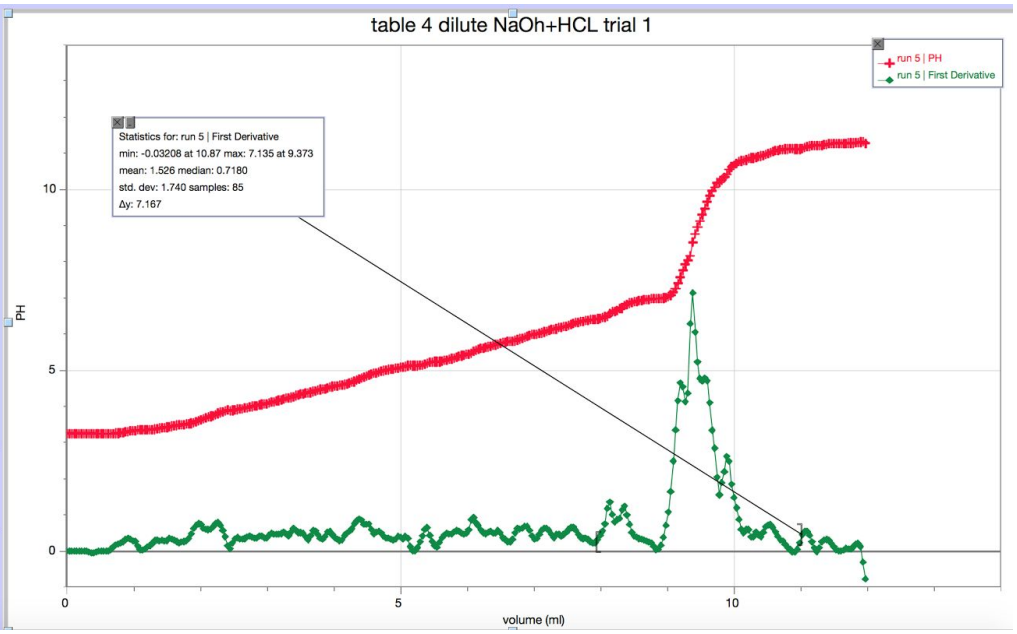
Table 4. Determination of the Mass Percentage of Acid in a Juice

Data	Trial 1	Trial 2	Trial 3
Sample Number of Juice	#4	#4	
Volume of Juice (mL)	10ml	10ml	
Volume of stock solution of NaOH (mL)	9.373ml	9.956ml	
Concentration of stock solution of NaOH (M)	.116232M	.116232M	
Concentration of acid in Juice (M)	.036315M	.038574M	
Average Concentration of Acid in Juice (M)	.37444M		
Density of Juice (g/mL)	.9998g/cm^3		
Molar Mass of acid in Juice (g/mol)	192.12g/mol		
Mass Percent of Acid in Juice (%)	.719521%		

	run 3		run 4
	FD	volume (ml)	PH
217	2.149	7.877	3.016
218	2.050	7.914	3.025
219	2.221	7.950	3.035
220	3.025	7.987	3.054
221	3.738	8.023	3.059
222	3.758	8.060	3.073
223	4.177	8.096	3.093
224	5.761	8.133	3.093
225	6.861	8.169	3.121
226	6.934	8.206	3.140
227	6.778	8.242	3.155
228	6.900	8.279	3.169
229	8.060	8.315	3.184
230	9.335	8.352	3.193
231	10.735	8.388	3.217
232	12.382	8.425	3.236
233	13.703	8.461	3.251
234	14.209	8.497	3.274
235	13.280	8.534	3.313
236	11.913	8.570	3.327

