Chemistry 12 Lab 18B
The Iodine Clock Reaction

NAME ______________________

Partner ______________________

DATE ______________ BLOCK ______

Pre-lab Questions:

1. Why is it important for chemists in the manufacturing industry to understand the conditions that affect reaction rates?

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2. In Parts 1 and 2 of this lab there are two reactions - one in which iodine is produced (slow) and one in which the iodine produced is consumed (rapid). Which of these two reactions is the rate determining step?

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3. Name the four conditions that may affect a reaction rate as studied in this lab.

   (A) ______________________ (B) ______________________

   (C) ______________________ (D) ______________________

4. Identify the "chemical indicator" (a substance which changes colour during the course of a chemical reaction) in Parts 1 & 2 of this experiment.

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5. How is the time measured in Parts 1 & 2 of this lab converted into a rate?

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6. Which substance produced in the reaction in Parts 1 & 2 of this experiment causes the indicator to change colour?

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7. What do we call a substance that is able to lower the activation energy of a reaction?

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8. Give the name and formula of the acid used in this lab.

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9. Why is surface area not a factor when considering the reaction rate in this experiment?

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Part 1: Effect of Concentration on Reaction Rate

You will follow the basic instructions as given on page 198 of your lab book. However, you will use 10 mL graduated pipets instead of graduated cylinders for greater accuracy.

- Obtain three 10 mL graduated pipets - one for solution A
  one for solution B
  one for water

- Obtain 10 18 mm × 180 mm test tubes.
  Clean the tubes and shake them partially dry.
  Set them into a test tube rack in two rows of five tubes.

- Into each of the five tubes in one row, carefully measure 10.0 mL of solution B.

- For the other row of test tubes, the class will be divided into two halves. Use the following chart for the amounts needed. Use your graduated pipets to measure the amounts.

Right side of room			Left side of room		
test tube #	mL of solution A	mL of water	test tube #	mL of solution A	mL of water
1	10.0	0.0	1	10.0	0.0
2	9.0	1.0	2	8.0	2.0
3	7.0	3.0	3	6.0	4.0
4	5.0	5.0	4	4.0	6.0
5	3.0	7.0	5	2.0	8.0

- Carefully follow steps 5 - 7 on page 198. Complete the following data table with your personal data and the class averages.

- In order to calculate the concentration of the KIO_3 (concentration is symbolized by square brackets - $[KIO_3]$ -) in the mixture, use the following equation;

$$M_1V_1 = M_2V_2 \quad \text{where}$$

M_1 = molarity of the original KIO_3 solution (= 0.020 M) V_1 = volume of the KIO_3 solution (see chart above)
M_2 = unknown molarity of the KIO_3 solution in the mixture V_2 = combined volume of the mixture (= 20.0 mL)

Fill in the chart on the next page. When you have finished with your data, come to the front board and copy your information down. When the class has finished, take the average values from each set of data and copy it into your chart.

volume of KIO_3 (mL) (V_1)	[KIO_3] in mixture (M_2)	time of reaction (seconds)	Rate of Reaction (1/s)	Class Average time	Class Average Rate
10.0					
9.0					
8.0					
7.0					
6.0					
5.0					
4.0					
3.0					
2.0					

Graphing your Results:

Graph your results on the following page.

We will **assume** that the class averages will be more accurate than your individual data.

Plot the class average points as **circled dots** on the graph.

Draw the best straight line through the majority of the points.

Try to include the (0,0) point if possible.

Plot your individual data points as small **"X"s** on the graph.

Questions:

1. Refer to collision theory and explain why an increase in concentration of reactant will lead to an increase in reaction rate.

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2. Refer to your graph of concentration verses reaction rate. If the concentration of reactant is doubled, by what approximate factor is the reaction rate increased?

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Part 2: Effect of Temperature on Reaction Rate

We will generally follow the instructions as given in Part 2 on page 199 of your lab book. Once again, use graduated pipets instead of graduated cylinders for greater accuracy.

We will once again split the class into two parts for the various temperature baths.

Right side of room test tube #	Water bath temperature	**Left side of room** test tube #	Water bath temperature
1	5°C	1	10°C
2	15°C	2	20°C
3	25°C	3	30°C
4	35°C	4	40°C

- Into each of four test tubes, carefully measure 5.0 mL of solution A and 5.0 mL of water.

- Into each of four other test tubes, carefully measure 10.0 mL of solution B.

- Place all eight test tubes into a 600 mL beaker partially filled with cool water. Place a thermometer into one of your solution B tubes and cool the beaker with ice down to your first test temperature. Remove the thermometer and mix one solution A test tube with one solution B test tube (solution B's are slightly cloudy). Leave the mixed tube in the water bath while you time the reaction.

- Remove the two used test tubes, rinse the thermometer and place it into another solution B test tube. Slowly heat the beaker with a low Bunsen burner flame until the temperature is a couple of degrees below your next test temperature. Mix a solution A test tube with a solution B test tube, leaving the mixed tube in the water bath while you time the reaction.

