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 Wed Thurs Fri

Time slot (circle): morning afternoon night

Lab Week (circle): 1 2

Laboratory Report Cover Page

Experiment 3.

Chemical Kinetics

Checklist:

- **Raw Data Sheet copy attached**
- **9 curves [3 for A vs t; 3 for log A vs t; 3 for log Rate vs log A] attached**
- **Completed formal report typed and attached**

Student's Initials __IL___

introduction

The speeds of a chemical reactions change from very fast to very slow reactions, for example the fast reaction would be mixing baking soda and vinegar, it would take a few seconds while the slow reaction would be diamond turning into graphite after millions of years. Chemical kinetics is the study of the factors that control the rates of reactions and the mechanisms by which the reactions occur.

[1] A+BP

or

[2] Rate $[A]_n [B]_m$

[3] Rate = k $[A]_n [B]_m$

k is the proportionality constant, also called the rate constant. The concentration of the reactants is expressed in mol L^{-1}, or mol/L.

The rate can also be determined graphically. We can solve by using the tangent line to find the slope of it which will give us the rate.

the exponents, n and m, are the order of the reaction with respect to the reactants [A] and [B]. The sum, n + m, gives the total order of the reaction. The order of a reaction must be determined experimentally, and cannot be deduced from the stoichiometric equation of the reaction.

the rate expression for this reaction can be expressed in different forms, as shown:

[4] Rate= -d[Cr(III)]/dt= d[Cr(III)-EDTA]/dt= k[Cr(III)]^$_a$[H+]^$_b$

Spectrophotometry is the study of the interaction of electromagnetic radiation with matter. The two most commonly used terms when making spectrophotometric measurements are transmittance and absorbance.

Transmittance is the ratio of the intensity of light after it passes through the medium being studied (I) to the intensity of light before it passes through the medium (I_0). we solve this by using the formula:

$$[5]\ T = I/I_0$$

On the spectrophotometer, percent transmittance is used rather than transmittance.

$$[6]\ \%T = T \times 100\%$$

to find absorbance we use the formula:

$$[7]\ A = -\log T = -\log (I / I_0)\ [7]$$

for equation 7 we use transmittance and not % transmittance

The relation between absorbance and concentration is called the Beer-Lambert law and the formula used is:

$$[8]\ A = \varepsilon bc$$

A is the absorbance, ε represents the molar absorptivity coefficient, b represents the path length and c represents the concentration of the absorbing species in the solution.

[8] shows that the absorbance is directly proportional to the concentration.

We can use this value to find the amount of unreacted Cr(III) at any time according to the equation:

$$[9]\ A_{Cr(III)} = A_{infinity} - A_t$$

k is a constant so we can take the logarithm of both sides of the equation.

$$[10]\ \text{Log Rate} = a \log [Cr(III)] + \log k$$

The slope of[10] represents the partial order with respect to Cr(III) ion

procedure

as given in lab manual

graphs/observation/tables

Experiment 1	
OH Level EDTA	4.0
Volume EDTA	10ml
% T at 40 min	75.999
% T at 42 min	5.004
ABS at 40 min	.11919
ABS at 42 min	1.3007

the EDTA got a little darker when adding 2 drops of chromium nitrate solution. after the heating, it turned purple as well as the graph slowly increased until the chromium was added then the absorption graph shot up and the transmittance graph shot down.

	Run 4	Run 1			Run 2			Run 3		
	absorbance	Time (min)	Trans @ (%)	absorbance	Time (min)	Trans @ (%)	absorbance	Time (min)	Trans @ (%)	absorbance
1		0	88.314	0.053969	0	88.098	0.055035	0	87.918	0.055923
2		2	94.322	0.025388	2	88.933	0.050935	2	82.446	0.083829
3		4	94.271	0.025623	4	85.727	0.066884	4	71.856	0.14354
4		6	93.807	0.027763	6	80.957	0.091747	6	61.236	0.21300
5		8	93.387	0.029712	8	76.088	0.11868	8	52.479	0.28001
6		10	92.665	0.033084	10	71.382	0.14641	10	45.033	0.34647
7		12	91.868	0.036838	12	67.301	0.17198	12	39.672	0.40152
8		14	91.024	0.040846	14	63.315	0.19849	14	35.296	0.45227
9		16	90.034	0.045591	16	59.931	0.22235	16	31.927	0.49585
10		18	88.716	0.051997	18	56.908	0.24483	18	29.206	0.53454
11		20	87.723	0.056889	20	54.262	0.26551	20	27.098	0.56706
12		22	86.332	0.063827	22	51.940	0.28450	22	25.458	0.59418
13		24	85.096	0.070089	24	49.938	0.30157	24	24.016	0.61949
14		26	83.962	0.075916	26	48.055	0.31826	26	22.813	0.64182
15		28	82.771	0.082122	28	46.407	0.33342	28	87.883	0.056097
16		30	81.633	0.088135	30	44.877	0.34797	30	4.444	1.3522
17		32	80.415	0.094664	32	43.530	0.36121			
18		34	79.249	0.10101	34	42.380	0.37284			
19		36	78.052	0.10762	36	41.290	0.38415			
20		38	77.017	0.11341	38	40.270	0.39501			
21		40	75.999	0.11919	40	39.359	0.40496			
22		42	5.004	1.3007	42	7.599	1.1192			
23										
24										
25										

