Title: Chemical Kinetics

Purpose: To study the kinetics of the reaction between crystal violet and sodium hydroxide, understand how concentration of reactants, salts, and solvent, temperature, and ionic strength influence rate, and to determine a rate law for this reaction.

"Before Lab" questions and information:

1. 550-610 nm

   500 – 570 = Green

   570 – 590 = Yellow

   590 – 610 = Orange

2. 20 mL of 0.020 M NaOH

3. Between 1-4 mL

Procedure: 25 mL of a stock crystal violet solution were combined with two concentrations of sodium hydroxide. The resulting reaction was allowed to react for 2 minutes and then it was viewed in a calorimeter. For 20 minutes, the absorbance was measured in increments of 1 minute. The second trial had double the concentration of sodium hydroxide. This was conducted twice. Trial 3 had 1-4 mL of potassium nitrate were added. Trial four had a dropperful of methanol added to sodium hydroxide. For trial 5, the sodium hydroxide and crystal violet reactions were conducted at 10, 15, 20, and 25 degrees Celsius. After sixty seconds of reaction, the calorimeter measured absorbance for 60 seconds.

After Lab:

1. See attached

2.

Table 1				
Orders of Trials				
Trial	**Best Fit**	**K^1**	**K (/s)**	
Trial 1	First Order	-0.0158	7.90	
Trial 2 – Run 1	Zero Order	-0.04302	10.76	
Trial 2 – Run 2	First Order	-0.05391	13.48	
Trial 3	First Order	-0.01344	3.36	
Trial 4	Second Order	-0.01023	25.58	

3. See attached

4. The addition of potassium nitrate made the rate constant decrease. The compound must have reacted with the sodium hydroxide to lower its concentration, thus affecting the rate constant in relation to trial 2. It was also found that the rate of reaction increased. From 10 to 25 degrees Celsius the rate constant increases by ten. The increase in temperature is due to an increase in the kinetic energy of molecules because they can alter the electron cloud and have collisions more often. The methanol increased the rate constant from 3.95 to 12.79 because methanol must have been a catalyst to speed up the reaction.

5. See attached

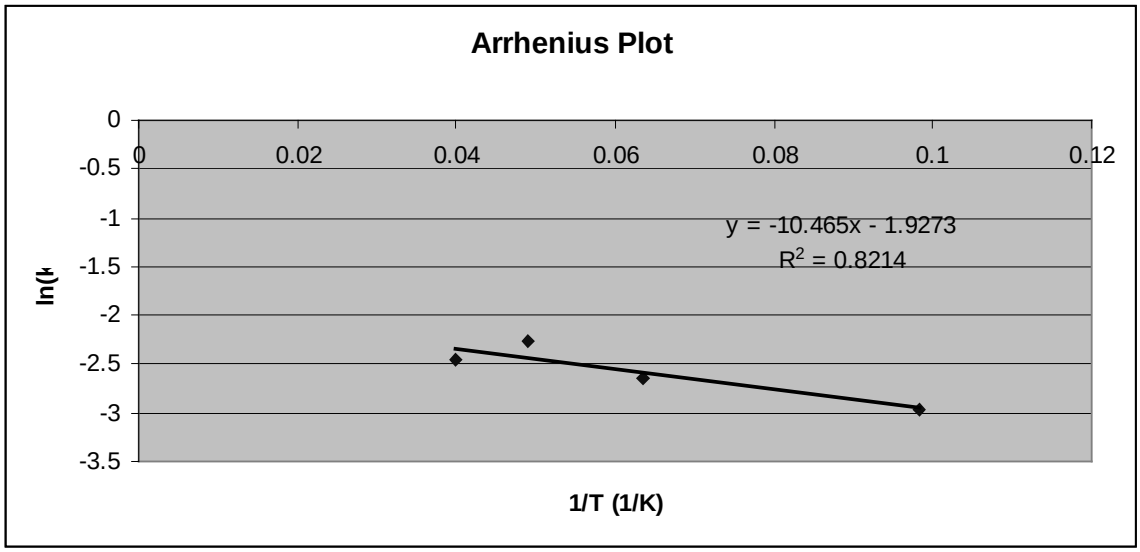

Table 2

Temperature Trial Calculated Values for Arrhenius Plot

Trial	k (/s)	k^1 (/s)	ln(k)	1/T (1/K)
283 K Trial	.05164	.002582	-2.963	.0984
288 K Trial	.07104	.003552	-2.645	.0636
293 K Trial	.10376	.005189	-2.265	.049
298 K Trial	.0852	.004267	-2.463	.04

6. The methanol increased the reaction and increased the rate constant because it was acting as a catalyst to the reaction. However, the salt lowered the rate of reaction and the rate constant because it neutralized some of the sodium hydroxide, thus lowering the concentration of sodium hydroxide to react with crystal violet.

Error Analysis: Dr. Groh revealed to use that there is a possibility of high error in this lab. If the data is slightly incorrect, the entire lab hinges on singular data plots. The slopes are needed to be so precise, that any error is magnified by the use of the ln function. The temperature probes might also have been malfunctioning and the plots are not accurate. The plots were also found to be too similarly correct, so assumptions were made upon the correct order of the reaction. The total reaction order should have been found to be first order, but our data mislead us into thinking that it might be zero order. Our data is not reliable because it didn't correlate to feasible scientific analysis. It is possible concentrations were off enough to affect rate of reaction and thus rate constants.

Conclusion: In Chemical Kinetics, we measured absorbance by conducting a reaction with crystal violet and sodium hydroxide. This data was then used to determine the rate of reaction and the order of reaction. The influence of temperature was also measured by conducting the same experiment in different temperature water baths to find an Arrhenius Plot. While our data was not accurate, we were able to distinguish good data from bad data by using our logical deductive scientific reasoning.