- Repeat the above steps for your next two test temperatures.

- Complete the following data table.

Water bath Temperature	Reaction Time (in seconds)	Reaction Rate (1 / s)	Class Average Reaction Time	Class Average Reacton Rate
5°C				
10°C				
15°C				
20°C				
25°C				
30°C				
35°C				
40°C				

Graphing your Results:

Graph your results on the following page. Once again, we will **assume** that the class averages will be more accurate than your individual data. Plot the class average points as **circled dots** on the graph.

Draw the best line through the majority of the points.
Your graph may or may not be a straight line graph.

Plot your individual data points as small **"X"s** on the graph.

Questions:

1. Refer to collision theory and explain why an increase in temperature will lead to an increase in reaction rate.

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2. Refer to your graph of temperature verses reaction rate. If the temperature of the reacting molecules is increased by 10°C, be what approximate factor is the reaction rate increased?

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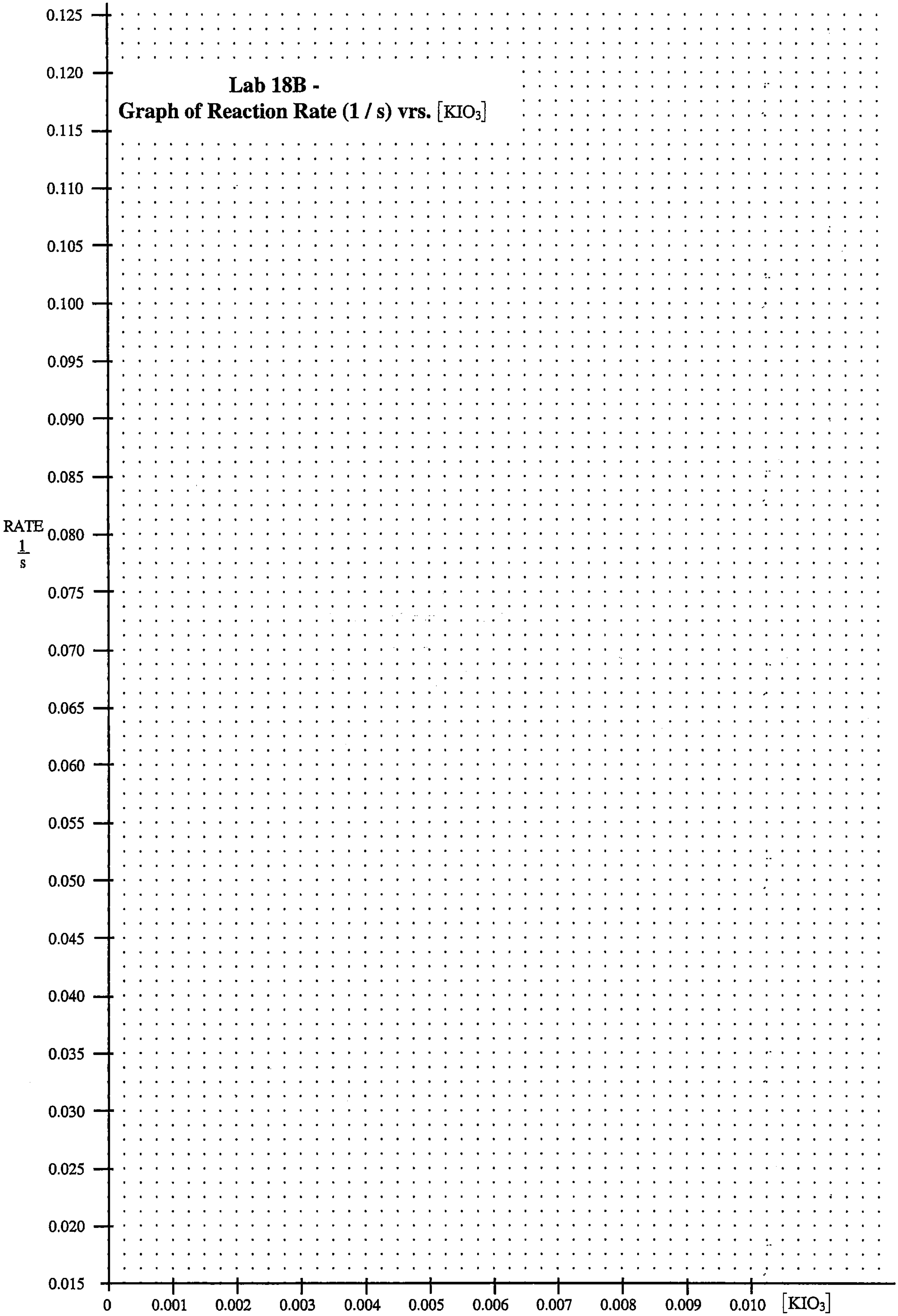