@ 548.3 nm

Data Set

	time	trans @	Abs	A Cr	A Cr(III)	Time (f)
1	0	88.314	0.05397	1.247	1.275	2
2	2	94.322	0.02539	1.275	1.275	4
3	4	94.271	0.02562	1.275	1.273	6
4	6	93.807	0.02776	1.273	1.271	8
5	8	93.387	0.02971	1.271	1.268	10
6	10	92.665	0.03308	1.268	1.264	12
7	12	91.868	0.03684	1.264	1.260	14
8	14	91.024	0.04085	1.260	1.255	16
9	16	90.034	0.04559	1.255	1.249	18
10	18	88.716	0.05200	1.249	1.244	20
11	20	87.723	0.05689	1.244	1.237	22
12	22	86.332	0.06383	1.237	1.231	24
13	24	85.096	0.07009	1.231	1.225	26
14	26	83.962	0.07592	1.225	1.219	28
15	28	82.771	0.08212	1.219	1.213	30
16	30	81.633	0.08813	1.213	1.206	32
17	32	80.415	0.09466	1.206	1.200	34
18	34	79.249	0.10101	1.200	1.193	36
19	36	78.052	0.10762	1.193	1.187	38
20	38	77.017	0.11341	1.187	1.181	40
21	40	75.999	0.11919	1.181		
22	42	5.004	1.30068	0.000		
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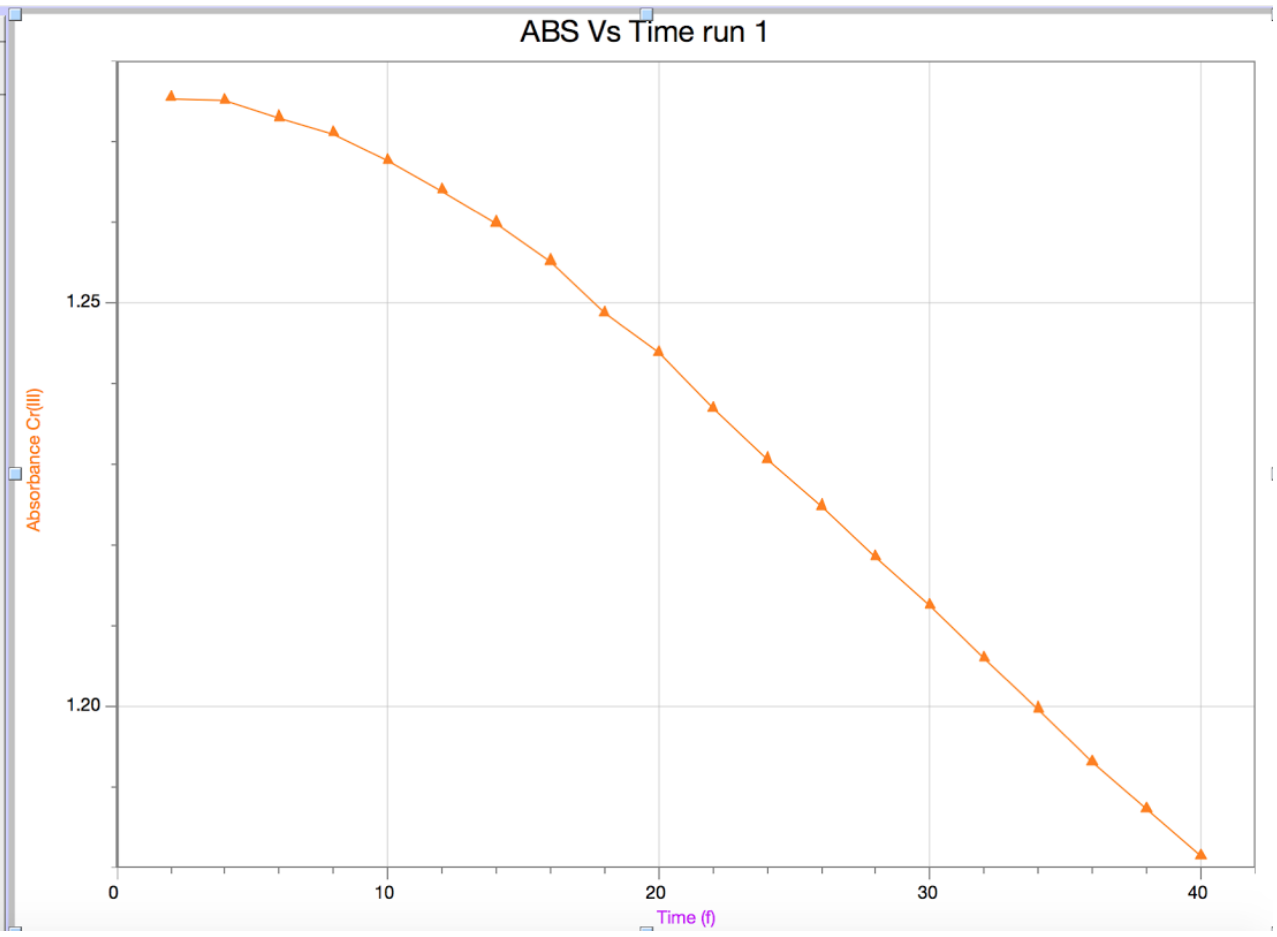

Data Set

	A Cr(III)	Time(f)	log A Cr(III)	Rate	Log Rate
1	1.2753	2	0.106	0.000	-3.424
2	1.2751	4	0.106	0.001	-3.157
3	1.2729	6	0.105	0.001	-2.990
4	1.2710	8	0.104	0.001	-2.871
5	1.2676	10	0.103	0.002	-2.766
6	1.2639	12	0.102	0.002	-2.706
7	1.2599	14	0.100	0.002	-2.646
8	1.2551	16	0.099	0.003	-2.576
9	1.2487	18	0.096	0.003	-2.548
10	1.2438	20	0.095	0.003	-2.525
11	1.2369	22	0.092	0.003	-2.501
12	1.2306	24	0.090	0.003	-2.514
13	1.2248	26	0.088	0.003	-2.517
14	1.2186	28	0.086	0.003	-2.513
15	1.2126	30	0.084	0.003	-2.504
16	1.2060	32	0.081	0.003	-2.496
17	1.1997	34	0.079	0.003	-2.497
18	1.1931	36	0.077	0.003	-2.510
19	1.1873	38	0.075	0.003	-2.527
20	1.1815	40	0.072	0.003	-2.535
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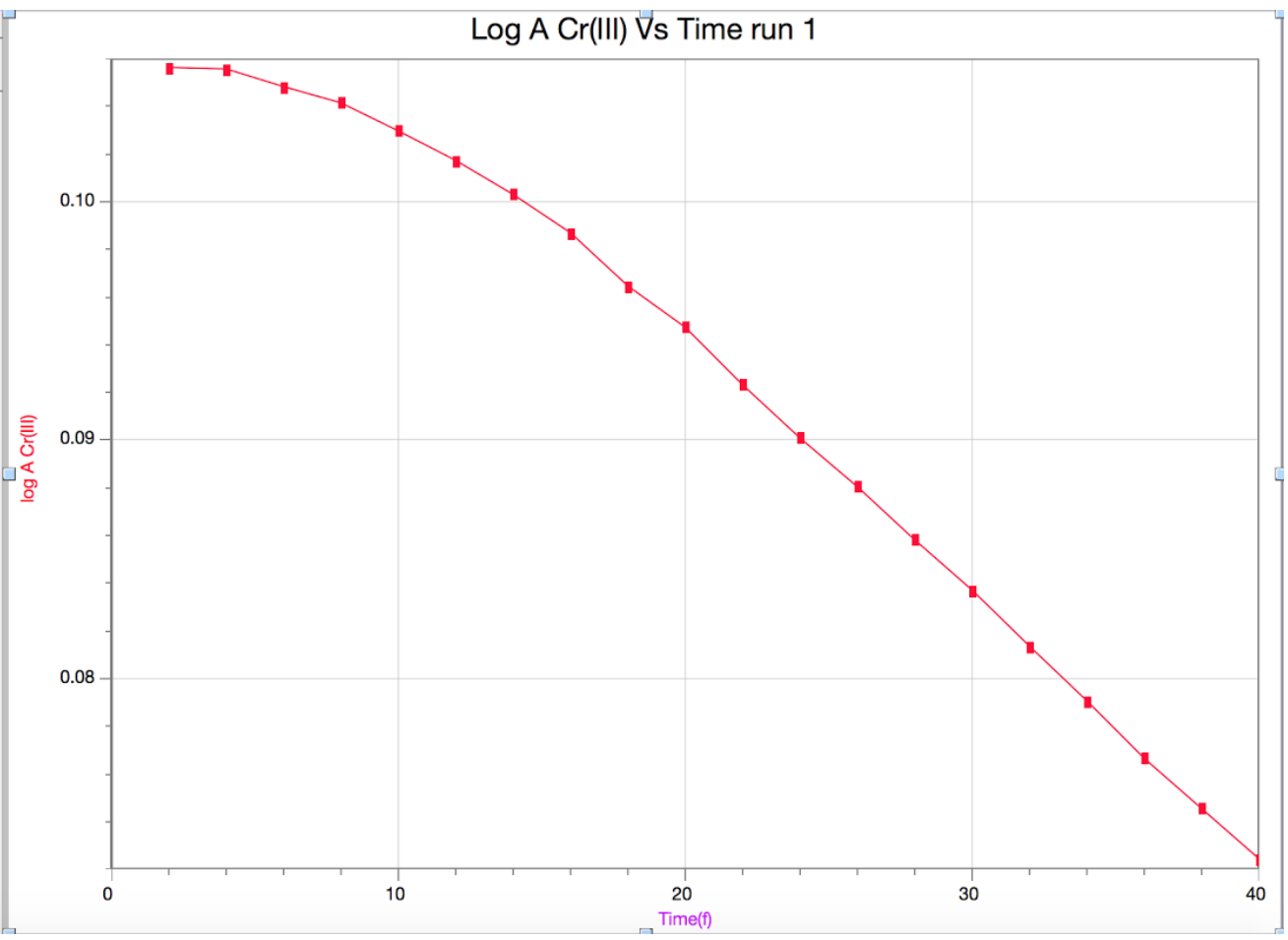

