

Iodine Clock Reaction
(Determination of order of reaction
and specific rate constant)

In-Lab Guidelines (This is a guide to the information that you should be observing while in the laboratory. Record this information in your Laboratory Notebook. Turn in the duplicate page(s) of your observations to your Instructor before you leave the laboratory period.)

Room Temperature _____ °C

Solution A Molarity $\text{KIO}_3 =$ _____ *M*

Solution B Molarity $\text{H}_2\text{SO}_3 =$ _____ *M*

Part A.

You may wish to already have all the volumes recorded in your table since these are listed in the Experimental Procedure – then all you would need to record was the time.

Mixture	Soln. A (KIO_3)	Soln. B (H_2SO_3)	mL H_2O	Time
1	_____ mL	_____ mL	_____ mL	_____ sec
2	_____ mL	_____ mL	_____ mL	_____ sec
3	_____ mL	_____ mL	_____ mL	_____ sec
4	_____ mL	_____ mL	_____ mL	_____ sec
5	_____ mL	_____ mL	_____ mL	_____ sec

Part B. Temperature

As above, you may wish to have the volumes already filled in when you come to lab. This way you won't have to look them up and you will finish faster.

Mixture	Soln. A (KIO_3)	Soln. B (H_2SO_3)	mL H_2O	Temp.	Time
1	_____ mL	_____ mL	_____ mL	_____ °C	_____ sec
2	_____ mL	_____ mL	_____ mL	_____ °C	_____ sec

Observations: (record any observations you make – how the color appeared, spills, evolution of heat, etc.)

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Post-Lab Report (Use the In-lab observations to complete the laboratory report. Turn in to your Instructor when you have completed the report.)

Part A. KIO₃ solution (Solution A).

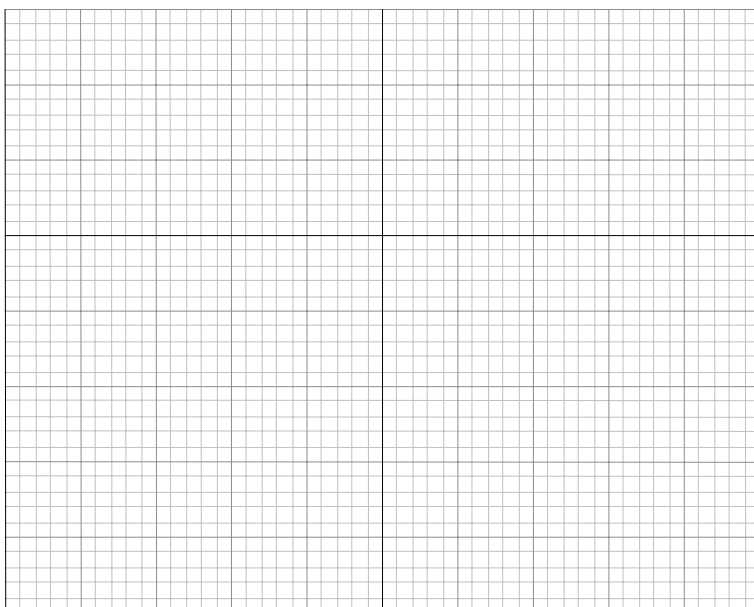
Molarity of KIO₃ stock solution _____ M Total volume of reaction _____ mL

Mixture	mL used	Initial conc. [KIO ₃] (M)	ln[KIO ₃]	1/ [KIO ₃]	Time required
1	_____ mL	_____ M	_____	_____	_____
4	_____ mL	_____ M	_____	_____	_____
5	_____ mL	_____ M	_____	_____	_____

Show your work for the calculation for the initial concentration of [KIO₃] in **Mixture 1**.

You will use graphical analysis to determine the order of [KIO₃] in this reaction. When you determine the order, you will also calculate the specific rate constant, *k*, relative to [KIO₃]. To do this you will plot the three different treatments of the concentration versus time. In the space provided beside each graph you will state whether that graph established the order of the reaction for [KIO₃] **and if it does**, calculate the specific rate constant *k* using your data from that plot.

