20 tests turned in
25
(38)

CHEM 1114 Take-Home Exam 1. February 18, 20089

Name __Key__

Useful information: $\ln\frac{[A]_t}{[A]_0} = -kt$, $\frac{1}{[A]_t} = kt + \frac{1}{[A]_0}$, $k = Ae^{-\frac{E_a}{RT}}$, $P_{solution} = P_A^0\chi_A + P_B^0\chi_B$,

$\Pi = MRT$, $R = 8.314\frac{J}{mol\cdot K}, 0.0821\frac{l\cdot atm}{mol\cdot K}$, $\Delta T_b = K_b c_m$, $\Delta T_f = -K_f c_m$, solubility=k•P,

$\ln P_{vap} = \frac{-\Delta H_{vap}}{RT} + C$, $\ln\frac{P_2}{P_1} = \frac{\Delta H_{vap}}{R}(\frac{1}{T_1} - \frac{1}{T_2})$ m=moles/kg

You must show work for credit.

(1) (4 points) What types of solvents (if any) should dissolve the following compounds?

(a) Na_2SO_4 very polar, H/B solvents

(b) CH_3OH polar solvents

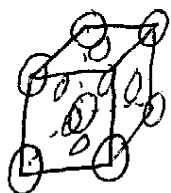(c) PCl_3 polar solvents

(d) W none

(2)(4 points) What types of compounds exhibit ionic bonding?

Compounds between a metal (low EN) and a nonmetal (high EN)

(3)(2 points) Sketch a face centered cubic unit cell. How many atoms are contained inside the unit cell?

$$8\left(\frac{1}{8}\right) + 6\left(\frac{1}{2}\right) = 4$$

corner   face

(4)(4 pts) If a compound has a normal boiling point of 85 °C, and ΔH_{vap} of 35.2 kJ/mol, what is its vapor pressure at 25 °C?

$T = 85\,°C \ (358\,K) \quad P = 1\,atm \qquad T_2 = 25\,°C \ (298\,K) \quad P_2 = ?$

$$\ln\frac{P_2}{1\,atm} = \frac{35,200\frac{J}{mol}}{8.314\frac{J}{mol}}\left(\frac{1}{358\,K} - \frac{1}{298\,K}\right) \qquad \boxed{P_2 = 0.0924\,atm} \qquad 70.1\,mmHg$$

$$\ln\frac{P_2}{1\,atm} = -2.381$$

$$\frac{P_2}{1\,atm} = 0.0924$$

(5)(4 pts) A solid as a simple cubic crystal structure with an edge length of 314 pm. If the density of the solid is 3.16 g/cm³ , what is the element?

$$314 \times 10^{-12}\,m = 3.14 \times 10^{-10}\,m \times \frac{100\,cm}{1\,m} = 3.14 \times 10^{-8}\,cm$$

$$density = mass/volume \qquad volume = (3.14 \times 10^{-8}\,cm)^3 = 3.10 \times 10^{-23}\,cm^3$$

$$\frac{3.16\,g}{cm^3} = \frac{mass}{3.10 \times 10^{-23}\,cm^3}$$

$$mass = 9.80 \times 10^{-23}\,g$$

$$MW = 59.79\,g/mol$$

element is Co

(6) (6 pts) Using the phase diagram shown, answer the following questions
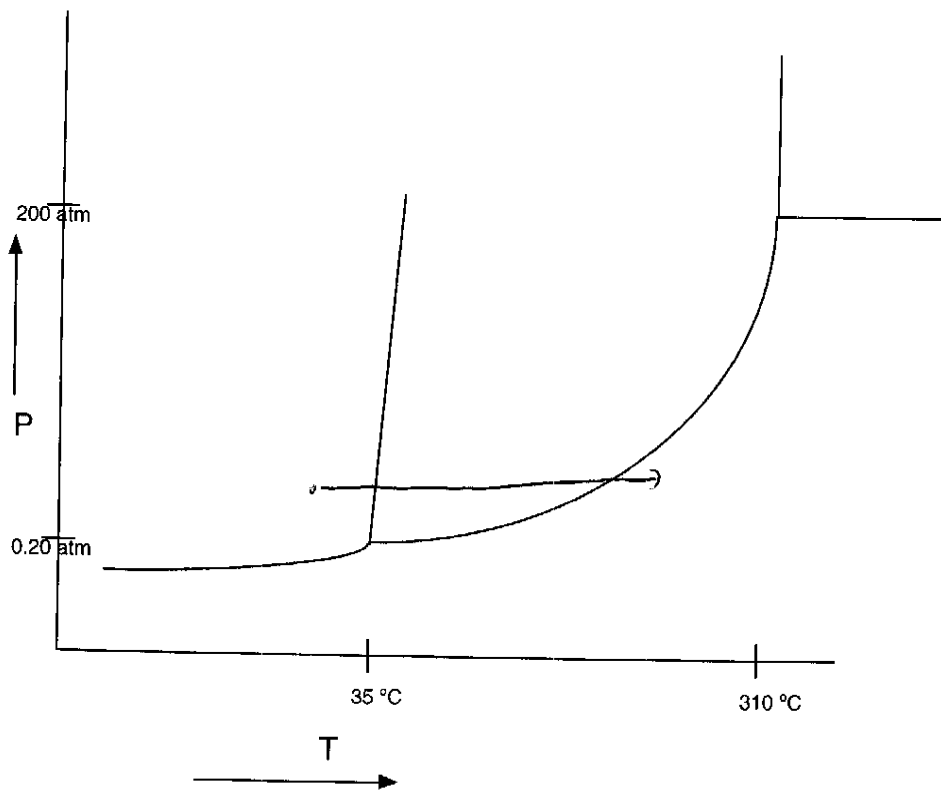
(a) What is the triple point?

