CHM 112 Chapter 12 Kinetics Extra Credit Name:_____

1. For each of the following reactions, write down the rate of the reaction in terms of the appearance of products and disappearance of reactants

   a) $2\ N_2O_5(g) \rightarrow 4\ NO_2(g) + O_2(g)$

Rate = $-1/2\ \Delta[N_2O_5]/\Delta t = \frac{1}{4}\ \Delta[NO_2]/\Delta t = \Delta[O_2]/\Delta t$

   b) $CH_3Cl\ (g) + 3\ Cl_{2(g)} \rightarrow CCl_4\ (g) + 3\ HCl\ (g)$

2. Given the following balanced equation, determine the rate of reaction with respect to $[O_2]$.

   $2\ O_3(g) \rightarrow 3\ O_2(g)$

3. Given the following balanced equation, determine the rate of reaction with respect to N_2O_5. If the rate of NO_2 0.015 M/s, what is the rate of reaction of N_2O_5?

   $2\ N_2O_5(g) \rightarrow 4\ NO_2(g) + O_2(g)$

Rate = (-)0.0075 M/sec

4. What is the **overall order** of the following reaction, given the rate law?

   $2\ X + 3\ Y \rightarrow 2\ Z$ Rate = $k[X]^1[Y]^2$

   What will happen to the Rate of the concentration of Y is doubled?

5. Determine the rate law and the value of k for the following reaction using the data provided.

   $S_2O_8^{2-}(aq) + 3\ I^-(aq) \rightarrow 2\ SO_4^{2-}(g) + I_3^-(aq)$

Run	$[S_2O_8^{2-}]_i$ (M)	$[I^-]_i$ (M)	Initial Rate (M/s)
1	0.30	0.42	4.54
2	0.44	0.42	6.65
3	0.44	0.21	3.33

Rate = 36 1/Ms $[S_2O_8^{2-}][I^-]$

Include the correct units for k!

6. Determine the rate law and the value of k for the following reaction using the data provided.

   $2\ NO(g) + O_2(g) \rightarrow 2\ NO_2(g)$

Run	$[NO]_i$ (M)	$[O_2]_i$ (M)	Initial Rate (M/s)
1	0.030	0.0055	8.55×10^{-3}
2	0.030	0.0110	1.71×10^{-2}
3	0.060	0.0055	3.42×10^{-2}

rate=$1700/M^2s\ [NO]^2[O_2]$

7. For a particular first order reaction, it takes 120.0 min for the concentration of the reactant to drop to 15% of its initial value. What is the rate constant for this reaction?

K=.0158 1/min

8. How many half-lives are required for the concentration of reactant to decrease to 25% of its original value? (Assume first order kinetics.)

2

9. Fluorine-18 undergoes positron emission with a half-life of 1.10×10^2 minutes. If a patient is given a 248 mg dose for a PET scan, how long will it take for the amount of fluorine-18 to drop to 83 mg? (Assume that none of the fluorine is excreted from the body.)

t = 174 min

10. The second-order decomposition of HI has a rate constant of $1.80 \times 10^{-3}\ M^{-1}s^{-1}$. How much HI remains after 27.3 s if the initial concentration of HI is 4.78 M?

[A]t = 3.87 M

11. The first-order rearrangement of CH_3NC is measured to have a rate constant of $3.61 \times 10^{-15}\ s^{-1}$ at 298 K and a rate constant of $8.66 \times 10^{-7}\ s^{-1}$ at 425 K. Determine the activation energy for this reaction.

E_a = 160 kJ/mole

12. The decomposition of NOCl has k= $9.3 \times 10^{-5}\ M^{-1}s^{-1}$ at 100. °C and an Activation Energy of 98.9 Kj/mole. What is the rate constant at 130 °C.

k=.0009988 1/Ms

13. Consider the reaction: $CO(g) + Cl_2(g) \rightarrow COCl_2(g)$

The reaction is first order in CO and 3/2 order in Cl_2

a) Write down the rate law for this reaction.

Rate = $k[CO][Cl_2]^{3/2}$

b) What will be the rate of the reaction when [CO] = 0.025 M and $[Cl_2]$ = 0.015 M, given that the rate constant is $11\ M^{-3/2}s^{-1}$

Rate = 0.000505 M/s

14. The decomposition of NOBr follows second order kinetics. The rate constant is found to be 0.556 $M^{-1}\ s^{-1}$.
If the initial concentration of NOBr in the container is 0.25 M, how long will it take for the concentration to decrease to 0.025 M?

65 sec

What is the half-life of the decomposition when the initial reactant concentration is 0.25 M?

t ½ = 7.19 sec

15. Using the diagram above:
(A) add the axes

(B) label the activation energies

(C) How many elementary steps are there?
2
(D) Which elementary step is limiting?
first
(E) What might happen if a catalyst is added. Show this effect on the diagram.

16. A possible mechanism for the overall reaction $Br_2(g) + NO\ (g) \rightarrow 2\ NOBr\ (g)$

is

Step 1: $NO\ (g) + Br_2\ (g) \underset{k_{-1}}{\overset{k_1}{\rightleftarrows}} NO\ Br_2\ (g)$ (fast)

Step 2: $NO\ Br_2\ (g) + NO\ (g) \xrightarrow{k_2} 2NOBr$ (slow)

The reaction is experimentally determined to be second order in NO and first order in Br_2

a) Write down the experimentally determined rate law.

Rate = $k[NO]^2[Br_2]$

b) Is the mechanism consistent with the observed rate law?

yes

17. Suppose a reaction occurs with the following mechanism.

Step 1	$2\ A \rightleftarrows A_2$	fast, equilibrium
Step 2	$A_2 + E\ (g) \rightarrow B + C$	slow

(A) What is the overall reaction?
(B) What are the intermediates in the mechanism?
(C) What is the molecularity of each step?
(D) Which is the rate determining step?
(E) What is the rate law predicted by this mechanism?

Rate = $k[A]^2[E]$