	Data Set					
	time	trans@	ABS	A Cr	A Cr(III)	Time(f)
1	0	88.314	0.053969	1.247	1.2753	2
2	2	94.322	0.025388	1.275	1.2751	4
3	4	94.271	0.025623	1.275	1.2729	6
4	6	93.807	0.027763	1.273	1.2710	8
5	8	93.387	0.029712	1.271	1.2676	10
6	10	92.665	0.033084	1.268	1.2639	12
7	12	91.868	0.036838	1.264	1.2599	14
8	14	91.024	0.040846	1.260	1.2551	16
9	16	90.034	0.045591	1.255	1.2487	18
10	18	88.716	0.051997	1.249	1.2438	20
11	20	87.723	0.056889	1.244	1.2369	22
12	22	86.332	0.063827	1.237	1.2306	24
13	24	85.096	0.070089	1.231	1.2248	26
14	26	83.962	0.075916	1.225	1.2186	28
15	28	82.771	0.082122	1.219	1.2126	30
16	30	81.633	0.088135	1.213	1.2060	32
17	32	80.415	0.094664	1.206	1.1997	34
18	34	79.249	0.10101	1.200	1.1931	36
19	36	78.052	0.10762	1.193	1.1873	38
20	38	77.017	0.11341	1.187	1.1815	40
21	40	75.999	0.11919	1.182		
22	42	5.0041	1.3007	0.000		
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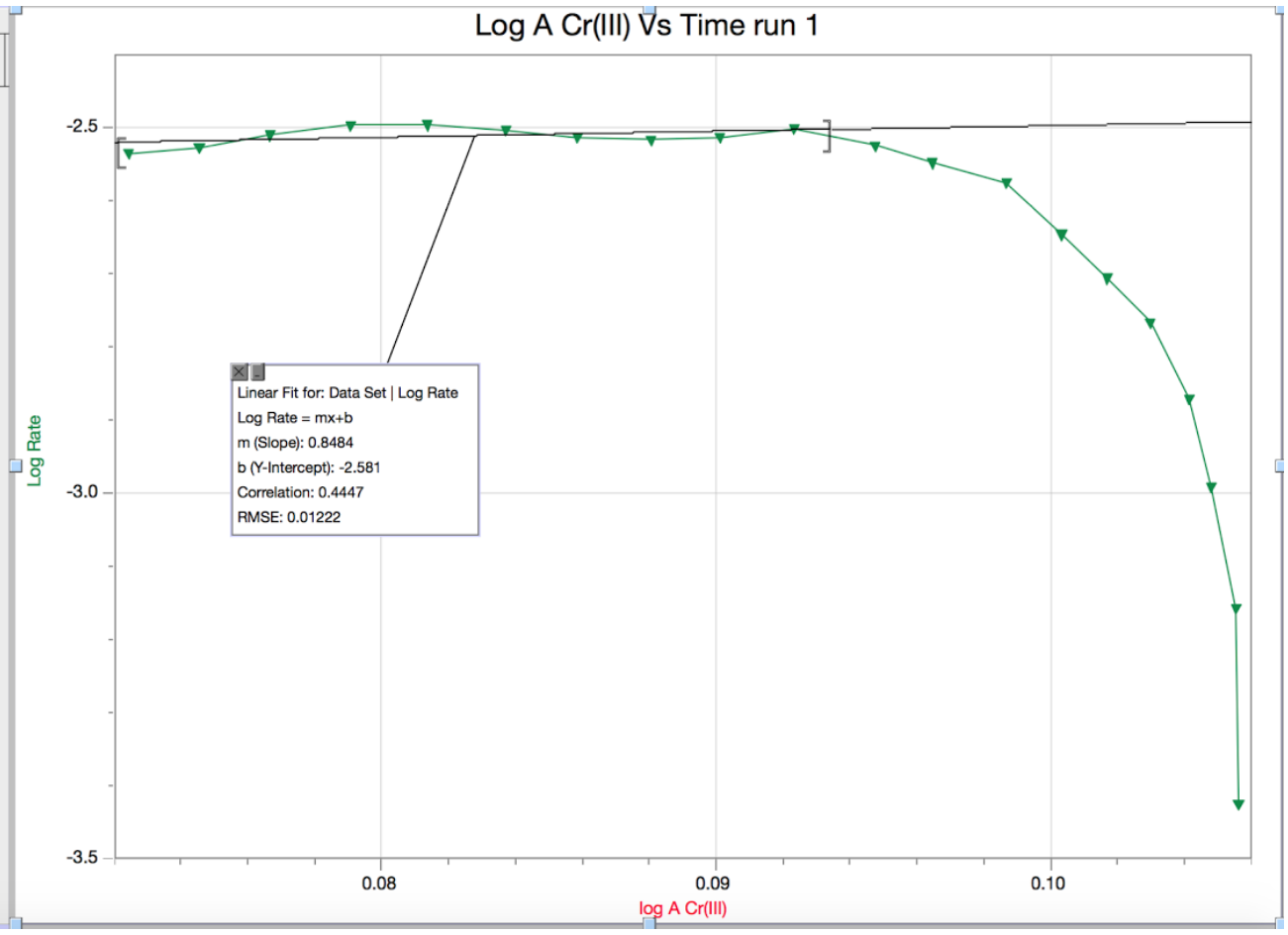
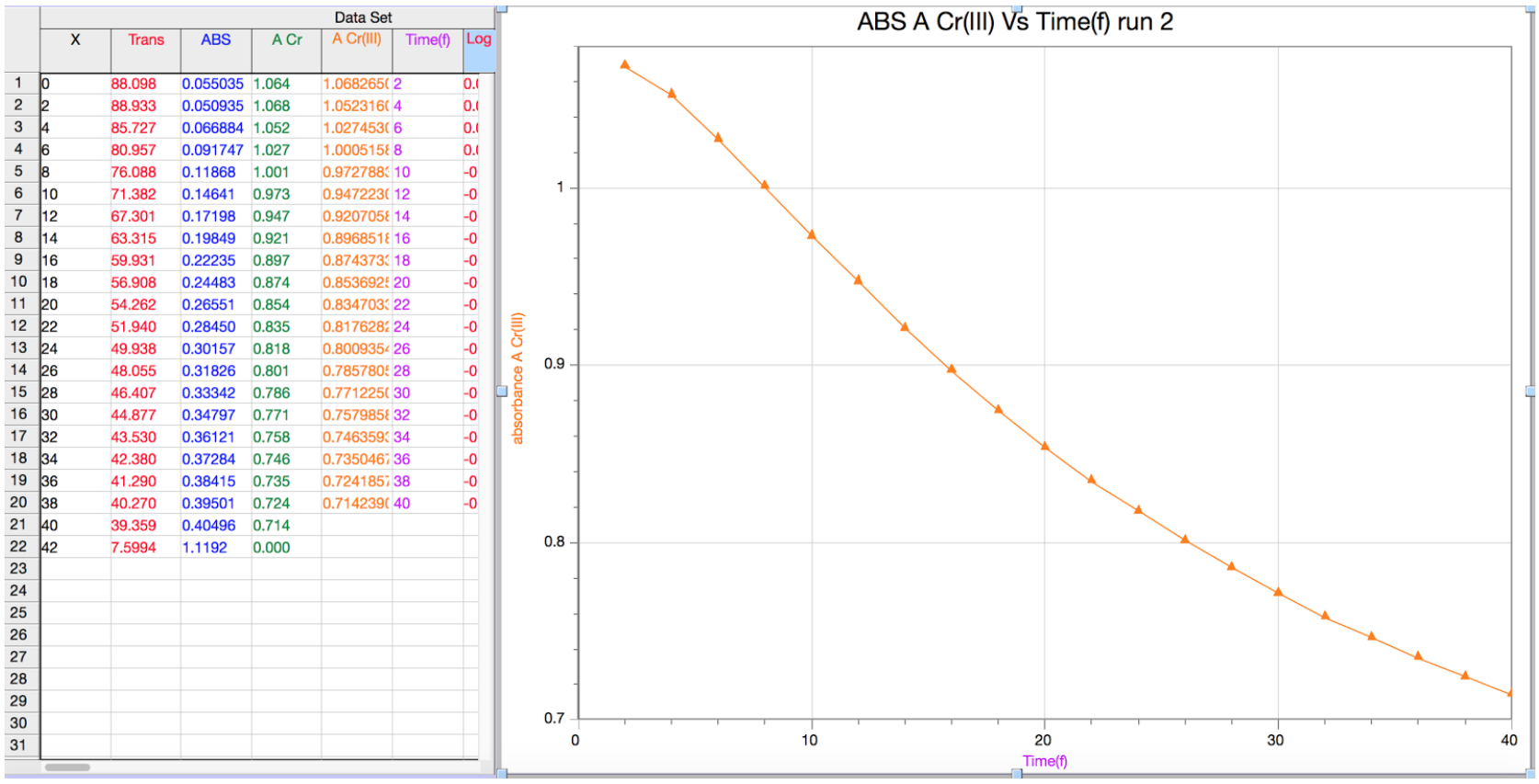


