Chem 1105-2016 Summer Problem Set #3

1. Consider the reaction:

$$2A \quad + \quad B \quad \rightarrow \quad 3C$$

If the rate of consumption of A is 3.06×10^{-3} M/s, determine the rate of consumption of B and the rate of formation of C.

2. For a reaction in which A and B form C, the following data were obtained from three experiments:

Experiment	[A](Molarity)	[B](Molarity)	Rate of Formation of C(M/s)
1	0.300	0.150	1.60×10^{-5}
2	0.600	0.300	2.59×10^{-4}
3	0.300	0.300	1.28×10^{-4}

a) What is the rate expression for the reaction and the overall reaction order?
b) What is the numerical value of the rate constant, k?

3. The reaction

$$C_2H_5Cl(g) \rightarrow C_2H_4(g) + HCl(g)$$

is first order in C_2H_5Cl. The rate constant is 1.60×10^{-6} s^{-1} for the reaction conducted at 650. K. In an investigation into the decomposition of $C_2H_5Cl(g)$, an initial concentration of 0.165 M was used. a) What will be the concentration of $C_2H_5Cl(g)$ after 125 hours? b) How long will it take for the concentration of C_2H_5Cl to drop to 0.100 M? c) How many hours will it take for 75.0% of the C_2H_5Cl to decompose? d) Determine the half-life, in hours, for this reaction at 650. K.

4. The decomposition of $NO_2(g)$:

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

is a second order reaction, and the rate constant is 0.755 $M^{-1}\cdot s^{-1}$ for the reaction conducted at 603 K. In an experiment at 603 K, the initial concentration of $NO_2(g)$ was 0.00650 M. a) What is the concentration of $NO_2(g)$ after 125 s have elapsed? b) How many seconds will it take for the concentration of $NO_2(g)$ to drop to 0.00100 M? c) Determine the half-life.

5. The reaction:

$$C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g)$$

is first order in C_2H_4, first order in H_2, and second order overall. The energy of activation for the reaction is 181 kJ/mol and k is 1.3×10^{-3} $M^{-1}\cdot s^{-1}$ for the reaction at 700. K. What is the value of k for the reaction at 730. K.

6. A mechanism for the gas-phase reaction between iodine and hydrogen is as follows:

Step 1: $I_2 \leftrightharpoons 2I$ (fast, equilibrium)
Step 2: $H_2 + I \leftrightharpoons H_2I$ (fast, equilibrium)
Step 3: $H_2I + I \rightarrow 2HI$ (slow)

a) Write the overall reaction. b) Identify the reaction intermediate?

Answer Set for Chem 1105-2016 Summer Problem Set #3

1. $-\Delta[B]/\Delta t = 1.53\times10^{-3}$ M/s; $\Delta[C]/\Delta t = 4.59\times10^{-3}$ M/s

2.a) rate = $k[A][B]^3$, 4^{th} order overall; b) $k = 0.0159\ M^{-3}\cdot s^{-1}$

3.a) 0.0803 M; b) 87.0 hours; c) 241 hours; d) $t_{1/2}$ = 120. hours

4.a) 0.00403 M; b) 1.12×10^{3} s; c) 204 s

5. $k = 4.7\times10^{-3}\ M^{-1}\cdot s^{-1}$

6.a) $H_2 + I_2 \rightarrow 2HI$; b) I, H_2I