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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:

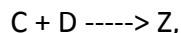
- Raw Data Sheet copy attached
- 9 curves [3 for A vs t; 3 for log A vs t; 3 for log Rate vs log A] attached
- Completed formal report typed and attached

Student's Initials EF

# TITLE: CHEMICAL KINETICS

## INTRODUCTION:

From the name “chemical kinetics”, it is clear that chemical reactions also have some sorts of movement within them during a given reaction. This eventually begs the question “how fast”. Chemical kinetics is defined as the study of factors that control the rate of reaction and how the reactions occur. Knowing that this has to do with the ratio of two media, we use the rate law equation is undoubtedly the working formula. So in any chemical equation given as



We can say that the rate is shown as

$$\text{Rate} \propto [C]^m [D]^n$$

Where [C] & [D] are the concentrations of the reactants C & D respectively, and m & n exponents are the reaction orders which show how the rate of the reaction is affected by each reactant concentration. The sum of m and n gives the total order of the whole reaction. The rate expression can be turned into the equation

$$\text{Rate} = k [C]^m [D]^n$$

Where k, is the proportionality constant (rate constant) which is specific by reaction and does not change when the reaction does but changes with temperature.

The rate of reaction can also be determined through graph method, it is called the “instantaneous rate of change” which is a common name. It is gotten from the slope of the graph.

**EXAMPLE:** For a graph which plots temperature (T) as a function of time (t), the slope is gotten from the equation

$$DT/Dt$$

Where DT is the change in temperature gotten by dividing the difference between any two points on the y-axis (temperature) by the difference between any two points on the x-axis (time).

**PROCEDURE:** As described in the lab manual “chemical kinetics” by Dr. Rashmi Venkateswaran.

## OBSERVATIONS:

The reaction had a transparent greenish gray colour when Cr(III) ion was originally added but turned dark purple during the process of heating it for all 3 runs

The colour change of the last run was not as severe as the first two.

## CALCULATIONS:

$$\text{Rate} = [\text{Cr(III)}]^m [\text{EDTA}]^n [\text{H}^+]^p$$

Where; EDTA and H<sup>+</sup> are kept constant

$$\text{Rate} = k' [\text{Cr(III)}]^m$$

$$\text{Where } k' = [\text{EDTA}]^n [\text{H}^+]^p$$

Using the log rule, we have

$$\text{Log}[\text{Rate}] = \text{Log}k' + m \text{Log} [\text{Cr(III)}]$$

The equation takes the linear form of equation

$$Y=b+mx$$

Plotting Log [Rate] as a function of Log [Cr (III)]

The slope gotten from the plot will give the rate order

For the first run, the slope was gotten as 4.078 approx., 4

The order with respect to [Cr (III)] is 4 from pH EDTA 4

The second run gave a slope of 8.431 approx. 8

The order with respect to [Cr (III)] is 8 from pH EDTA 4.5

The third run gave a slope of 0.9881 approx. 1

The order with respect to [Cr (III)] is 1 from pH EDTA 5

#### DISCUSSION:

The purpose the whole reaction was to achieve the rate order with respect to Cr(III) in the long run. For the second run we did not run the standard 40minute time plus 2minutes we were asked to but rather, because of time factor we were instructed to run somewhere between 20-30minutes and then 2minutes, so this might be a source of error. The curve of the first run of the first graph was not exactly a drop because it took time for the reaction to get started so this might be another source of error. The normal waiting time for the experiment is about 6 hours at room temperature because it is temperature based but time was not in our favour, so the reaction was sped up by heating and then cooling. This is another likely source of error. This is assumed to be the result after 6 hours. For the graph plots, the values in the original table were not used but rather modified to get the values for the plots. For the first graph which was a plot of the chromium ion absorbance (A Cr (III)) as a function of time, we subtracted the absorbance at any time (t) from the absorbance at the final time ( $A_{\infty}$ ). For the second graph, we plotted the log of chromium ion absorbance ( $\log [A \text{ Cr(III)}]$ ) as a function of time (t). We then got the rate which was gotten for negative derivative of the chromium ion absorbance and then found the log of the rate of each value ( $\log \text{ rate}$ ). This brought rise to the third graph which was a plot of ( $\log \text{ rate}$ ) as a function of ( $\log [A \text{ Cr(III)}]$ ). To get the order with respect to Cr(III), we need the concentration, but we were given the absorbance. Therefore the formula

$$A=\epsilon bc$$

Where A is the absorption, b is the path length,  $\epsilon$  represents the molar absorptivity and c is the concentration. The path length and molar absorptivity are relatively constant so the absorption and concentration are proportional. The assigning of the runs with the pH values are as follows

Run 1-EDTA 4

Run 2-EDTA 4.5

Run 3-EDTA 5

#### CONCLUSION:

The partial order with respect to Cr (III) is:

4 from pH EDTA 4

8 from pH EDTA 4.5

1 from pH EDTA 5