run 2

Experiment 1	
PH Level EDTA	4.5
Volume EDTA	10ml
% T at 40 min	39.359
% T at 42 min	7.5994
ABS at 40 min	.040496
ABS at 42 min	1.1192

the EDTA got a little darker after adding 2 drops of chromium nitrate solution. after the heating, it turned purple as well as the graph slowly increased as it did in trial 1 but it increased a little faster. When the chromium was added the absorption graph shot up and the transmittance graph shot down.



Data Set

	X	Trans	ABS	A Cr	A Cr(III)	Time(f)	Log
1	0	88.098	0.055035	1.064	1.068265(	2	0.(
2	2	88.933	0.050935	1.068	1.052316(	4	0.(
3	4	85.727	0.066884	1.052	1.027453(	6	0.(
4	6	80.957	0.091747	1.027	1.0005158	8	0.(
5	8	76.088	0.11868	1.001	0.972788(	10	-0
6	10	71.382	0.14641	0.973	0.947223(	12	-0
7	12	67.301	0.17198	0.947	0.920705(	14	-0
8	14	63.315	0.19849	0.921	0.896851(	16	-0
9	16	59.931	0.22235	0.897	0.874373(	18	-0
10	18	56.908	0.24483	0.874	0.853692(	20	-0
11	20	54.262	0.26551	0.854	0.834703(	22	-0
12	22	51.940	0.28450	0.835	0.817628(	24	-0
13	24	49.938	0.30157	0.818	0.800935(	26	-0
14	26	48.055	0.31826	0.801	0.785780(	28	-0
15	28	46.407	0.33342	0.786	0.771225(	30	-0
16	30	44.877	0.34797	0.771	0.757985(	32	-0
17	32	43.530	0.36121	0.758	0.746359(	34	-0
18	34	42.380	0.37284	0.746	0.735046(	36	-0
19	36	41.290	0.38415	0.735	0.724185(	38	-0
20	38	40.270	0.39501	0.724	0.714239(	40	-0
21	40	39.359	0.40496	0.714			
