ASSIGNMENT 8

CHEMISTRY 300

Due: 4:30 pm Monday 17 November 2008

- 1. The rate of formation of phosgene in the reaction $\text{Cl}_2 + \text{CO} \rightarrow \text{Cl}_2\text{CO}$ has been studied extensively. Consider an experiment in which Cl_2 and CO are mixed rapidly in a constant volume container. Derive an expression for the rate of this reaction in terms of the rate of change of the pressure in the container and any other experimental variables that are relevant.
- 2. The only isotope of radium that occurs naturally is 226 Ra which decays through the emission of α particles. A 0.1 mg sample emits $3.7 \times 10^6 \alpha$ particles per second. This rate is observed to be constant over many years. Why?
- 3. Consider the decomposition of cyclobutane at 438°C:

$$C_4H_8 \rightarrow 2C_2H_4$$

The rate is to be measured by observing the pressure change in a constant volume system. Assume that the gas mixture is ideal.

- (a) Express the rate of reaction $d(\xi/V)/dt$ in terms of dp/dt.
- (b) Let p^{∞} be the pressure in the system after the C₄H₈ is completely decomposed. If the reaction is first order in C₄H₈, derive the relation between pressure and time. What function of pressure should be plotted against time to determine the rate coefficient?
- (c) If the rate coefficient is $2.48 \times 10^{-4} \text{ s}^{-1}$, what is the half life? How long would it take for 98% of the C₄H₈ to decompose?
- (d) What will the value of p/p^{∞} be after 2.0 hours?
- 4. At 24.8° C, the reaction:

$$C_{6}H_{5}N(CH_{3})_{2} + CH_{3}I \rightarrow [C_{6}H_{5}N(CH_{3})_{3}]^{+} + I^{-}$$

has a rate coefficient $k = 8.39 \times 10^{-5} \text{ L mol}^{-1} \text{ s}^{-1}$ in nitrobenzene. The reaction is first order with respect of each of the reactants.

- (a) If equal volumes of the solutions that are $0.12 \text{ mol } \text{L}^{-1}$ in dimethylaniline and methyl iodide are mixed, how much time is required for 70% of the reactants to disappear?
- (b) If the concentration of each reagent is doubled, what length of time is required for 70% to disappear?