PH

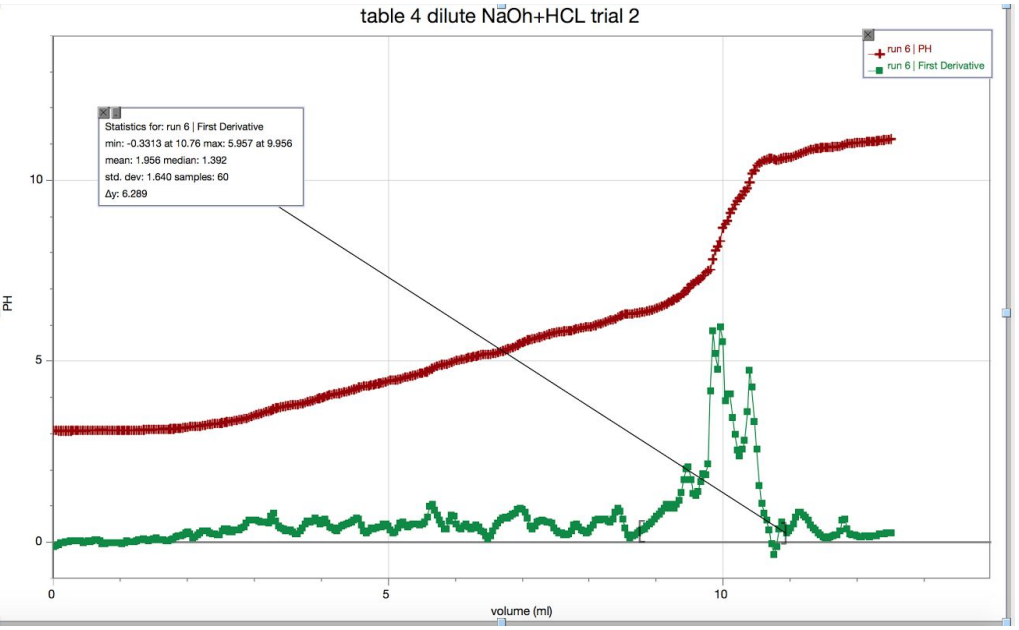
volume ml



	run 5		run 6
	FD	volume (ml)	PH
223	1.183	8.096	5.995
224	1.355	8.133	6.024
225	1.017	8.169	6.043
226	0.804	8.206	6.067
227	0.867	8.242	6.091
228	0.906	8.279	6.115
229	1.135	8.315	6.134
230	1.247	8.352	6.153
231	1.000	8.388	6.177
232	0.744	8.425	6.215
233	0.517	8.461	6.254
234	0.421	8.497	6.283
235	0.385	8.534	6.302
236	0.344	8.570	6.311
237	0.328	8.607	6.311
238	0.312	8.643	6.316
239	0.276	8.680	6.326
240	0.260	8.716	6.330
241	0.228	8.753	6.345
242	0.132	8.789	6.354

PH

volume ml



Sample Calculation: (Part 1)

1. Approximate concentration of stock solution

$M_1V_1 = M_2V_2$
$M_2 = M_1V_1 / V_2$
$M_2 = (6\ M)(4mL)/ (249mL)$
$M_2 = .096386M$

Sample Calculation: (Part 2)

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

trial 1:

n(HCl)=n(NaOH)

$(cv)_{HCl} = (cv)_{NaOH}$

(.100M)(.010L)=(cNaOH)(.008716)

.001/.008716=.114732M

trial 2:

.119732M

2. Average concentration of stock solution:

.114732M+.119732M/2=.116232M

Sample Calculation: (Part 3)

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

trial 1:

M(NaOH)*V(NaOH) = ((*n base*)* MAcid #5*VAcid #5) /n *aci*d

MAcid #5 = (*MNaOH*× *VNaOH* × *n*(*acid*))/ (*Vacid* × *nbase*)

M Acid #5 = ((.116232M)(.008497 *L*)(1 *mol*))(.01 *L*)(2 *mol*)

M Acid #5 = .049381M

trial 2:

.056378M

1. Average concentration of unknown acid:

.049381M +.056378M/2=.05288M

Sample Calculation: (Part 4)

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

trial 1:

M(NaOH)*V(NaOH) = (*n base** M(Acid in Juice #4) *V(Acid in Juice #4))/(*n acid*)

M(Acid in Juice #4) = *M*(*NaOH*)* *VNaOH* * *n*(*acid*) /(*V*(*acid in Juice* #4) * *nbase*)

MAcid in Juice #4 = ((.116232M)(.009373*L*)(1 *mol*))(0.01 *L*)(3 *mol*)

MAcid in Juice #4 =.036315 M

trial 2:

. 038574 M

1. Average concentration of acid in juice:

.036315 M+ . 038574 M/2=.037444M

8. Mass percentage of acid in juice:

% m(*acid in juice* #4)=(M(*acid in juice* #4) × MM(*acid in juice* #4))/(D(*acid in juice* #4)× 1000mL/L) × 100% %m(*acid in juice* #4)=.037444M * 192.12$gmol$/(0.9998g/mL× 1000mL/L) × 100%

% m(*acid in juice* #4)=0.719521 %

Discussion (in space provided):

We began this lab by setting up the equipment needed, the first thing was to attach the Drop Counter to an L bar, we then connected the Drop Counter to the DG1 port of the LabQuest 2 and used a universal clamp to secure the plastic burette above the detector of the Drop Counter. After all the setting up we started the actual lab by calibrating the drop counter. We did 2 trials and recorded that to get 2ml in a graduated cylinder it took 38 drops the first trial and 39 drops the second trial. so it took about 19 drops per ml, the next step is where we believe a mistake with logger happened because we recorded that we used approximately 55 ml in our trials but when we looked at the buret we only had used about 14-17 and if we do the calculation of about an average of 345 drops used in our trials and divided it by 19 (which is what we calculated in the calibration, for how much drops were needed for 1 ml) we calculate approximately 18 which is pretty close to the actual amount used compared to the results logger pro gave us. When i realized this i asked dr Rashmi what to do and she directed me to calculate manually all the new volumes, which are the ones i used for all calculations and in the graphs. After obtaining these results we continued by using a unknown acid. The point where the pH goes from clear to light pink is called the endpoint, and it is very close to the equivalence point of a titration. When the colour of the solution is a darker shade of pink, this means that the titration has gone past the equivalence point. For all of our trials in this experiment, the solution was a little past the endpoint based on the colour of the solution. We noticed that the trial would be clear and the addition of one drop would change the entire colour to a light pink in certain areas of the beaker and took about 6 drops for the beaker to be all pink.
besides the main error stated above this lab could have other errors from the indicator phenolphthalein changes when the solution changed pink at it took a little longer with the indicator in. Also the buret could have started slowing down the rate of drop a little so the rate was not constant anymore so the NaOH had more time to affect the acid before the next drop came in contact with the acid. When we calculated the mass percent of acid in the juice, there was a factor of 1000 in the equation. This factor is actually 1000mL/L, and is used to convert the density from g/mL to g/L. For each trial the procedure was the same and we had to make sure that the we did not touch the top knob of the buret to affect the rate at which the NaOH was being released and the only difference between each step was the acid used.

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.)

The average concentration of the stock solution of NaOH was determined to be 0.116232 M. The average concentration of unknown acid #3 was determined to be .05288M. The average concentration of the acid in juice #4 was determined to be 0.037444 M. The mass percent of the acid in juice #4 was determined to be 0.719521%.