CHEM 1114 Exam 1. February 27, 2008 Name_____

Useful information: $\ln \frac{[A]_{t}}{[A]_{0}} = -kt \quad \frac{1}{[A]_{t}} = kt + \frac{1}{[A]_{0}} \quad k = Ae^{-\frac{E_{a}}{RT}} \quad P_{solution} = P_{A}^{0}\chi_{A} + P_{B}^{0}\chi_{B},$ $\Pi = MRT, \quad R = 8.314 \frac{J}{mol \cdot K}, \quad 0.0821 \frac{l \cdot atm}{mol \cdot K}, \quad \Delta T_{b} = K_{b}c_{m}, \quad \Delta T_{f} = -K_{f}c_{m}, \text{ solubility=k} \cdot \mathsf{P},$ $\ln P_{vap} = \frac{-\Delta H_{vap}}{RT} + C, \quad \ln \frac{P_{2}}{P_{1}} = \frac{\Delta H_{vap}}{R} (\frac{1}{T_{1}} - \frac{1}{T_{2}}) \quad \text{m=moles/kg}$ You must show work for credit.



(a) Which of the molecules above should be soluble in water?

(b) Which should be soluble in nonpolar solvents?

(2)(4 pts) The solubility of N_2 in water is 3.8 x 10⁻³ M when the partial pressure of CO_2 is 0.0100 atm. What pressure of CO_2 would be required to form a 00.500 M solution of CO_2 ?

(3) Sketch a face centered cubic unit cell. How many atoms are contained inside the unit cell?

(4)(4 pts) If a compound has a vapor pressure of 25 mm Hg at 50 °C, and its normal boiling point is 115 °C, what is its ΔH_{vap} ?

(5) (6 pts) (a) Sketch a phase diagram using the information given below
The triple point is at 125 °C and 5.25 atm
The critical point is at 1200 °C and 11.2 atm
The is solid denser than the liquid
label the phases

(b) What phase(s) is (are) present at 700 °C and 9 atm?

(6)(3 pts) Convert a 0.50 mole fraction solution of methanol(CH₃OH) in water to molality.

(7)(4 points) If 15.0 g of acetone (CH₃COCH₃, MW = 58.09 g/mol) is added to 325 g of an unknown solvent, the freezing point of the mixture is 2.2 °C. The freezing point of the pure solvent is 5.7 °C. What is K_f for this solvent?

(8)(4 pts) What is the minimum pressure needed to get pure water from a 0.0150 M solution of Na_3PO_4 by reverse osmosis at 273K?

Experiment	Initial Concentrations [O ₂]	[C]	Initial rate (in M/s)
1	0.21	0.15	1.8 x 10 ⁻⁵
2	0.21	0.30	3.7 x 10 ⁻⁵
3	0.10	0.30	4.5 x 10 ⁻⁶

(9)(6 points) From the following kinetic data, determine the form of the rate law.

Write out the form of the rate law (you don't need to evaluate k)

O₂ + 2C ---> 2CO

(10)(2 points) What intermolecular forces are present in CH_2Cl_2 and why?

- (11)(3 points) rate = $k[NO][ClO]^2$
- (a) What is the order of the rate with respect to [NO]?
- (b) What is the order of the rate with respect to [ClO]?
- (c) What is the overall order of the rate?
- (12)(2 pts) The vapor pressure of a given liquid depends on
 - (A) volume of the container.
 - (B) barometric pressure.
 - (C) partial pressure of oxygen in the air.
 - (D) relative humidity of the air.
 - (E) temperature.

(13)(2 pts) A crystal of anhydrous CO₂ made up of

- (A) a pattern of CO_3^{2-} ions and CO^{2-} ions
- (B) atoms of carbon and oxygen alternately spaced in the crystal.
- (C) a geometrical pattern of carbide ions and oxide ions in the crystal.
- (D) molecules of CO_2

(14) (2 pts) How many atoms are in a unit cell of a body-centered cubic crystal?

(A) one (B) two (C) three (D) four

(extra credit) 6 points. The rate constant for a reaction is 2.2×10^{-3} 1/Ms at 298 K. If the energy of activation is 35 kJ/mol, at what temperature will the rate constant k = 0.500 1/Ms?