Procedure

Preparing the Red Dye No. 3 Calibration Curve

1. Place five clean, dry test tubes in a test tube rack.
2. Using clean 3-mL and 5-mL syringes, add the standard FD&C Red Dye No. 3 solution and distilled or deionized water to each test tube in the amounts listed in the table below.

Standard	Red Dye No. 3 Solution (mL)	DI Water (mL)
1	0	6
2	1	5
3	2	4
4	4	2
5	6	0

3. *Note:* For best results in the steps that follow, handle cuvets at the top so no fingerprints are in the light path and polish cuvets with a tissue.
4. Follow the procedure for colorimetric measurements of the solution as directed by the instructor. Generally, spectrophotometers are used as follows: Turn the instrument on and allow it to warm up for 15 minutes. Set the wavelength at 530 nm. With no light passing through the instrument, set the percent transmittance to zero with the "zero" control. Place a cuvet that is about ⅔ full of standard 1 (distilled water) into the sample holder and set the percent transmittance to 100% with the appropriate control (not the zero control). Fill a cuvet about ⅔ full of the standard 2 solution, place it in the spectrophotometer and read the absorbance. Consult the instrument manual for details on its use. Measure and record the absorbance of the solution. The absorbance of this solution should fall between 0.300 to 0.600. (Consult your instructor if the value falls outside of this range.)
5. Measure the absorbance of each of the standard solutions at 530 nm, using distilled water as the zero absorbance reference in the spectrophotometer. Record the absorbance value for each standard solution used in the Standard Solutions Data Table.
6. Clean and rinse the 5 test tubes. Dispose of the red dye solutions as directed by your instructor.

Sample Preparation

1. Label six test tubes with numbers 1–6.
2. Use the 12-mL syringes to add the appropriate amount of standard solution 3, and distilled water to each test tube as specified in the first two columns of the table below. *Note:* Do not add the bleach to any of the solutions at this point.

Sample	Standard 3	Distilled Water	Bleach
1	2 mL	3 mL	1 mL
2	3 mL	2 mL	1 mL
3	4 mL	1 mL	1 mL
4	5 mL	0 mL	1 mL
5	2 mL	2 mL	2 mL
6	2 mL	1 mL	3 mL

Data Collection

1. Select one team member to be the timer and one to be the sample preparer. The timer will time the reaction, while the second person will prepare the reaction solutions and record their absorbance at timed intervals.
2. If not already on, set up the spectrophotometer as in step 4 of the calibration procedure.
3. Fill a clean, 3-mL syringe with 1 mL of the sodium hypochlorite solution.
4. With test tube 1 in one hand and the 3-mL syringe in the other, inject the 1 mL of sodium hypochlorite solution into the test tube as your partner starts timing.
5. Quickly stopper the test tube, mix the solutions, and then place the test tube in the spectrophotometer.
6. Record the absorbance at the next 20-second interval from the initial mixing start time, and each subsequent 20-second interval.
7. Leaving the test tube in the spectrophotometer, continue recording the absorbance of the solution until the absorbance reaches 0.050.
8. Repeat steps 3–7 for test tubes 2, 3 and 4.
9. For test tube 5, add 2 mL of sodium hypochlorite solution to the 3-mL syringe in step 3. Then repeat steps 4–7.
10. For test tube 6, add 3 mL of sodium hypochlorite solution to the 3-mL syringe in step 3. Repeat steps 4–7.

Data Tables and Graph

Standard Solutions Data Table

Standard	[Red No. 3] $\times 10^{-5}$ Moles/L	Absorbance, *A*
1	0.00	
2	0.17	
3	0.33	
4	0.67	
5	1.00	