1. Plot of initial concentration [KIO₃] versus time.



Does this graph establish the order of the reaction? **If** it does, what is the rate law in respect to [KIO₃] **and** what is *k* for this reaction? (show all work)

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Name _____

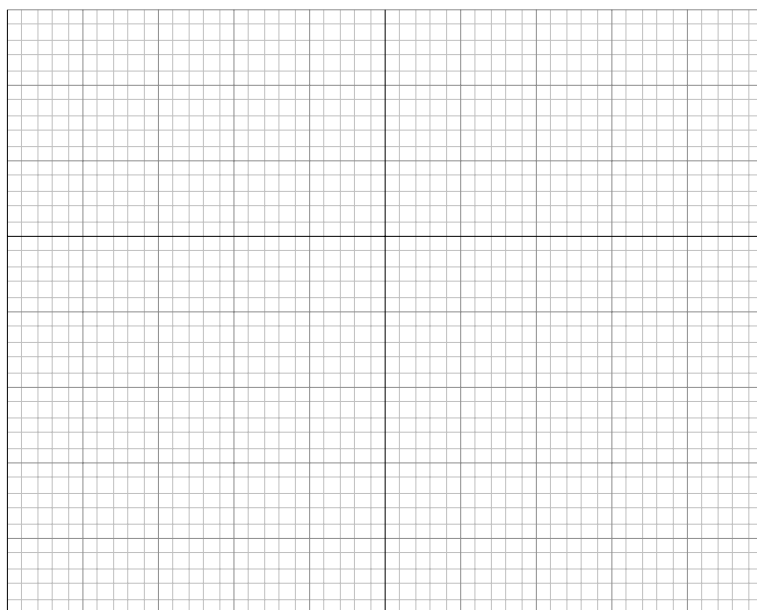
Instructor _____

Lab Section _____

Date _____

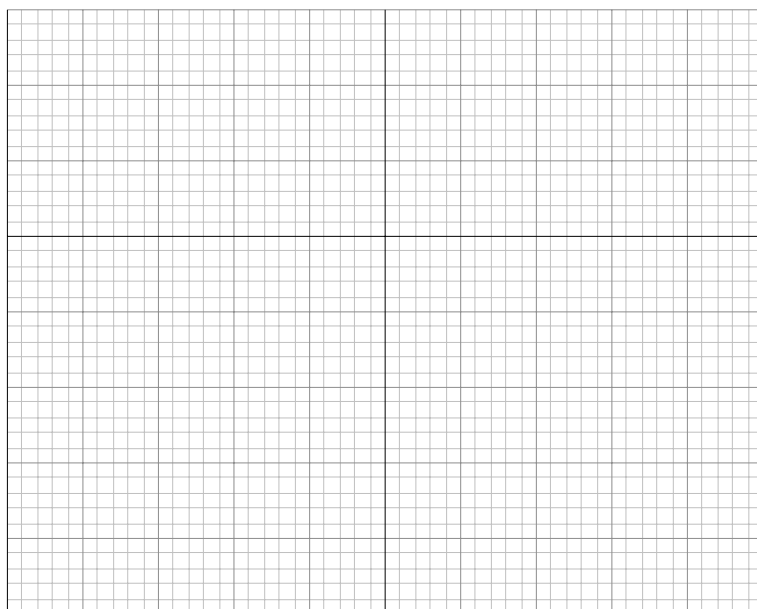
Part A. KIO_3 solution (Solution A) *continued*.

2. **Plot of $\ln[\text{KIO}_3]$ versus time.** (Hint: The natural logarithm, \ln , will be a negative (-) value. This means that the "0" for concentration is positioned at the upper left hand corner of the graph.)



Does this graph establish the order of the reaction? **If** it does, what is the rate law in respect to $[\text{KIO}_3]$ **and** what is k for this reaction? (Show all work.)

3. **Plot of $1/[\text{KIO}_3]$ versus time.**



Does this graph establish the order of the reaction? **If** it does, what is the rate law in respect to $[\text{KIO}_3]$ **and** what is k for this reaction? (Show all work.)

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Part A. H₂SO₃ solution (Solution B).