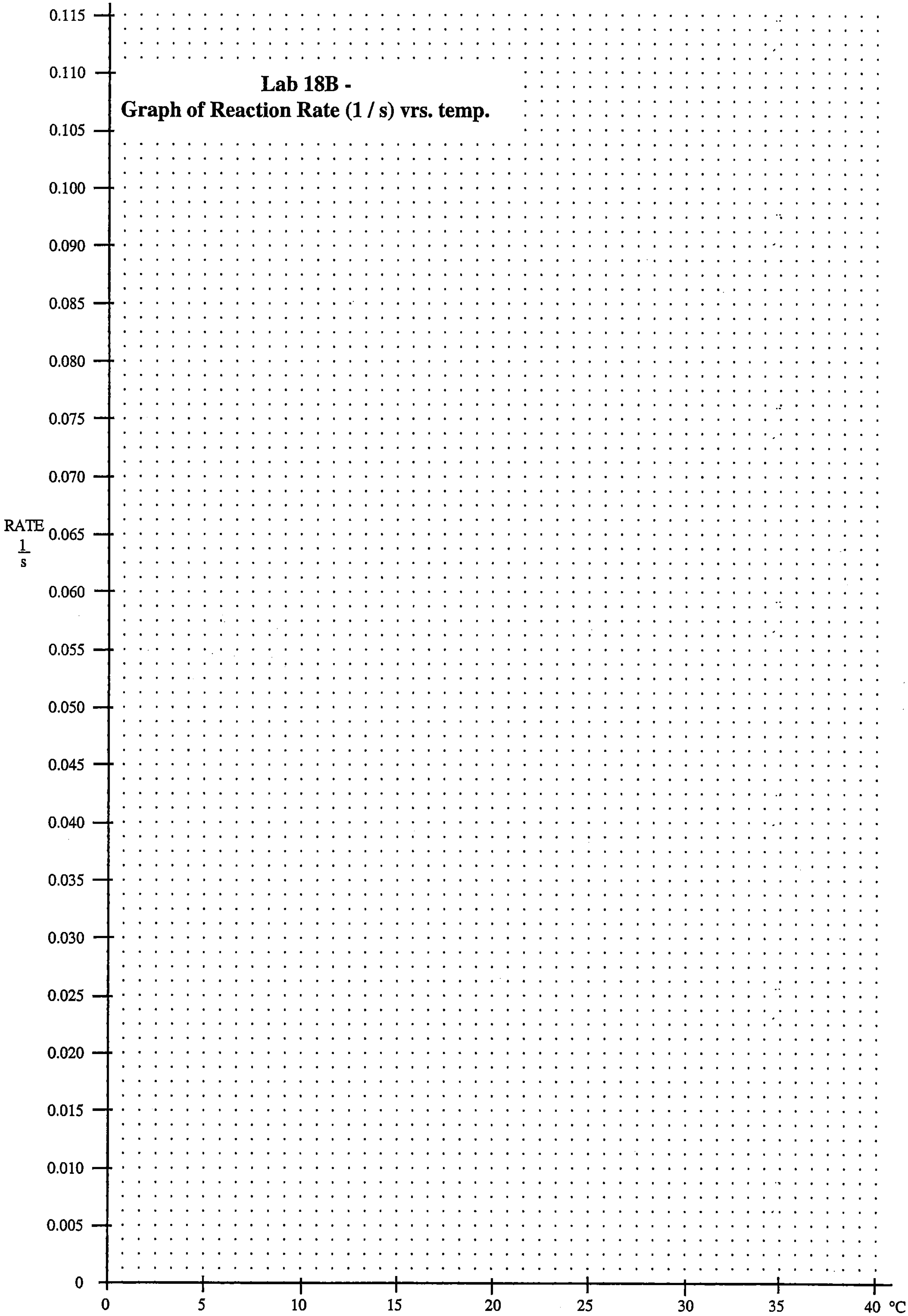
Lab 18B -
Graph of Reaction Rate (1 / s) vrs. [KIO_3]



Lab 18B -
Graph of Reaction Rate (1 / s) vrs. temp.



Part 3: Effect of the Nature of the Reactants

Follow the instructions as given on page 199 of the lab text.

Complete the following table.

	time for reaction
Fe^{2+} + MnO_4^- + H^+	
$C_2O_4^{2-}$ + MnO_4^- + H^+	

Question:

1. Explain the reason for this result by comparing what is involved in changing Fe^{3+} to Fe^{2+} to what is involved in changing $C_2O_4^{2-}$ to 2 CO_2.

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Part 4: Effect of a Catalyst

Follow the instructions as given on page 200 of the lab text.

Complete the following table.

		time (s)		time (s)
With Mn^{2+} catalyst	room temp.		50 °C	
Without Mn^{2+} catalyst	room temp.		50 °C	

BONUS: Enzymes are catalysts made of protein which are necessary for almost every reaction occurring in living cells. Find out why the rates of these reactions increase with increasing temperature only up to about 37°C (body temp.), then decrease above that temperature.

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