22	42	7.5994	1.1192	0.000			
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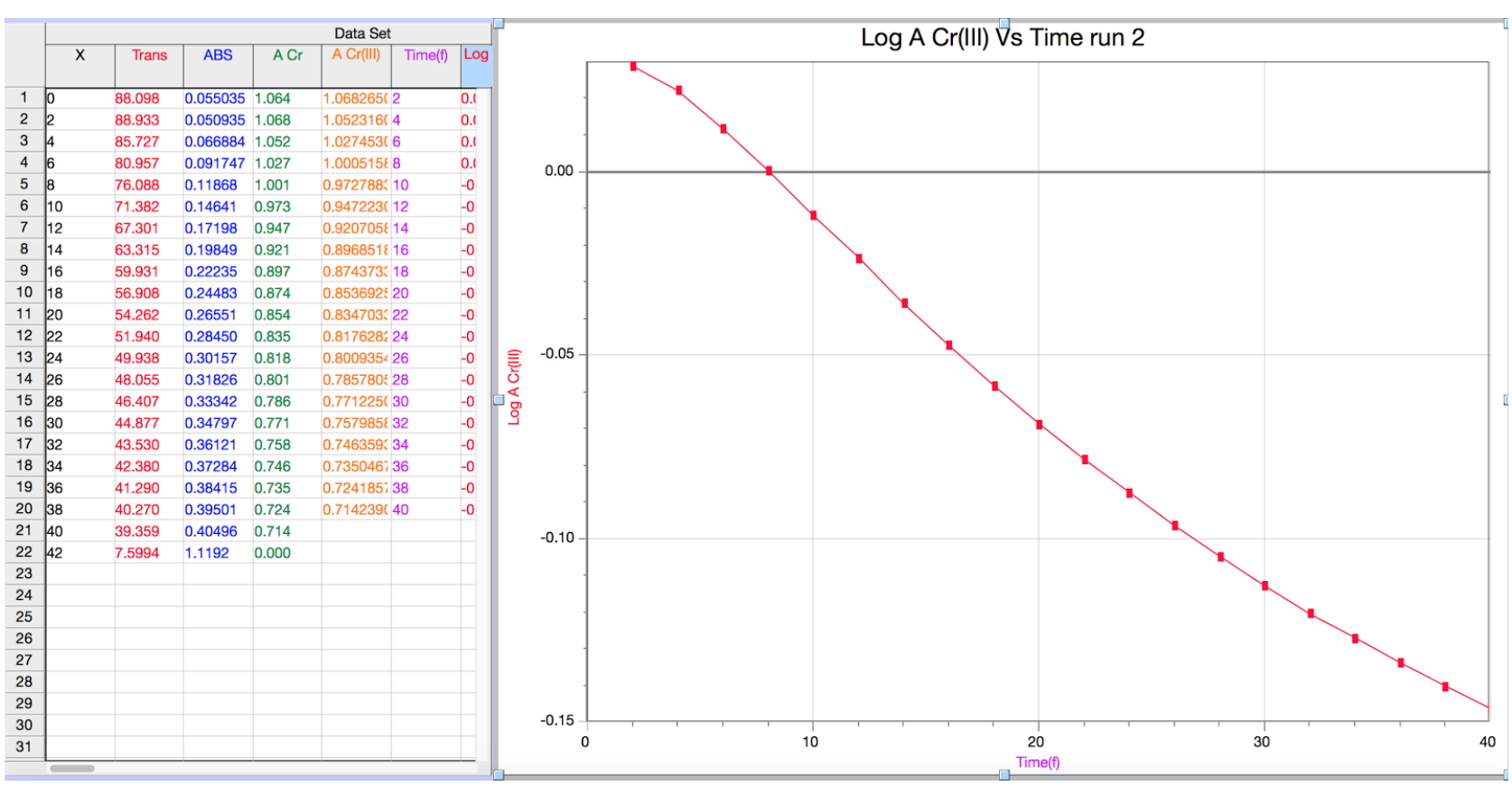

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5	8	76.088	0.11868	1.001	0.972788(	10	-0
6	10	71.382	0.14641	0.973	0.947223(	12	-0
7	12	67.301	0.17198	0.947	0.920705(	14	-0
8	14	63.315	0.19849	0.921	0.896851(	16	-0
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12	22	51.940	0.28450	0.835	0.817628(	24	-0
13	24	49.938	0.30157	0.818	0.800935(	26	-0
14	26	48.055	0.31826	0.801	0.785780(	28	-0
15	28	46.407	0.33342	0.786	0.771225(	30	-0
16	30	44.877	0.34797	0.771	0.757985(	32	-0
17	32	43.530	0.36121	0.758	0.746359(	34	-0
18	34	42.380	0.37284	0.746	0.735046(	36	-0
19	36	41.290	0.38415	0.735	0.724185(	38	-0
20	38	40.270	0.39501	0.724	0.714239(	40	-0
21	40	39.359	0.40496	0.714			
22	42	7.5994	1.1192	0.000			
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9	16	59.931	0.22235	0.897	0.874373(	18	-0
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11	20	54.262	0.26551	0.854	0.834703(	22	-0
12	22	51.940	0.28450	0.835	0.817628(	24	-0
13	24	49.938	0.30157	0.818	0.800935(	26	-0
14	26	48.055	0.31826	0.801	0.785780(	28	-0
15	28	46.407	0.33342	0.786	0.771225(	30	-0
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19	36	41.290	0.38415	0.735	0.724185(	38	-0
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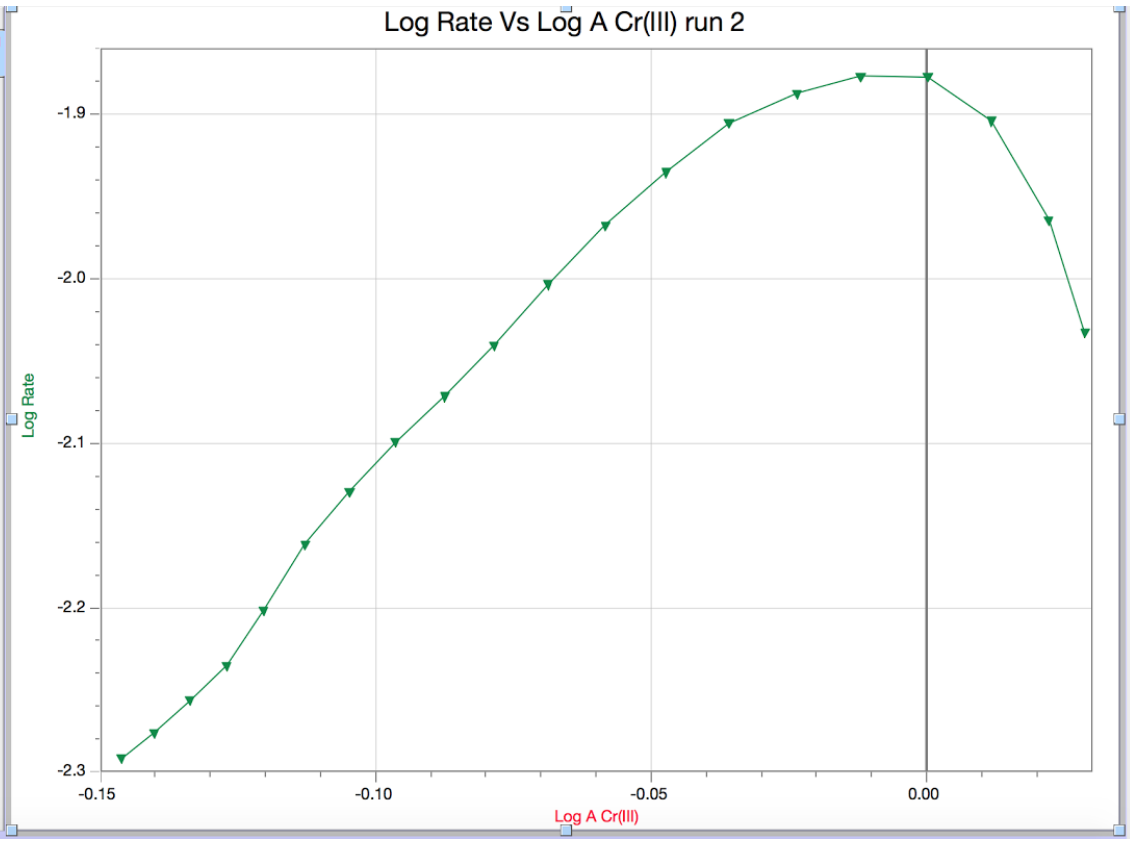