(Starch was added to the H₂SO₃ solution as an indicator. It does not enter into the reaction mechanism under study. As a result, you do not need to be concerned with the quantity of starch contained in this solution. The molarity listed on the H₂SO₃ stock solution only reflects the concentration of H₂SO₃.)

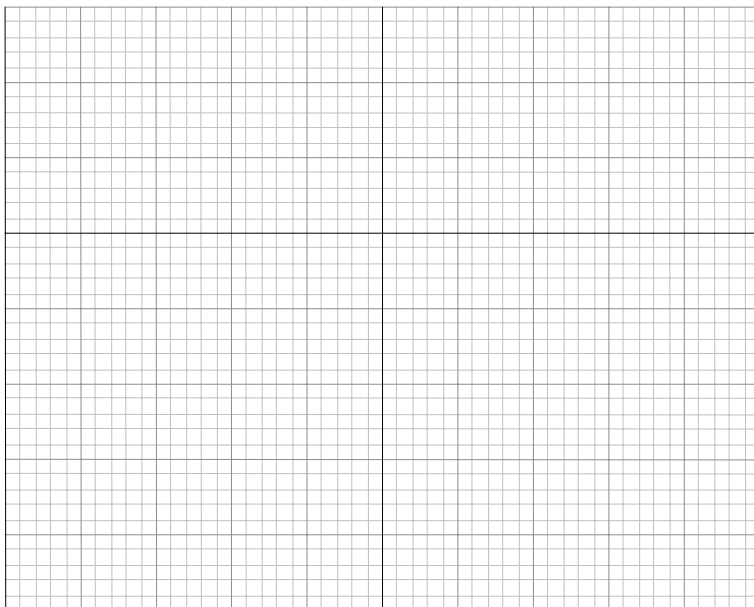
Molarity of H₂SO₃ stock solution _____ M Total volume of reaction _____ mL

Mixture	mL used	Initial conc. [H ₂ SO ₃] (M)	ln[H ₂ SO ₃]	1/[H ₂ SO ₃]	Time required
1	_____ mL	_____ M	_____	_____	_____
2	_____ mL	_____ M	_____	_____	_____
3	_____ mL	_____ M	_____	_____	_____

Show your work for the calculation for the initial concentration of [H₂SO₃] in **Mixture 1**.

You will also use graphical analysis to determine the order of [H₂SO₃] in this reaction. When you determine the order, you will also calculate the specific rate constant, *k*, relative to [H₂SO₃].

4. Plot of initial concentration [H₂SO₃] versus time.

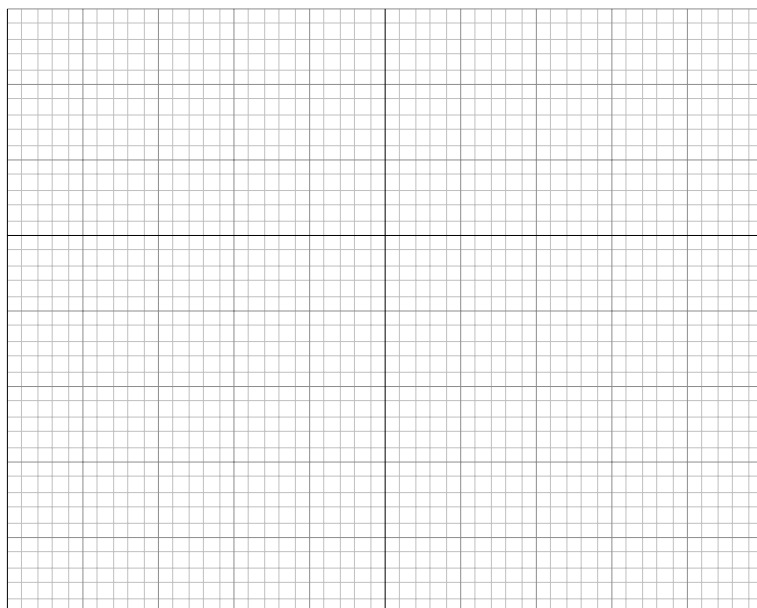


Does this graph establish the order of the reaction? **If** it does, what is the rate law in respect to [H₂SO₃] **and** what is *k* for this reaction? (show all work)

