CHM5070 Su2008

Assignment #2

Due in class Tuesday, June 16

1. For a mixture prepared by mixing 5.00 g of caffeine ($C_8H_{10}N_4O_2$) with 250.0 mL of water. The final density of this mixture is 1.05 g /mL.
   a. Calculate the boiling point of this mixture
   b. Calculate the freezing point of this mixture
   c. Calculate the osmotic pressure of this mixture at 25 °C.

2. Add 5.00 g NaCl to 500 ml $H_2O$. What is the freezing point? What is the boiling point? Assume that all of the NaCl dissociates in solution.

3. Note: Omit this problem.There is not enough information given to find a solution for part a or b.

A solution is 6.00% by mass of a solute and the rest is water.

a. Calculate the molar mass of the solute. Assume it is not an ionic compound.
b. The density of the solution is 1.023 g/mL. Calculate the osmotic pressure of the solution.

4. The reaction

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

a) For the reactant and each of the products write expressions for the rate of reaction.

b) If oxygen is produced at a rate of $4.8 \times 10^{-3}$ mol $L^{-1}s^{-1}$ at what rate is $N_2O_5$ disappearing and at what rate is $NO_2$ forming?

5. The rate of the reaction

$$2HgCl_2\ (s) + C_2O_4^{2-}(aq) \rightarrow 2\ Cl^-\ (aq) + 2\ CO_2\ (g) + Hg_2Cl_2(s)$$

is followed by measuring the initial rate at different concentrations of the reactants.

| **Expt** | **[$HgCl_2$], M** | **[$C_2O_4^{2-}$], M** | **Initial rate, mol/(L min)** |
|---|---|---|---|
| 1 | 0.105 | 0.15 | $1.8 \times 10^{-5}$ |
| 2 | 0.105 | 0.30 | $7.1 \times 10^{-5}$ |
| 3 | 0.052 | 0.30 | $3.5 \times 10^{-5}$ |
| 4 | 0.052 | 0.15 | $8.9 \times 10^{-6}$ |

a) Determine the order of the reaction with respect to $HgCl_2$. with respect to $C_2O_4^{2-}$, and overall.

b) Write the rate law for this reaction.

c) What is the value of the rate constant k?

d) What would be the initial rate of reaction if [$HgCl_2$] = 0.020 M and [$C_2O_4^{2-}$] = 0.22 M?

6. The following reaction is first order with a rate constant of $6.2 \times 10^{-4}\ s^{-1}$ at 45˚C.

$$N_2O_5 \rightarrow N_2O_4 + 1/2\ O_2$$

If an initial amount of 80.0 g of $N_2O_5$ is allowed to decompose at 45˚C......

a. How long will it take for the quantity of $N_2O_5$ to be reduced to 2.5 g.?

b. What volume of $O_2$ at 1 atm and 45˚C will be produced at this point?

7. Textbook Chapter 13 Problem 54