run 3

Experiment 1	
PH Level EDTA	5.0
Volume EDTA	10ml
% T at 40 min	87.883
% T at 42 min	4.444
ABS at 40 min	.056097
ABS at 42 min	.13572

the EDTA got a little darker after adding 2 drops of chromium nitrate solution. after the heating, it turned purple as well as the graph slowly increased as it did in trial 1 and 2 but it increased drastically. When the chromium was added the absorption graph shot up and the transmittance graph shot down.

Data Set

	A Cr	A Cr(III)	Time(f)	Log A	Rate	Log Rate
1	1.2963	1.2684	2	0.103	0.031	-1.507
2	1.2684	1.2087	4	0.082	0.033	-1.488
3	1.2087	1.1392	6	0.057	0.033	-1.478
4	1.1392	1.0722	8	0.030	0.033	-1.487
5	1.0722	1.0057	10	0.002	0.030	-1.522
6	1.0057	0.95068	12	-0.022	0.027	-1.574
7	0.95068	0.89993	14	-0.046	0.024	-1.627
8	0.89993	0.85635	16	-0.067	0.021	-1.686
9	0.85635	0.81766	18	-0.087	0.018	-1.749
10	0.81766	0.78514	20	-0.105	0.015	-1.817
11	0.78514	0.75802	22	-0.120	0.005	-2.308
12	0.75802	0.73271	24	-0.135	-0.023	
13	0.73271	0.71038	26	-0.149	-0.111	
14	0.71038	1.2961	28	0.113	-0.208	
15	1.2961					
16	-1.4891E-					
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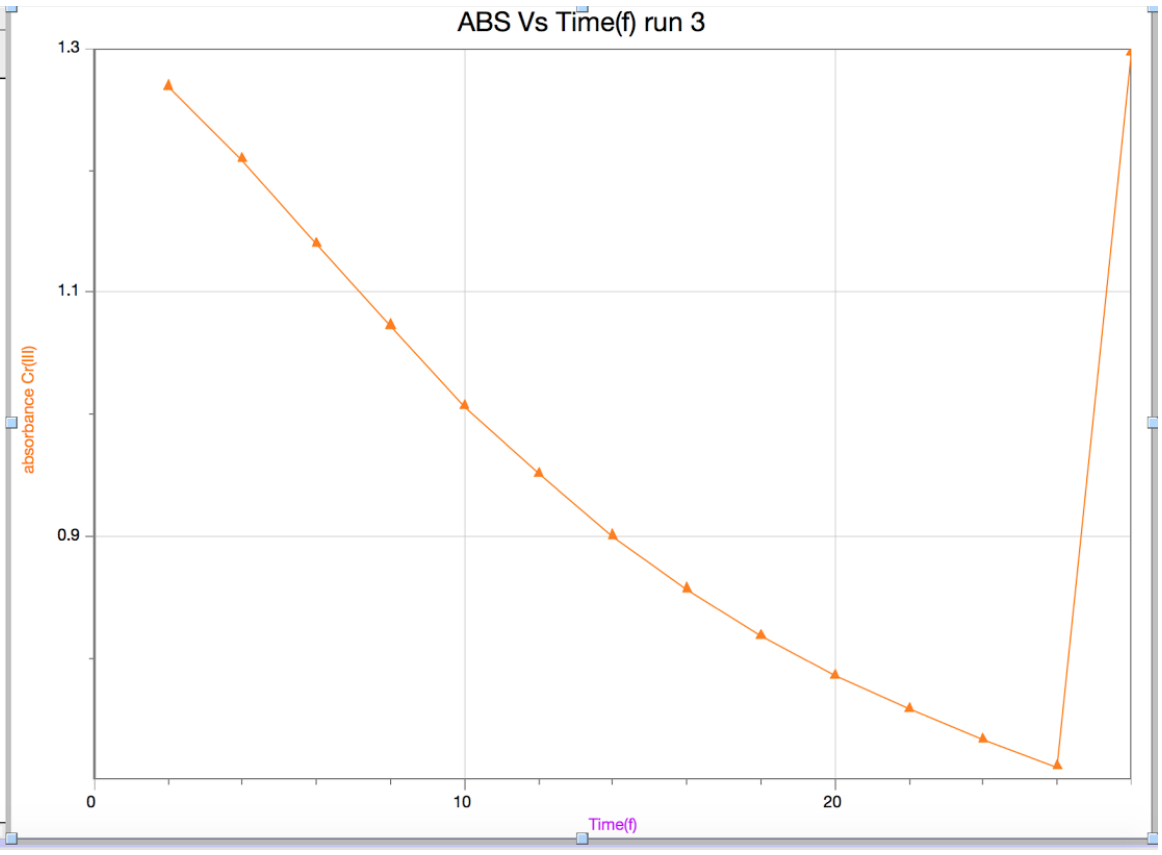