$35\,^{\circ}C,\ 0.20\,atm$

(b) Is the solid or the liquid more dense?

Solid

(c) If the temperature is raised from 15 °C to 350 °C at a pressure of 30 atm, what phase changes, if any, would occur?

Melting and vaporization
(fusion)   (boiling)

(7)(4 points) At a certain town in Colorado, the atmospheric pressure is only 0.88 atm. How much NaCl (in g) needs to be added to 1.00 L of water to make it boil at 100 °C?

$$P_{sln} = P^o_{H_2O} X_{H_2O}$$

$$P_{sln} = 0.88 atm = 1.00 atm \cdot X_{H_2O}$$

$$X_{H_2O} = 0.88$$

$$\frac{moles H_2O}{total moles} = 0.88$$

1.00 L = 1000 g · $\frac{1 mol}{18.02 g}$ =

1000 g ÷ 18.02 g/mol = 55.5 mol

0.88 moles particles = 6.67 mol

mols particles = 8.33 mol

mto N₀Cl = 4.17 mol

$$\frac{55.5 mol}{55.5 mol + moles particles} = 0.88$$

$4.17 \times 58.44 g/mol =$

$\boxed{243.6 \, g \, NaCl}$

(8)(4 pts) If it requires 0.442 atm of pressure to purify water from a freshwater stream, what is the concentration of dissolved particles in the stream?

$$\Pi = MRT$$

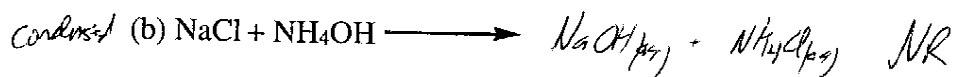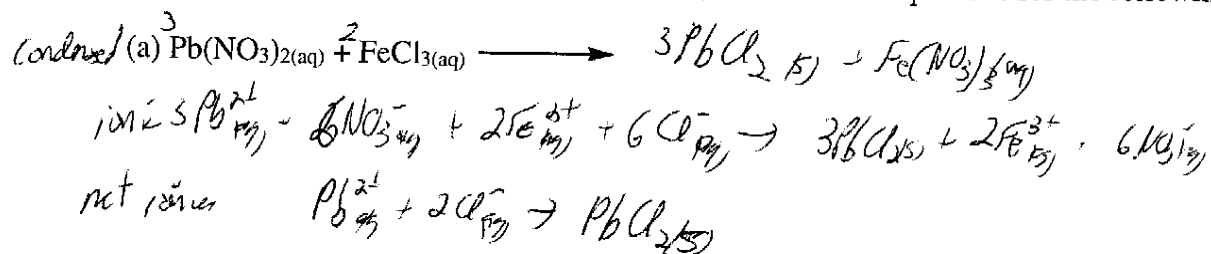$$0.442 \, atm = M \left(0.0821 \frac{L \cdot atm}{mol \cdot K}\right)(300 K)$$

$$\boxed{0.0171 \, M = M}$$

(9)(2 points) What intermolecular forces are present in the following molecules?

(a) CH₃OH   dispersion forces, dipole-dipole forces, hydrogen bonding

(b) PCl₃   dispersion forces, dipole-dipole forces

(11)(4 points) Write out the condensed, ionic, and net ionic equations for the following reactions.

condensed (a) $3Pb(NO_3)_{2(aq)} + 2FeCl_{3(aq)} \longrightarrow 3PbCl_{2(s)} + Fe(NO_3)_{3(aq)}$

ionic $3Pb^{2+}_{(aq)} + 6NO_3^-{}_{(aq)} + 2Fe^{3+}_{(aq)} + 6Cl^-{}_{(aq)} \rightarrow 3PbCl_{2(s)} + 2Fe^{3+}_{(s)} + 6NO_3^-{}_{(aq)}$

net ionic $Pb^{2+}_{(aq)} + 2Cl^-{}_{(aq)} \rightarrow PbCl_{2(s)}$

condensed (b) $NaCl + NH_4OH \longrightarrow NaOH_{(aq)} + NH_4Cl_{(aq)}$ NR

$\underline{No\ reaction}$

(12)(4 points) Label the following as electrolytes or nonelectrolytes.

(a) Al non electrolyte

(b) Na_3PO_4 electrolyte

(c) NH_3 non electrolyte

(d) PCl_5 nonelectrolyte