

Data Sheet 1

I. Preparing to Measure Solution Volumes

concentration of $\text{H}_2\text{C}_2\text{O}_4$ solution, mol/L _____

concentration of KMnO_4 solution, mol/L _____

room temperature, $^\circ\text{C}$ _____

II. Determining the Effect of Reactant Concentrations on the Reaction Rate

Table I

determination number	volume of $\text{H}_2\text{C}_2\text{O}_4$ solution, mL	volume of KMnO_4 solution, mL	volume of water, mL	elapsed time, s
1	5.0 mL	1.0 mL	6.0 mL	3.05.85
	5.0 mL	1.0 mL	6.0 mL	3.22.18
	5.0 mL	1.0 mL	6.0 mL	3.10.12
	5.0 mL	1.0 mL	6.0 mL	3.05.88
	average elapsed time, s			
2	10.0 mL	1.0 mL	1.0 mL	51.70 sec
	10.0 mL	1.0 mL	1.0 mL	43.69 sec
	10.0 mL	1.0 mL	1.0 mL	1.00.49 sec
	10.0 mL	1.0 mL	1.0 mL	1.21.13 sec
	average elapsed time, s			
3	5.0 mL	2.0 mL	5.0 mL	2.53.79 sec
	5.0 mL	2.0 mL	5.0 mL	2.36.77 sec
	5.0 mL	2.0 mL	5.0 mL	2.33.74 sec
	5.0 mL	2.0 mL	5.0 mL	3.06.
	average elapsed time, s			

Table II

determination number	calculated initial concentrations, mol/L		average elapsed time, s	reaction rate, mol/L·s
	$\text{H}_2\text{C}_2\text{O}_4$	KMnO_4		
1				
2				
3				

Order of reaction with respect to:

(a) $H_2C_2O_4$ _____

(b) $KMnO_4$ _____

Overall reaction order _____

Calculated rate constant, k , for the reaction _____

Rate equation for the reaction: _____

Data Sheet 2

III. Determining the Effect of Temperature on the Reaction Rate

Table III

determination number	volume of $H_2C_2O_4$ solution, mL	volume of $KMnO_4$ solution, mL	volume of water, mL	temperature, °C	elapsed time, s
4	5.0 mL	1.00 mL	6.0 mL	30.6	1.33.60 sec
				30.4	1.28.19 sec
				30.4	1.31 sec
				average temperature, °C	
average elapsed time, s					
5	5.0 mL	1.00 mL	6.0 mL	40.5	47
				41.3	41 sec
				average temperature, °C	
				average elapsed time, s	
6	5.0 mL	1.00 mL	6.0 mL	51	25.
				51	16
				average temperature, °C	
				average elapsed time, s	

On average, the reaction time is decreased _____ times when the reaction temperature was raised 10 °C.

On average, the reaction rate is increased _____ times when the reaction temperature was raised 10 °C.

Post-Laboratory Questions

(Use the spaces provided for the answers and additional paper if necessary.)

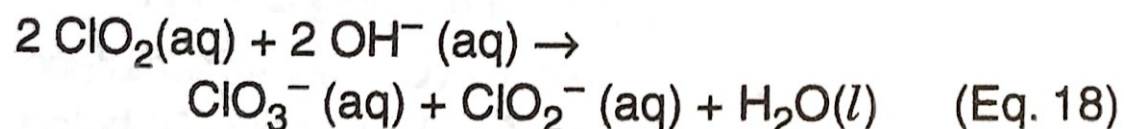
1. When you calculated k in the rate equation for the reaction of KMnO_4 solution and $\text{H}_2\text{C}_2\text{O}_4$ solution, you assumed k had the same value under the conditions of determinations 1, 2, and 3.

(a) What assumption did you make about the reaction of KMnO_4 solution and $\text{H}_2\text{C}_2\text{O}_4$ solution in those determinations that allowed you to consider k to be a constant?

(b) Would it be sound practice to compare the results of determinations 4–6 when calculating k ? Briefly explain.

2. Do your experimental data substantiate the rule of thumb regarding the effect on the reaction rate of a 10-degree increase in reaction temperature? Briefly explain.

3. Consider the reaction that occurs when a ClO_2 solution and a solution containing hydroxide ions (OH^-) are mixed at 0°C , shown in Equation 18.



When solutions containing ClO_2 and OH^- in various concentrations were mixed at 0°C , the following rate data were obtained:

determination number	initial concentration of ClO_2 , mol/L	initial concentration of OH^- , mol/L	initial rate for formation of ClO_3^- , mol/L·s
1	1.25×10^{-2}	1.30×10^{-3}	2.33×10^{-4}
2	2.50×10^{-2}	1.30×10^{-3}	9.34×10^{-4}
3	2.50×10^{-2}	2.60×10^{-3}	1.87×10^{-3}

(a) Use the method of initial rates to find the order of the reaction with respect to ClO_2 and with respect to OH^- . Write the rate equation for the reaction of ClO_2 and OH^- at 0°C .

(b) Calculate the rate constant, k , for the reaction of ClO_2 and OH^- at 0°C .

(c) Calculate the reaction rate for the reaction ClO_2 and OH^- at 0°C when the initial ClO_2 and OH^- concentrations are 8.25×10^{-3} mol/L and 5.35×10^{-2} mol/L, respectively.