

Name :

Honors Chemistry

Section :

Kinetics Problem Set

1. The following reaction was studied at 10°C: $2 \text{NO(g)} + \text{Cl}_2\text{(g)} \rightarrow 2 \text{NOCl(g)}$
The results of the kinetics study are shown below.

[NO]	[Cl ₂]	initial rate (mol/min)
0.10	0.10	0.18
0.10	0.20	0.35
0.20	0.20	1.45

- a) What is the rate law for this reaction? What is the overall reaction order?
b) Determine the value of the rate constant for this reaction.

2. The following reaction was studied at 5°C? $2 \text{ClO}_2\text{(aq)} + 2 \text{OH}^- \rightarrow \text{ClO}_3^-\text{(aq)} + \text{ClO}_2^-\text{(aq)} + \text{H}_2\text{O(l)}$
The kinetics data are shown below:

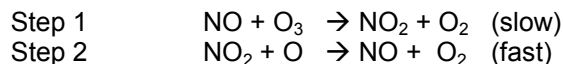
[ClO ₂]	[OH ⁻]	Initial rate (mol/sec)
0.0500	0.100	5.75×10^{-2}
0.100	0.100	2.30×10^{-1}
0.100	0.050	1.15×10^{-1}

- a) What is the rate law for this reaction? What is the overall reaction order?
b) Determine the value of the rate constant for this reaction.

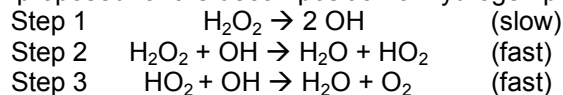
3. The following reaction was studied at 15°C: $2 \text{I}^- (\text{aq}) + \text{S}_2\text{O}_8^{2-} (\text{aq}) \rightarrow \text{I}_2 (\text{aq}) + 2 \text{SO}_4^{2-} (\text{aq})$

[I ⁻]	[S ₂ O ₈ ²⁻]	initial rate (mol/sec)
0.080	0.040	12.50 x 10 ⁻⁶
0.040	0.040	6.250 x 10 ⁻⁶
0.080	0.020	5.560 x 10 ⁻⁶
0.032	0.040	4.350 x 10 ⁻⁶
0.060	0.030	6.410 x 10 ⁻⁶

- What is the rate law for this reaction?
 - Determine the value of the rate constant for this reaction.
 - If the same reaction was run at 15°C, with [I⁻] = 0.050 M and [S₂O₈²⁻] = 0.95 M, what would the rate have been?
4. The following mechanism has been proposed for the destruction of ozone, O₃, in the upper atmosphere:



- Write the net equation.
 - Which species is a catalyst?
 - Which species is an intermediate?
5. The mechanism proposed for the decomposition of hydrogen peroxide is:



- Write the net equation.
- What will be the effect on the reaction rate if the concentration of H₂O₂ is increased? Explain your answer in terms of collision theory.
- What will be the effect on the reaction rate if the concentration of HO₂ is decreased? Why?

Answers:

- rate = k[NO]²[Cl₂]¹; k = 1800; 3rd order overall (2nd order wrt NO; 1st order wrt Cl₂)
- rate = k[ClO₂]²[OH]¹; k = 230; 3rd order overall (2nd order wrt ClO₂; 1st order wrt OH)
- rate = k[I⁻]²[S₂O₈²⁻]; 2nd order overall; k = 0.0039; rate = 0.00185 mol/sec
- overall rxn: O₃ + O → O₂; catalyst = NO; intermediate = NO₂