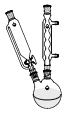
Kinetics of the Iodine Clock Reaction



[1]Iodate ion reacts with bisulfite ion in aqueous solution according to the following equation:

$$2\ IO_3^{1-} + 5\ HSO_3^{1-} = I_2 + 5\ SO_4^{2-} + H_2O + 3\ H^+$$

I_2 forms a blue-black complex with starch, so if starch is added to a solution of iodate and bisulfite, the solution turns dark blue when sufficient I_2 is produced. Since the rate of reaction is inversely proportional to the time for a given amount of product to form, the appearance of the blue color can be used to determine the rate (or something proportional to the rate) of the reaction and, by varying concentrations of reactants, the order with respect to each reactant can be determined.

Part I- Is Cu^{2+} a catalyst for the reaction?

A. Add 8 drops of 0.010 M $CuSO_4$ solution to a 50 mL beaker containing 20 mL of 0.024 M KIO_3. In a second 50 mL beaker, place 5 drops of the starch indicator solution and 20 mL of 0.016 M $NaHSO_3$. Quickly pour the contents of one beaker into the other as you start your stopwatch. Stir the solutions continuously and stop the stopwatch when the solution turns dark blue.

B. Repeat the experiment but DO NOT add the $CuSO_4$ solution to the first beaker.

C. Repeat IA but add 16 drops of the $CuSO_4$ solution.

[1] Adapted from **Conceptual Chemistry** by Gibson and Suchoki, Benjamin Cummings: San Francisco,2001.

Part II-Reaction Order

Prepare 50 mL beakers as indicated by the table below. Add 8 drops of $CuSO_4$ solution to each X beaker and 5 drops of starch indicator solution to each Y beaker. Pour the contents of the beakers together and time the appearance of the deep blue as in Part IA.

Experiment #	Beaker X mL of [KIO_3]	Beaker Y mL of [$NaHSO_3$	Time (secs)
1 (from Part IA)	20 mL 0.024 M	20 mL 0.016 M	
2	20 mL 0.048 M	20 mL 0.016 M	
3	20 mL 0.024 M	20 mL 0.032 M	
4	20 mL 0.048 M	20 mL 0.032 M	

Part III-Temperature Effects

Prepare two beakers as in Part IA. Cool the beakers in an ice bath until the temperature of each is about 10°C. Mix the contents, and time the appearance of the deep blue color (keep the mixture in the ice bath while stirring and waiting for the color).

Prepare two beakers as in Part IA and heat each in a water bath until the temperature is about 40°C. Mix and time the appearance of the blue color.

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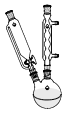

Part I

	drops $CuSO_4$	$[IO_3^{1-}]$	$[HSO_3^{1-}]$	time(sec)	rate∝1/time
A					
B					
C					

Part II

Exp #	$[IO_3^{1-}]$	$[HSO_3^{1-}]$	time(sec)	rate∝1/time
1 (from Part IA)				
2				
3				
4				

Using the date from the table above, determine the values for x and y in the rate expression:

$$\text{rate} = k[IO_3^{1-}]^x[HSO_3^{1-}]^y$$

Part III

Exp	T(K)	$[IO_3^{1-}]$	$[HSO_3^{1-}]$	time (sec)	rate∝1/time	k∝rate
1(from IA)						
2						
3						