CHEM 102 PS-2
Chapter-13 Chemical Kinetics

1. Write the reaction rate expressions for the following reactions in terms of the disappearance of the reactants and the appearance of products.
(a) $H_2(g)+O_2(g)\rightarrow 2H_2O(g)$
(b) $4\ NH_3\ (g)+5O_2(g)\rightarrow 4NO(g)+6H_2O(g)$

2. Consider the reaction $N_2 + 3\ H_2 \rightarrow 2\ NH_3$
Suppose that at a particular moment during the reaction molecular hydrogen is reacting at the rate of 0.074 M/s.
(a) At what rate is ammonia being formed?
(b) At what rate is molecular nitrogen reacting?

3. Use the data in Table 13.2 to calculate the rate of the reaction at the time when $[F_2]$ = 0.010 M and $[C1O_2]$ = 0.020 M

Table 13.2 Rate Data for the Reaction Between F_2 and ClO_2

	$[F_2]$ (*M*)	$[ClO_2]$ (*M*)	Initial Rate (*M*/s)
1.	0.10	0.010	1.2×10^{-3}
2.	0.10	0.040	4.8×10^{-3}
3.	0.20	0.010	2.4×10^{-3}

4. Consider the reaction $X+Y\rightarrow Z$
The following data were obtained at 360 K. (a) determine the rate law and overall order of the reaction. (b) determine the initial rate of disappearance of X when the concentration of X is 0.30 M and that of Y is 0.40 M

Initial Rate of Disappearance of X (*M*/s)	[X] (*M*)	[Y] (*M*)
0.053	0.10	0.50
0.127	0.20	0.30
1.02	0.40	0.60
0.254	0.20	0.60
0.509	0.40	0.30

5. Consider the reaction A → B. The rate of the reaction is 1.6 $x10^{-2}$ M/s when the concentration of A is 0.35 M. Calculate the rate constant if the reaction is: (a) first-order in A, and (b) second-order in A.

6. The thermal decomposition of phosphine (PH_3) into phosphorus and molecular hydrogen is a first-order
reaction: $4\ PH_3 \rightarrow P_4 + 6H_2$
The half-life of the reaction is 35.0 s at 680°C. Calculate
(a) the first-order rate constant for the reaction
(b) the time required for 95 percent of the phosphine to decompose.

7. The rate constant for the second-order reaction
$2\ NO_{2\,(g)} \rightarrow 2NO_{(g)} + O_{2\,(g)}$
is 0.54 / M·s at 300°C. How long (in seconds) would it take for the concentration of NO_2 to decrease from 0.62 M to 0.28 M?

8. The rate constant of a first-order reaction is $4.60 \times 10^{24}\ s^{-1}$ at 350 °C. If the activation energy is 104 kJ/mol, calculate the temperature at which its rate constant is $8.80 \times 10^{24}\ s^{-1}$.

9. Consider the first-order reaction
$CH_3NC\ (g) \rightarrow CH_3CN\ (g)$
Given that the frequency factor and activation energy for the reaction are $3.98 \times 10^{13}\ s^{-1}$ and 161 kJ/mol, respectively, calculate the rate constant at 600 °C.

10. The reaction A + 2B → products has the rate law, rate = $k[A][B]^3$. If the concentration of B is doubled while that of A is unchanged, by what factor will the rate of reaction increase?
A. 2
B. 4
C. 6
D. 8
E. 9

11. A reaction was experimentally determined to follow the rate law, Rate = k[A] where k = 0.15 s^{-1}. Starting with [A]o = 0.225M, how many seconds will it take for [A]t = 0.0350M?
A. 3.4 x 10-2 s
B. 5.3 x 10-3 s
C. 12 s
D. 160 s
E. 1.3 s

12. When the concentrations of reactant molecules are increased, the rate of reaction increases. The best explanation for this phenomenon is that as the reactant concentration increases,
A. the average kinetic energy of molecules increases.
B. the frequency of molecular collisions increases.
C. the rate constant increases.
D. the activation energy increases.
E. the order of reaction increases.

13. The activation energy for the following first-order reaction is 102 kJ/mol.
$N_2O_5\,(g) \rightarrow 2NO_2\,(g) + ½\,O_2\,(g)$
The value of the rate constant (k) is $1.35 \times 10^{-4}\ s^{-1}$ at 35°C. What is the value of k at 0°C?
A. $8.2 \times 10^{-7}\ s^{-1}$
B. $1.9 \times 10^{-5}\ s^{-1}$
C. $4.2 \times 10^{-5}\ s^{-1}$
D. $2.2 \times 10^{-2}\ s^{-1}$
E. none of these

14. A certain first-order reaction A → B is 25% complete in 42 min at 25°C. What is the half-life of the reaction?
A. 21 min
B. 42 min
C. 84 min
D. 20 min
E. 101 min

15. The following initial rate data apply to the reaction below.
$F_2(g) + 2Cl_2O(g) \rightarrow 2FClO_2(g) + Cl_2(g)$
Which of the following is the rate law (rate equation) for this reaction?
A. rate = $k[F_2]^2[Cl_2O]^4$
B. rate = $k[F_2]^2[Cl_2O]$
C. rate = $k[F_2][Cl_2O]$
D. rate = $k[F_2][Cl_2O]^2$
E. rate = $k[F_2]^2[Cl_2O]^2$