Chem 1105-2015 Summer Problem Set #2

1. Express the rate of reaction in terms of the change in concentration of each of the reactants and products: $2A(g) \rightarrow B(g) + C(g)$

When [C(g)] is increasing at 2 mol/L·s, how fast is [A(g)] decreasing?

2. The accumulation of stratospheric ozone was one of the crucial processes that allowed life to develop on our planet: $3O_2(g) \rightarrow 2O_3(g)$

At a given instant the reaction rate in terms of O_2 is 2.17×10^{-5} mol/L·s. What is the rate of formation of O_3 ?

3. By what factor does the rate change in each of the following cases(assuming constant temperature)?

a) A reaction is first order in reactant A, and [A] is doubled.

b) A reaction is second order in reactant B, and [B] is halved.

c) A reaction is second order in reactant C, and [C] is tripled.

d) Write the rate law expression for this reaction and state the overall reaction order.

4. For the reaction $4A(g) + 3B(g) \rightarrow 2C(g)$ the following data were obtained at constant temperature:

Experiment	[A](Molarity)	[B](Molarity)	Initial Rate(M/min)
1	0.100	0.100	5.00
2	0.300	0.100	45.0
3	0.100	0.200	10.0
4	0.300	0.200	90.0

a) What is the order with respect to each reactant? b) Write the rate law. c) Calculate k using data from experiment 1.

5. How are integrated rate laws used to determine reaction order? What is the order in the reactant if a plot of

a) The natural logarithm of [reactant] vs. time is linear?

b) The inverse of [reactant] vs. time is linear?

c) [reactant] vs. time is linear?

6. In a first-order decomposition reaction, 50.0% of a compound decomposes in 10.5 min. a) What is the rate constant of the reaction? b) How long does it take for 75.0% of the compound to decompose?

7. The rate constant of a reaction is 4.7×10^{-3} s⁻¹ at 25°C, and the activation energy is 33.6 kJ/mol. What is k at 75°C?

8. For the reaction ABC + D \Rightarrow AB + CD, $\Delta H^{\circ} = -55 \text{ kJ/mol}$ and $E_a(\text{fwd}) = 215 \text{ kJ/mol}$.

Assuming a one-step reaction

a) draw a reaction energy diagram; b) calculate $E_a(rev)$

Answer Set for Chem 1105-2015 Summer Problem Set #2

1.
$$rate = -\frac{1}{2} \times \frac{\Delta[A]}{\Delta t} = \frac{\Delta[B]}{\Delta t} = \frac{\Delta[C]}{\Delta t}; 4 \text{ mol/L} \cdot \text{s}$$

2. 1.45×10^{-5} mol/L·s

3.a) Rate doubles; b) Rate decreases by a factor of four; c) Rate increases by a factor of nine; d) rate = $k[A][B]^{2}[C]^{2}$; 5th overall.

- 4.a) second order in A, first order in B; b) rate = $k[A]^2[B]$; c) $5.00 \times 10^3 L^2/mol^2 \cdot min$
- 5.a) first order; b) second order; c) zero order

