Experiment 3 Kinetics 6 February 2020

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Objectives: To determine the order of a reaction and determine the rate law and rate constant.

Interesting blue reaction! I wonder what the rate law is? We will figure that and more! We'll also figure out the rate constant using a single timeconcentration study!

Overview:

- 1. Kinetics and reaction order
- 2. Collecting the data
- 3. Using Excel
- 4. Procedure: What we will do today
- 5. Your lab report

It's selfie day in lab! Send a selfie of you and your lab partner to Dr M for the lab website.

The formula for blue food coloring is complicated enough that we refer to it as **Blue**.

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Here we have a cup of blue food coloring
 undergoing the reaction. Each cup
 represents a certain period of time

Blue(aq) + OCl⁻(aq) \rightarrow Colorless(aq) + Cl⁻(aq)



The Blue is blue food coloring.

The hypochlorite ion is the active ingredient in household bleach.

Blue + OCl⁻(aq) \rightarrow Colorless(aq) + Cl⁻(aq)

The experiment is designed so that there is plenty of hypochlorite throughout the course of the reaction, so our focus is on the kinetics of the reaction in terms of Blue.

> We wish to determine the order in terms of Blue. In other words, what is x?

chemistry

rate = $k[Blue]^{x}$, Is x = 0, 1 or 2?

Info for Introduction









Second order reactions have this rate law and timeconcentration expression.

Info for Introduction



2. Collecting the data



We'll also need the molar absorptivity from last week's experiment

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3. Using Excel: Transferring data from LoggerPro

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3. Using Excel: Writing a formula

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3. Using Excel: Copy and paste formulas

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3. Using Excel: Making a scatter chart

Now we are ready to test for zero order...

We highlight data to plot... To do this, highlight Cells A1 – A22 in this example. Use Command (on Mac) to highlight Cells C1 – C22. Note Column B is not highlighted.

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3. Using Excel: Test for zero order



3. Using Excel: Adding chart titles, legend

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3. Using Excel: Custom fitting the layout



3. Using Excel: Test for first order

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3. Using Excel: Test for second order





Arrange your data and charts so they have this general shape and can be printed on one page. It may take a little fiddling... You can make this arrangement in Excel or by taking screen shots and pasting into a Word document.

> The rate constant, k, comes from the slope of the straight-line plot and is always positive. Absorbance data had 3 significant figures, but trendline uses data from them as a set, so it is possible to report four sig figs.

Your Excel data should be presented here – all of the data – 5 columns and ~25 rows.

chart First order

Zero order

chart

Second order chart

20

Eye on the prize! What is the rate law? rate = k[Blue]⁰ rate = k[Blue]¹ rate = k[Blue]²

Save your Excel spreadsheet for the quiz next week. You will use your laptop during the quiz. Data that will be used in the quiz are provided at the Chm 206 website so you can prepare the worksheet prior to the quiz.

Use the same cell layout as in the examples. A question might be: "What formula is entered in Cell D15?"

Only this one
way will work!

You'll be entering data into a Google form. Exponential numbers are entered as in this example: 8.00 x 10⁻⁶ would be entered as 2.005 6 – note there are no spaces!



Wearing your safety glasses is necessary due to the bleach. Also, dress for a mess.

(1)

2)

(4)

Take time writing an introduction in your own words before lab. Include Objective from Slide 2 and equations from Slides 3-8. Also mention how the slope gives us k for each order.

Each pair of students performs Parts A - D of the procedure as per lab manual.

Record observations and details as carefully as possible. Show your calculations with formulas, units, and significant figures!

5 Analysis is done using Excel. For the purposes of next week's quiz, use the format given here rather than in the Lab Manual.

6 Determine order, rate constant (from slope of trendline) and half-life as part of your lab report. Determine the rate constant from the slope of the line. Calculate half life – watch the sig figs.

Submit on-line data before you leave today.

5. Your lab report

First, the cover page with TA initials. Next, the trimmed copy pages from your lab notebook.

On-line results due at the end of class today. Remember the required format for exponentials: 8.00E-6 (and no spaces). Late submissions are not graded – see the syllabus.

Attachments: Your Excel data and three graphs (preferably all on one page). Staple entire report together.

5 Turn in lab report *before* the start of class to Late labs may not be graded – see the syllar

Stick people inspired by xkcd cartoons by Randall Munroe (www.xkcd.com)

3)

Chem Lab with the Stick People and Bird was created and produced by Dr. Bruce Mattson, Creighton Chemistry. Enjoy it and share it if you wish.