

Name:

Period:

Seat#:

Required Sections: (Refer to R-15 for guidelines and requirements. Make note of any specific changes given by your teacher in class.)

Prelab: Materials, Reagent Table, Procedures, and set up Data Tables before you get to class.

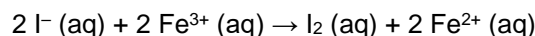
During Lab: Data section – Fill out your data table that is already set up from the prelab.

Post-lab: Calculations and Discussion Questions are one section this time, Post-Lab Two Pager done on separate Worksheet.

Introduction

A basic kinetic study of a chemical reaction often involves conducting the reaction at varying concentrations of reactants. In this way, you can determine the order of the reaction in each species, and determine a rate law expression. Once you select a reaction to examine, you must decide how to follow the reaction by measuring some parameter that changes regularly as time passes, such as temperature, pH, pressure, conductance, or absorbance of light.

In this experiment you will conduct the reaction between solutions of potassium iodide and iron (III) chloride. The reaction equation is shown below, in ionic form.



As this reaction proceeds, it undergoes a color change that can be precisely measured by a Vernier Colorimeter or a Vernier Spectrometer. By carefully varying the concentrations of the reactants, you will determine the effect each reactant has on the rate of the reaction, and consequently the order of the reaction. From this information, you will write a rate law expression for the reaction.

Objectives

In this experiment, you will

- Conduct the reaction of KI and FeCl₃ using various concentrations of reactants.
- Determine the order of the reaction in KI and FeCl₃.
- Determine the rate law expression for the reaction.

Materials

Chemicals

- * 0.02 M Potassium Iodide, KI solution
- * 0.020 M Iron(III) Chloride, FeCl₃ in 0.10 M HCl
- Distilled water

Equipment

- Computer that has a standard USB or an adapter
- Vernier computer interface
- Logger Pro Software
- Spectrometer
- 250 mL beakers x3
- 100 mL beakers x3
- 1cm plastic cuvette
- Pipettes with pumps x3
- Disposable pipettes x5
- Kimwipes



SAFETY PRECAUTIONS


The FeCl₃ solution in this experiment is prepared in 0.1 M HCl and should be handled with care, and disposed of in a heavy metal container per your teacher's instructions in class.

Procedure

- 1) Obtain and wear goggles.

Spectrometer Use

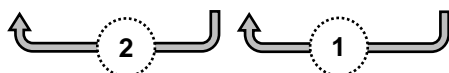
- 2) Prepare a *blank* by filling a cuvette 3/4 full with distilled water. To correctly use cuvettes, remember:
 - Wipe the outside of each cuvette with a lint-free tissue.
 - Handle cuvettes only by the top edge of the ribbed sides.
 - Dislodge any bubbles by gently tapping the cuvette on a hard surface.
 - a. Always position the cuvette so the light passes through the clear sides.
- 3) Use a USB cable to connect the Spectrometer to the computer. Choose New from the File menu.
- 4) To calibrate the Spectrometer, place the blank cuvette into the cuvette slot of the Spectrometer, choose Calibrate → Spectrometer from the Experiment menu. The calibration dialog box will display the message: "Waiting 60 seconds for lamp to warm up." After 60 seconds, the message will change to "Warmup complete." Click .


- 5) Determine the optimal wavelength for the FeCl_3 solution and set up the mode of data collection.
- Empty the blank cuvette and rinse it twice with small amounts of 0.020 M FeCl_3 solution. Fill the cuvette about 3/4 full with the FeCl_3 solution and place it in the spectrometer.
 - Click . The absorbance vs. wavelength spectrum will be displayed. Note that one area of the graph contains a peak absorbance. Click .
 - To save your graph of absorbance vs. wavelength, select Store Latest Run from the Experiment menu.
 - To set up the data collection mode and select a wavelength for analysis, click on the Configure Spectrometer Data Collection icon, , on the toolbar.
 - Click Abs vs. Time (under the Set Collection Mode). The wavelength of maximum absorbance (λ_{max}) will be selected. Click . Remove the cuvette of FeCl_3 solution from the spectrometer and dispose of the FeCl_3 as directed. Save the cuvette for Step 8.
- 6) During this experiment you will conduct 5 trials of the reaction between KI and FeCl_3 , using the volumes of liquids described in the table below.

Trial	FeCl_3 (mL)	KI (mL)	H_2O (mL)
1	20.0	20.0	0.0
2	20.0	10.0	10.0
3	10.0	20.0	10.0
4	15.0	10.0	15.0
5	10.0	15.0	15.0

IMPORTANT!

- Add water to KI 100 mL beaker
- Add $\text{H}_2\text{O} + \text{KI}$ mixture to FeCl_3 100 mL beaker



- 7) Conduct Trial 1.
- Measure 20.0 mL of FeCl_3 solution into a 100 mL beaker.
 - Measure 20.0 mL of KI solution into a second 100 mL beaker.
 - Add the 20.0 mL of KI solution to the beaker of FeCl_3 solution. Swirl the beaker to mix.
 - Rinse the cuvette twice with ~1-mL amounts of the reaction mixture, fill it 3/4 full, and place it in the device.
- 8) Click . The default settings are 1 sample per second for 200 seconds. You may click to end the data collection early. Observe the progress of the reaction.
- 9) When the data collection is complete, carefully remove the cuvette from the device. Dispose of the contents of the beaker and cuvette as directed. Rinse and clean the beakers and the cuvette for the next trial.
- 10) Examine the graph of the first trial. Select a **linear region in the first minute** of the data collection to analyze (for example, from 20 seconds to 50 seconds). Click the Linear Regression button, . Record the slope, as the initial rate of the Trial 1 reaction, in your data table and then close the Linear Regression box.
- 11) Repeat Steps 8–11 to conduct Trials 2-5. You will add the water to the beaker of KI, then you will add that mixture into the 100 mL beaker that has the FeCl_3 in it. Use the same region of the graph to calculate the initial rates for Trials 2-5 that you used in Trial 1.

Data Table

Descriptive Title			
Trial	$[\text{FeCl}_3]$	$[\text{KI}]$	Initial rate (s^{-1})
1			
2			
3			
4			
5			

Calculations

Include a copy of your graph(s) with

- a descriptive title
 - the line of best fit equation
 - labels and units on axes when appropriate
- Calculate the molar concentration of FeCl_3 and KI for each reaction and record the values in your data table.
 - What is the order of the reaction in FeCl_3 and KI? Explain/show how you got the orders you did.
 - Write the rate law expression for the reaction.
 - Based on your rate law, what are the units on k , the rate constant?
 - Is it possible to calculate the rate constant, k , from your data? If so, calculate the rate constant. If not, explain why not.