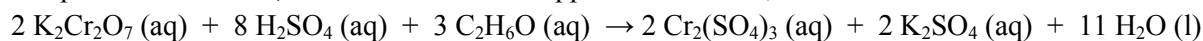
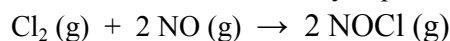


## CHM152 – Chapter 12: Chemical Kinetics – Homework

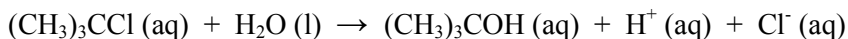
1. The reaction that occurs in a breathalyzer is given below. If the rate of appearance of  $\text{Cr}_2(\text{SO}_4)_3$  is 1.24 mol/min at a particular moment, what is the rate of disappearance of  $\text{C}_2\text{H}_6\text{O}$  at that moment?



2. Write the rate law for the reaction below without any experimental data.



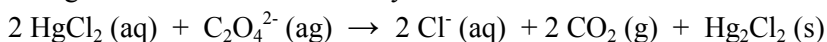
3. The hydrolysis of tert-butyl chloride is given in the reaction below:



If the rate law is:  $\text{rate} = k[(\text{CH}_3)_3\text{CCl}]$ , what is the order of the reaction with respect to water?

4. What is the overall order of the reaction that has the rate law:  $\text{rate} = k[\text{H}_2][\text{NO}]^2$ ?

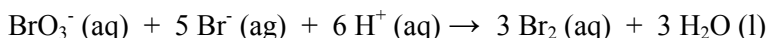
5. The following set of data was obtained by the method of initial rates for the reaction:



What is the rate law for the reaction? What is the value of the rate constant? What is the overall order?

$[\text{HgCl}_2], \text{M}$	$[\text{C}_2\text{O}_4^{2-}], \text{M}$	Rate, M/s
0.10	0.10	$1.3 \times 10^{-7}$
0.10	0.20	$5.2 \times 10^{-7}$
0.20	0.20	$1.0 \times 10^{-6}$

6. The following set of data was obtained by the method of initial rates for the reaction:



What is the rate law for the reaction? What is the value of the rate constant? What is the overall order?

Expt	$[\text{BrO}_3^-], \text{M}$	$[\text{Br}^-], \text{M}$	$[\text{H}^+], \text{M}$	Rate, M/s
1	0.10	0.10	0.10	$8.0 \times 10^{-4}$
2	0.20	0.10	0.10	$1.6 \times 10^{-3}$
3	0.20	0.15	0.10	$2.4 \times 10^{-3}$
4	0.10	0.10	0.25	$5.0 \times 10^{-3}$

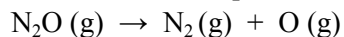
7. For a particular first order reaction, it takes 48 minutes for the concentration of the reactant to decrease to 25% of its initial value. What is the value for the rate constant (in  $\text{s}^{-1}$ ) for the reaction?
8. The rate constant for a first order reaction is equal to  $4.2 \times 10^{-4} \text{ s}^{-1}$ . What is the half-life for the reaction?
9. A plot of  $1 / [\text{BrO}^-]$  vs. time is linear for the reaction:  $3 \text{ BrO}^- (\text{aq}) \rightarrow \text{BrO}_3^- (\text{aq}) + 2 \text{ Br}^- (\text{aq})$   
What is the order of the reaction with respect to the hypobromite ion?
10. Nitrogen dioxide decomposes at  $300^\circ\text{C}$  via a second order process to produce nitrogen monoxide and oxygen gas. A sample of  $\text{NO}_2 (\text{g})$  is initially placed in a 2.50 L reaction vessel at  $300^\circ\text{C}$ . If the half-life and rate constant at  $300^\circ\text{C}$  are 11 seconds and  $0.54 \text{ M}^{-1} \text{ s}^{-1}$ , respectively, how many moles of  $\text{NO}_2$  were in the original sample?
11. Which statement about the half-life of a second order reaction is true?
- Each half-life is half as long as the preceding one.
  - Each half-life is twice as long as the preceding one.
  - Each half-life is four times as long as the preceding one.
  - The length of the half-life remains unchanged throughout the course of the reaction.
12. Which statement about the half-life of a zero order reaction is true?
- Each half-life is half as long as the preceding one.
  - Each half-life is twice as long as the preceding one.
  - Each half-life is four times as long as the preceding one.
  - The length of the half-life remains unchanged throughout the course of the reaction.
13. What percentage of a sample would remain after 8 half lives?
14. The elementary reaction:  $2 \text{ HI} \rightarrow \text{H}_2 + \text{I}_2$ , is an example of a \_\_\_\_\_ reaction.
- unimolecular
  - bimolecular
  - termolecular
  - tetramolecular
15. A three-step mechanism has been suggested for the formation of carbonyl chloride:
- Step 1:  $\text{Cl}_2 \rightarrow 2 \text{ Cl}$  (fast, equilibrium)  
Step 2:  $\text{Cl} + \text{CO} \rightarrow \text{COCl}$  (fast, equilibrium)  
Step 3:  $\text{COCl} + \text{Cl}_2 \rightarrow \text{COCl}_2 + \text{Cl}$  (slow)

What is the rate-determining step? What is the molecularity of the rate-determining step?

16. For this reaction:  $2 \text{NO} (\text{g}) + \text{Cl}_2 (\text{g}) \rightarrow 2 \text{NOCl} (\text{g})$ , the real rate law is  $\text{rate} = k [\text{NO}][\text{Cl}_2]$   
If the following steps are the mechanism, which one must be the rate determining step? \_\_\_\_\_  
What is the intermediate in this mechanism? \_\_\_\_\_ What is the overall order? \_\_\_\_\_  
Step 1:  $\text{NO} (\text{g}) + \text{Cl}_2 (\text{g}) \rightarrow \text{NOCl}_2 (\text{g})$   
Step 2:  $\text{NO} (\text{g}) + \text{NOCl}_2 (\text{g}) \rightarrow 2 \text{NOCl} (\text{g})$

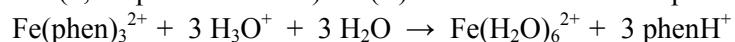
17. What are three factors that affect the rate of a reaction?

18. The reaction for the decomposition of dinitrogen monoxide gas to form an oxygen radical is:



If the activation energy is 250 kJ/mol and the frequency factor is  $8.0 \times 10^{11} \text{ s}^{-1}$ , what is the rate for the first order reaction at 1000 K?

19. The aquation of tris(1, 10-phenanthroline)iron(II) in acid solution takes place according to the equation:



If the activation energy is 126 kJ/mol and the rate constant at 30°C is  $9.8 \times 10^{-3} \text{ min}^{-1}$ , what is the rate constant at 50°C?