

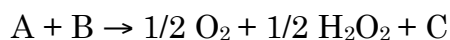
Spring 2008

CBE 430
Problem Set #2
Due Friday, February 8

Read Chapter 3 in the textbook

1. Reaction order analysis

In the reaction of acetic acid [call this species A] with dioxygen (pyridine)-N,N'-ethylene bis(acetylacetoniminato) cobalt (II) [call this species B], in organic solvents containing excess pyridine the reaction stoichiometry is of the form



where C represents the dipyridine-N, N' ethylene bis(acetylacetoniminato) cobalt (III) ion. Data below show the concentration evolution of species B in the presence of a large excess of acetic acid at -11°C .

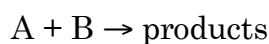
Time (s)	[B] $\times 10^3$ (M)
10	2.02
50	1.74
100	1.55
150	1.37
175	1.29
200	1.22
250	1.10
300	0.99
350	0.91
400	0.84
450	0.78
475	0.76

Perform an integral test of these data to determine if the rate expression for this reaction is consistent with any of the power-law form $r = k C_B^n$, where n may be 1, 3/2, 2, or 5/2. Observe any curvatures of the plots you prepare to test the proposed rate expressions and comment on what they indicate. Evaluate the rate constant for any case in which the proposed rate expression is consistent with the data.

2. Chapter 3, problem #5 – Integral data analysis

(more on back)

3. Decomposition of hazardous compound
Isopropyl methylphosphonofluorodate is a highly toxic ester that is a chemical warfare agent. To characterize the potential for degradation during storage, this data was collected to monitor the kinetics of the reaction between the phosphonate (A) and hydrogen chloride (B).



Analyze the data to determine whether they are consistent with either of the following mixed third order rate expressions:

$$r = k (A)^2 (B)$$

$$r = k (A) (B)^2$$

Use an integral method of data analysis and report the value of the rate constant for the rate expression that provides a suitable fit. The reaction was carried out isothermally at 25°C with an initial concentration of HCl of 4.5 M.

Time (hours)	C _A (moles/kg solution)
0	6.0
2.1	5.6
4.2	5.3
21.4	4.4
27.2	4.1
32.7	4.2
69.8	3.4
74.8	3.3
141.8	2.8
167.2	2.7
180.5	2.7
189.7	2.6

4. Chapter. 3, #7 – Initial rate analysis
5. Chapter. 3, #8 – Rate analysis with pressure data