

## Rate Law Determination of the Crystal Violet Reaction

In this experiment, you will observe the reaction between crystal violet and sodium hydroxide. One objective is to study the relationship between concentration of crystal violet and the time elapsed during the reaction. The equation for the reaction is shown here:



A simplified (and less intimidating!) version of the equation is:



The rate law for this reaction is in the form:  $\text{rate} = k[\text{CV}^+]^m[\text{OH}^-]^n$ , where  $k$  is the rate constant for the reaction,  $m$  is the order with respect to crystal violet ( $\text{CV}^+$ ), and  $n$  is the order with respect to the hydroxide ion. Since the hydroxide ion concentration is more than 5000 times as large as the concentration of crystal violet,  $[\text{OH}^-]$  will not change appreciably during this experiment. Thus, you will find the order with respect to crystal violet ( $m$ ), but not the order with respect to hydroxide ( $n$ ).

As the reaction proceeds, a violet-colored reactant will be slowly changing to a colorless product. Using the green (565 nm) light source of a colorimeter, you will monitor the absorbance of the crystal violet solution with time. We will assume that absorbance is proportional to the concentration of crystal violet (Beer's law). Absorbance will be used in place of concentration in plotting the following three graphs:

- Y Absorbance vs. time:      A linear plot indicates a *zero order* reaction ( $k = \text{slope}$ ).
- Y  $\ln$  Absorbance vs. time:    A linear plot indicates a *first order* reaction ( $k = \text{slope}$ ).
- Y  $1/\text{Absorbance}$  vs. time:    A linear plot indicates a *second order* reaction ( $k = \text{slope}$ ).

Once the order with respect to crystal violet has been determined, you will also be finding the rate constant,  $k$ , and the half-life for this reaction.

# Crystal Violet Rate Law Lab Answers Chemistry

**Yicheng Fang**



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