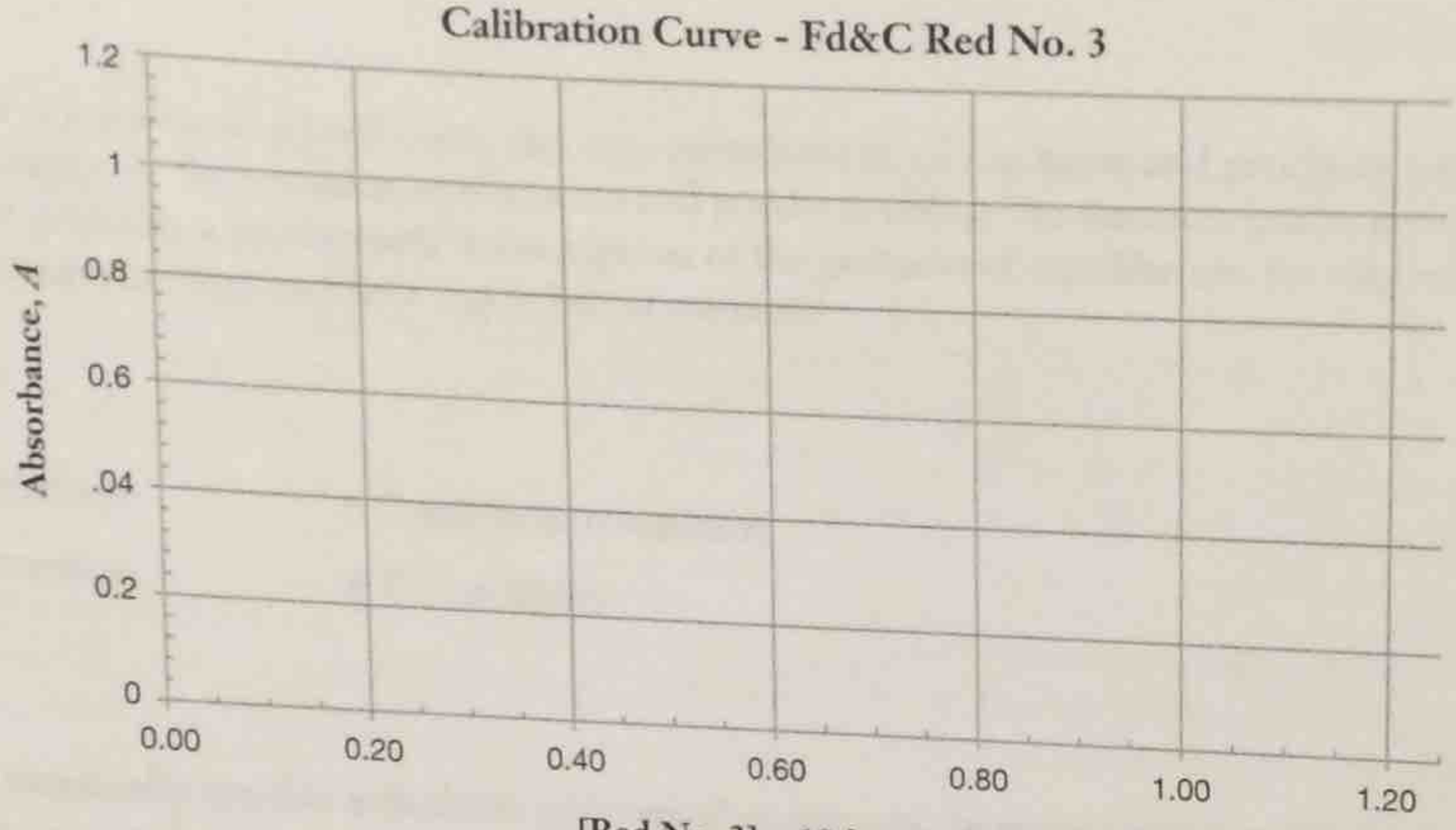
Sample 3

Time (sec)	Absorbance, *A*	Time (sec)	Absorbance, *A*	Time (sec)	Absorbance, *A*	Time (sec)	Absorbance, *A*
20	1.761	220	1856	420		620	
40	1.767	240	1856	440		640	
60	1.760	260	1856	460		660	
80	1.767	280	1856	480		680	
100	1.767	300	1847	500		700	
120	1.760	320	1857	520		720	
140	1.767	340	1856	540		740	
160	1.789	360	1846	560		760	
180	1.771	380	1847	580		780	
200	1.881	400	1855	600		800	

Post-Laboratory Review Questions

1. Calibration Curve

   Plot the molar concentration of Red Dye No. 3 versus absorbance as below, and draw the best-fitting straight line through the data points. Include the origin (zero absorbance for zero concentration) as a valid point.



2. Calculate the initial concentration of Red Dye No. 3 in each trial. This is the concentration at time = 0.
3. Set up a spreadsheet table for each trial. Label the columns: Time, Absorbance, [Red No. 3], *ln*([Red No. 3]), 1/[Red No. 3]. *Note:* [ ] means concentration in mol/L.
4. Calculate the data for each cell. *Note:* Use the measured absorbance of the solution during the trial, then multiply this value by the slope of your calibration curve to determine the concentration of the Red Dye No. 3, [Red No. 3].
5. Prepare three graphs for each trial:
   - [Red No. 3] vs. time
   - *ln*[Red No. 3] vs. time
   - 1/[Red No. 3] vs. time
6. From a visual inspection of these plots, select the best linear relationship to establish *a*, the order of the reaction with respect to the dye.
7. Using the plots that give linear relationships, determine the rate constant for each trial.
8. By comparing the slopes of the lines for trials 1, 5 and 6, determine *b*, the order of the reaction with respect to hypochlorite.