Data Set

	A Cr	A Cr(III)	Time(f)	Log A	Rate	Log Rate
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8	0.89993	0.85635	16	-0.067	0.021	-1.686
9	0.85635	0.81766	18	-0.087	0.018	-1.749
10	0.81766	0.78514	20	-0.105	0.015	-1.817
11	0.78514	0.75802	22	-0.120	0.005	-2.308
12	0.75802	0.73271	24	-0.135	-0.023	
13	0.73271	0.71038	26	-0.149	-0.111	
14	0.71038	1.2961	28	0.113	-0.208	
15	1.2961					
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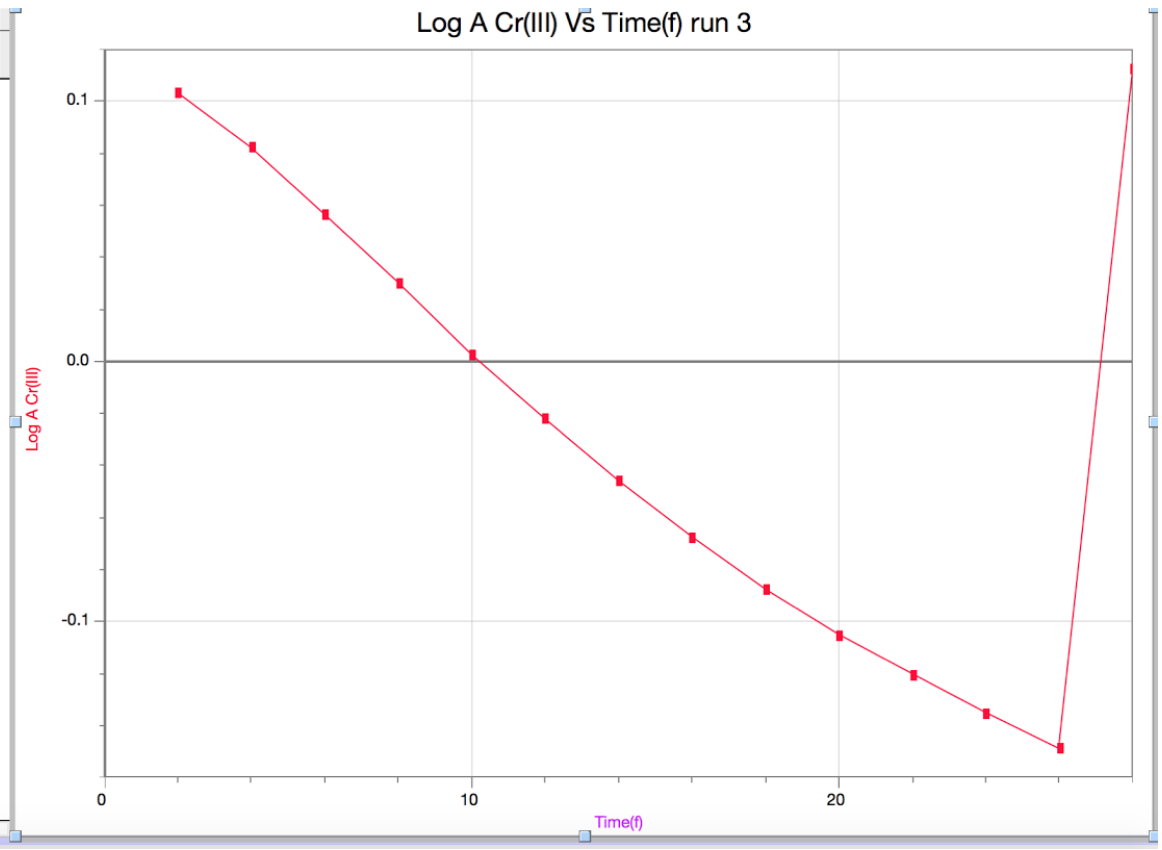

	Data Set				
	A Cr(III)	Time(f)	Log A	Rate	Log Rate
1	1.2684	2	0.103	0.031	-1.507
2	1.2087	4	0.082	0.033	-1.488
3	1.1392	6	0.057	0.033	-1.478
4	1.0722	8	0.030	0.033	-1.487
5	1.0057	10	0.002	0.030	-1.522
6	0.95068	12	-0.022	0.027	-1.574
7	0.89993	14	-0.046	0.024	-1.627
8	0.85635	16	-0.067	0.021	-1.686
9	0.81766	18	-0.087	0.018	-1.749
10	0.78514	20	-0.105	0.015	-1.817
11	0.75802	22	-0.120	0.005	-2.308
12	0.73271	24	-0.135	-0.023	
13	0.71038	26	-0.149	-0.111	
14	1.2961	28	0.113	-0.208	
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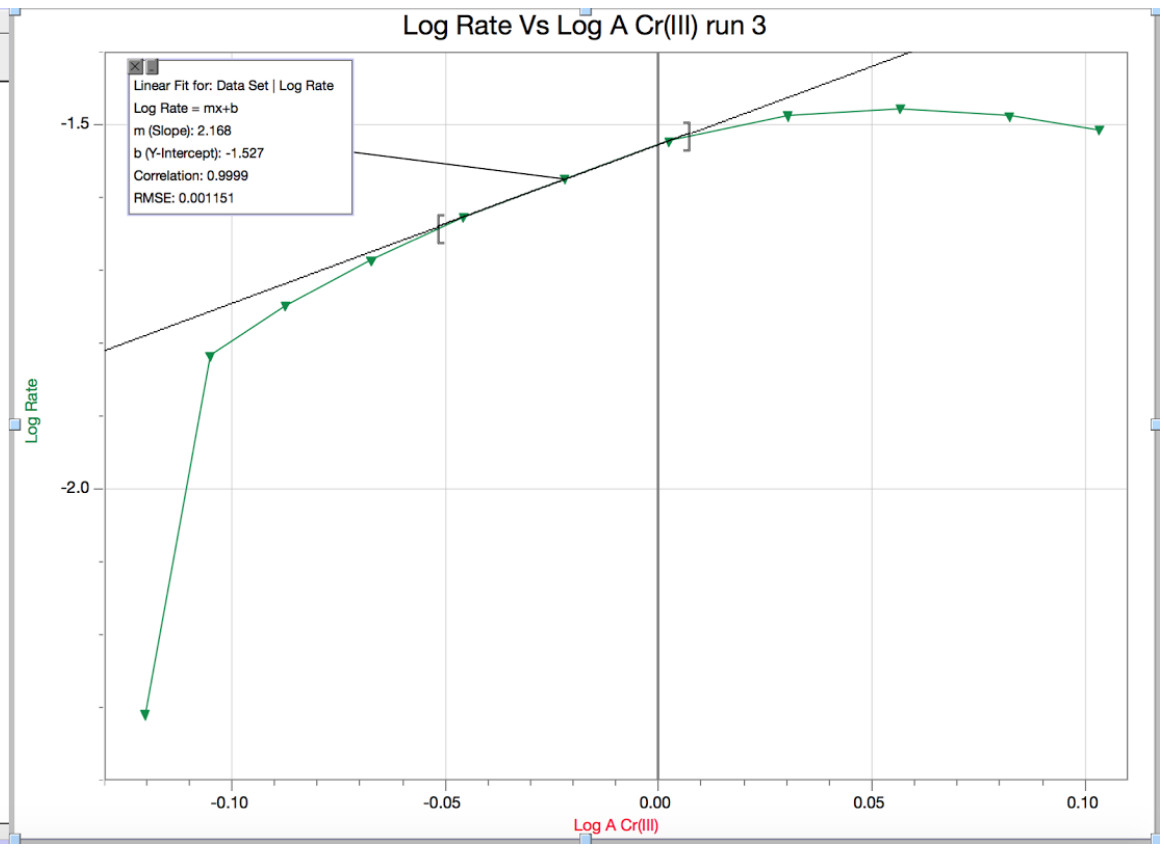


Calculations

run 1

1) A=-Log(88.314/100)

A=-Log(.88314)

