

Name _____

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Date _____

Chemistry 12Experiment 18-B—Factors Affecting Reaction Rate**Purpose:**

To examine the effect of concentration, temperature, nature of reactants and catalysts on reaction rates.

Procedure:**Part 1-Effect of Concentration**

- Mix the solutions in test tubes 1 and 2 as shown in the following table. Do only the trials directed by the teacher. In each trial record the time it takes for the solution to start turning blue.

Trial #	To go into Test tube # 1		Test tube #2	Reaction Time (s)
	Volume of Solution A (mL)	Volume of Water (mL)	Volume of Solution B (mL)	
1	10.0	0.0	10.0	
2	9.0	1.0	10.0	
3	8.0	2.0	10.0	
4	7.0	3.0	10.0	
5	6.0	4.0	10.0	
6	5.0	5.0	10.0	
7	4.0	6.0	10.0	
8	3.0	7.0	10.0	
9	2.0	8.0	10.0	

There is no “Part 2”

Part 3-Effect of The Nature of Reactants

1. Follow Procedures 1, 2 and 3 on the **bottom** of page 199 of the Heath Lab Manual. Record the results in the following table: (Put a check in the box that applies to each rate.)

Reactants (Active Ions Only)	Relative Reaction Rate			
	Very Fast	Fast	Moderate	Slow
$\text{Fe}^{2+} + \text{MnO}_4^- + \text{H}^+$	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
$\text{C}_2\text{O}_4^{2-} + \text{MnO}_4^- + \text{H}^+$	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Part 4-Effects of A Catalyst and Temperature

1. Do Procedures 1-7 on the top of page 200 in the Heath Lab Manual. (Don't worry about the fingernail brush!)
Record your results in the following table. NOTE: Record the time for any colour change. In some cases, the purple will go completely clear and in other cases it will go from purple to yellow.

	Temperature	Time (s)	Temperature	Time (s)
With Mn^{2+} Catalyst	Room Temp.		~ 50 °C	
Without Mn^{2+} Catalyst	Room Temp.		~ 50 °C	

Calculations and Questions:

1. Solution "A" is **0.02 M KIO_3** (IO_3^-). Use the **dilution formula** to calculate the **$[\text{IO}_3^-]$ right after mixing** test tube 1 and 2 in each trial.

$$\text{Eg) } FC = IC \times \frac{IV}{FV}$$

$$[\text{IO}_3^-] \text{ in Trial 2} = 0.02 \text{ M} \times \frac{9.0 \text{ mL}}{20.0 \text{ mL}} = \mathbf{0.009 \text{ M}}$$

Volume of
Solution "A"

Total Volume of
"A" + Water + "B"

- Put the results for the calculations of $[\text{IO}_3^-]$ in the table below:
- For each trial, calculate “reciprocal time” Reciprocal time is $(1/\text{Reaction Time})$ and the units are s^{-1} . Since Time is **inversely proportional** to Rate, reciprocal time is **directly proportional** to rate. In this experiment we will call it ‘Rate (s^{-1})’. Put the results for these calculations in the table below:

Trial	$[\text{IO}_3^-]$	Reaction Time (s)	Reciprocal Time or Rate (s^{-1})
1	0.01 M		
2	0.009 M		
3			
4			
5			
6			
7			
8			
9			

- Use the Microsoft Excel program to plot a graph of Rate (s^{-1}) vs $[\text{IO}_3^-]$. (“Time” is NOT used)

Follow these directions:

Enter the values for $[\text{IO}_3^-]$ in the “A” column on the spreadsheet. Do it in order of lowest to highest concentration (**Trial 9 1st ♦ Trial 1 last**)

Enter the values for the **Rate(s^{-1})** in the “B” column on the spreadsheet. (**Trial 9 ♦ Trial 1**)

Click in **Cell (C1)**, then click the “**Chart Wizard**” icon  at the top.

Select The “**X-Y Scatter**” graph and select the **second** graph down:



Click the “Next” button and fill in the Chart Title (Rate vs Iodate Concentration), the Value for “X” axis (Iodate Concentration (M)) and the Value for “Y” axis (Rate (1/s))

Click the “Gridlines” tab and just select the “Major” Gridlines for X and Y.

Click the “Legend” tab and click the “Show Legend” box to deselect it.

Click the “Next” button and then **Click the “As New Sheet” radio button.**

Click the “Finish” button and print enough graphs for your group.

Staple a copy of this graph to each lab report.

5. a) What is the general relationship between $[\text{IO}_3^-]$ (a reactant) and the **Rate** of Reaction?

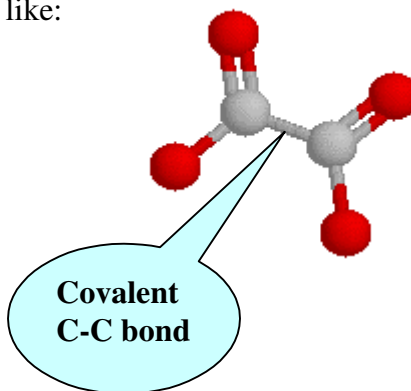
b) Is this relationship a direct proportion or not? (A direct proportion would have close to a straight line graph)

Answer _____

6. Which reacted more quickly with acidified MnO_4^- , the Fe^{2+} solution or the $\text{C}_2\text{O}_4^{2-}$?

Answer _____

The structure of the $\text{C}_2\text{O}_4^{2-}$ ion is like:



Suggest some reasons why this reaction is **slow**.

7. a) Summarize the effect of **temperature** on the **rates** of reactions (See Part 4).

b) Come up with a **hypothesis** on the molecular level to explain the effect in “a”.
(Don’t worry if it is correct or not at this point!)

8. Introducing a suitable **catalyst** to a reaction seem to _____ the reaction rate.