

## Reaction Kinetics: The Iodine Clock Reaction

### Introduction

The “clock reaction” is a reaction famous for its dramatic colorless-to-blue color change, and is often used in chemistry courses to explore the rate at which reactions take place. The color change occurs when  $I_2$  reacts with starch to form a dark blue iodine/starch complex. The ability to record the time at which the blue complex appears allows the rate of reaction to be determined accurately with a stopwatch.

In this experiment, the rate law for a reaction is determined using the method of initial rates. The effect of concentration on the rate of this reaction is determined by measuring the initial reaction rate at several reactant concentrations. You will also examine the effect of a catalyst on the reaction rate. Lastly, you will investigate the effect of temperature on the rate of this reaction, which will allow you to determine the activation energy.

### The Clock Reaction

The primary reaction to be studied is the oxidation of the iodide ion by the bromate ion in aqueous solution:



This reaction will be run in the presence of a known amount of  $S_2O_3^{2-}$  (thiosulfate), which reacts very rapidly with  $I_2$ . As long as  $S_2O_3^{2-}$  is present,  $I_2$  is consumed by  $S_2O_3^{2-}$  as fast as it is formed. This competing reaction prevents the  $I_2$  produced from our reaction of interest from reacting with starch, so no color change is observed until the thiosulfate is completely used up. The “clock” reaction is the reaction of a very small amount of  $S_2O_3^{2-}$  (thiosulfate) with the  $I_2$  produced in the primary reaction:



The “clock” reaction will signal when the primary reaction forms a specific amount of  $I_2$ . The amount of  $I_2$  formed before the color change can be calculated from the known amount of  $S_2O_3^{2-}$  added using the molar ratio in Equation 2. To find the rate of Equation 1, the change in the concentration of  $I_2$  is monitored over time. Below,  $\Delta[I_2]$  is the change in the concentration of  $I_2$ , and  $\Delta t$  represents the change in time:

$$Rate = \frac{1}{3} \cdot \frac{\Delta[I_2]}{\Delta t} \quad \text{Equation 3}$$

Recall that:

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**PT Brinkman**

A red circular graphic with a gradient, appearing as a partial circle or a thick arc, located to the right of the PT Brinkman text.

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