A=.05397

$A_{Cr(III)} = A_{infinity} - A_t$

ACr(III)=1.3007-.05397

ACr(III)=1.24673

run 2

2) A=-Log(87.918/100)

A=-Log(.87918)

A=.0559222

$A_{Cr(III)} = A_{infinity} - A_t$

ACr(III)=1.1192-.055922

ACr(III)=1.0641605

run3

3) A=-Log(88.098/100)

A=-Log(.88098)

A=.05503395

$A_{Cr(III)} = A_{infinity} - A_t$

ACr(III)=1.3522-.0550395

ACr(III)=1.2971605

discussion

We started the experiment by calibrating the spectrometer with an initial test that lasted a few minutes. For our first trial with the EDTA with a PH level of 4.0 we observed the graph of absorption Vs time we noticed that the slope was negative at a pretty constant rate. We observed that the difference between the level of PH affect the slope of the graph. The higher the PH the greater the rate of change was and this was both for absorbance or %transmittance. During all our trials we kept everything constant except for the PH level of the EDTA so the only thing affecting our result is the PH of the EDTA.

we created three graph for each of our trials, the ABS Vs Time, Log A Cr(III) Vs Time, and Log Rate Vs Log A Cr(III). we were able to come to the conclusion that the ABS Vs Time and the Log A Cr(III) Vs Time had the same rate but they had different intervals where the ABS is on a larger scale than the Log

during each trial we started by boiling water and measuring ten ml of EDTA and the transferred it to a test tube and proceeded by dropping two drops of Cr(III) at t=0 as soon as we started lab quest, then we filled a cuvette to the mark with the mixture. Wiped the outside of the cuvette with a Kimwipe to clean fingerprints. then we observed the labquest until t=40 where we rapidly pulled out the cuvette and replaced it with the test tube of the mixture that sat in boiling water for ten min. We then observed till t=42 and repeated the same process for all three trials. The only difference was the level of PH for the EDTA in all trials.

We made a mistake on our third trial because we were running out of time and had to finish the experiment a little earlier. At around t=30 min we made the mistake of taking the cuvette out of spectrometer right before lab quest took a reading so it took a value of nothing. The next reading was normal but it still messed up all of our graphs and gave us negative numbers were we should get positive.

conclusion

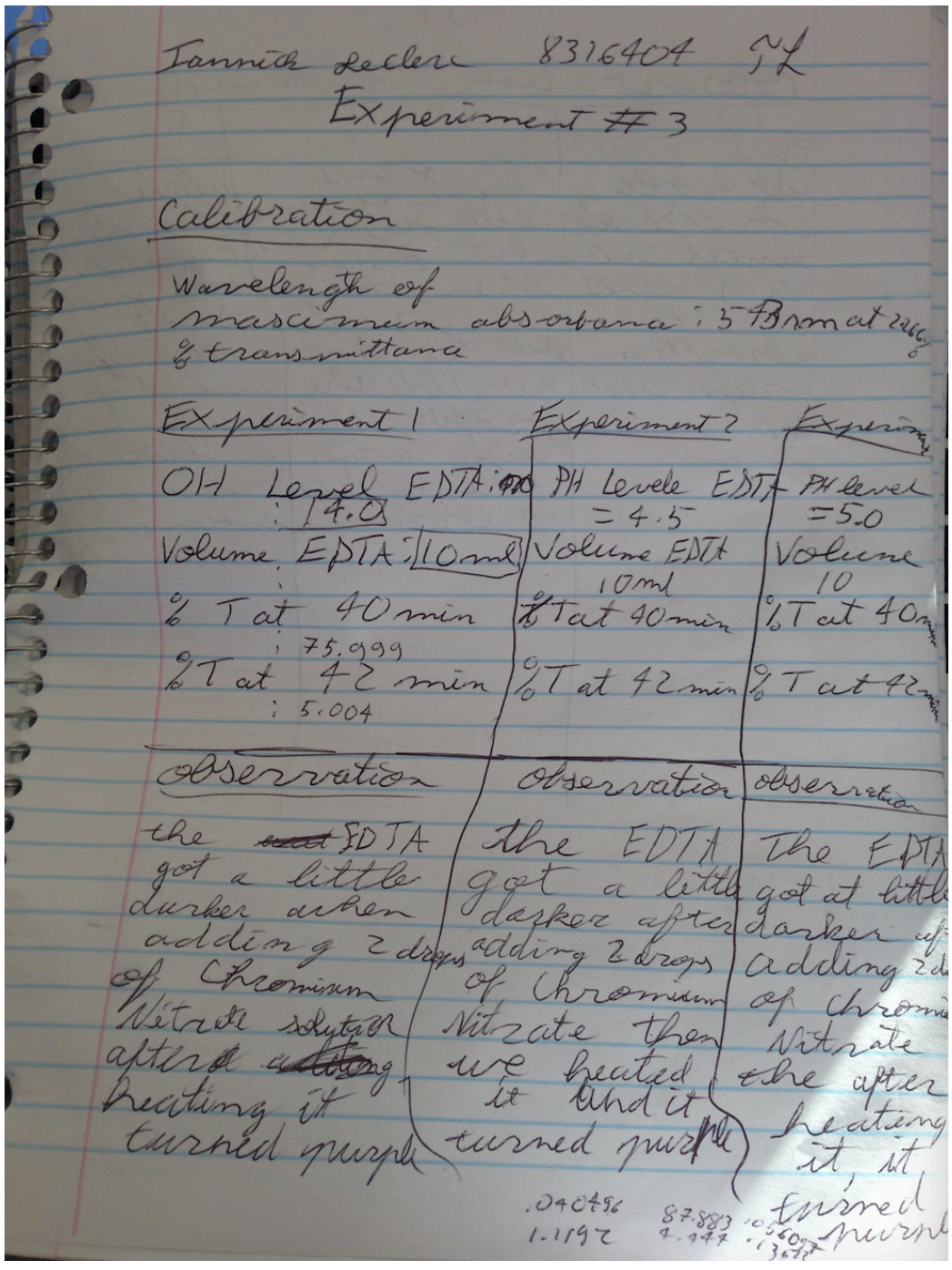
The ACr(III) of trial 1 was 1.24673 the second trial was 1.0641605 and the third trial was 1.2971605 so we can assume that the PH would affect the ACr(III) but since of our mistake in trial 3 we cannot prove this assumption.

sources

IF IT WERE DONE...THEN ‘TWERE WELL IT WERE DONE QUICKLY” CHEMICAL KINETICS -- lab packet

Lab tutorial video

raw data



Observation Continued

4.0	4.5	5.0
the graph slowly increased until chromium was added the the absorbtion graph shot up	the graph slowly increased but just a little bit faster than the 4.0 graph but as the 4.0 did the graph shot up with the addition of Chromium	~~u~~unlike the other two this ~~one~~ graph shot up rapidly instead of increasing a little then raising quick when chromium was added