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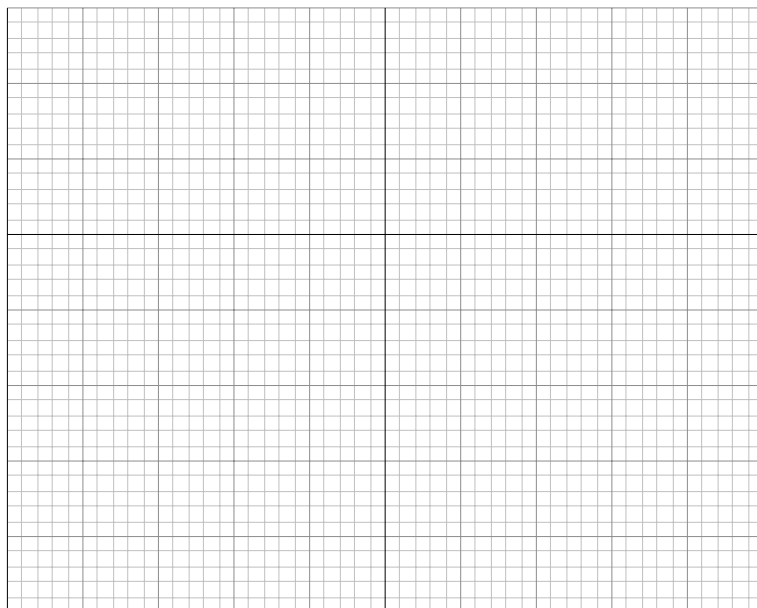
Part A. H_2SO_3 solution (Solution B) *continued*.

5. **Plot of $\ln[\text{H}_2\text{SO}_3]$ versus time.** (Hint: The natural logarithm, \ln , will be a negative (-) value. This means that the "0" for concentration is positioned at the upper left hand corner of the graph.)



Does this graph establish the order of the reaction? **If** it does, what is the rate law in respect to $[\text{H}_2\text{SO}_3]$ **and** what is k for this reaction? (Show all work.)

6. **Plot of $1/[\text{H}_2\text{SO}_3]$ versus time.**



Does this graph establish the order of the reaction? **If** it does, what is the rate law in respect to $[\text{H}_2\text{SO}_3]$ **and** what is k for this reaction? (Show all work.)

EXPERIMENT #22:

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Instructor _____

Lab Section _____

Date _____

Based upon your data, what is the rate expression for the overall reaction?

Part B. Temperature.

Summarize the data you gather for the effect of temperature on this reaction. Use the room temperature you recorded for the temperature of Mixture 1.

	Temperature °C	Time required
Mixture 1	_____ °C	_____
Trial 1	_____ °C	_____
Trial 2	_____ °C	_____

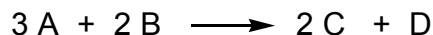
Briefly describe the effect of temperature on the rate of the reaction. Was this expected?

Experimental Error (what errors may have occurred during the performance of this experiment and altered your results)

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Post-Lab Questions (Turn in to your Instructor with the post laboratory report for this experiment.)

- Based upon your experiment. What would have happened to the rate of the reaction had the initial concentration of H_2SO_3 been doubled while the concentration of KIO_3 was held constant.
- Based upon your experiment. What would have happened to the rate of the reaction had the initial concentration of both H_2SO_3 and KIO_3 been tripled?
- Why wasn't the starch indicator added to KIO_3 instead of H_2SO_3 ?
- A reaction between the substances A and B has been found to give the following data:



[A] (mol/L)	[B] (mol/L)	Rate of appearance of C (mol/L-hr)
1.0×10^{-2}	1.0	0.30×10^{-6}
1.0×10^{-2}	3.0	8.10×10^{-6}
2.0×10^{-2}	3.0	3.24×10^{-5}
2.0×10^{-2}	1.0	1.20×10^{-6}
3.0×10^{-2}	3.0	7.30×10^{-5}

Using the above data, determine the order of the reaction with respect to A and B, and the rate law.