Chapter 9 Assignment
(Answers are in parenthesis)

1. The liquids, perfluoro-n-heptane and benzene are only partially miscible at temperatures below their UCST of 113.4°C. At 100°C one liquid phase is approximately 0.48 mole fraction benzene, and the other 0.94 mole fraction benzene. The liquid molar volume of perfluoro-n-heptane and benzene at 25°C are 226 cc/mole and 89cc/mole, respectively. Check if above data is consistent with Regular Solution behaviour with δ(benzene)=9.2(cal/cc)$^{1/2}$; δ(perfluoroheptane)=12.0(cal/cc)$^{1/2}$ **[No]**

2. In a binary mixture of B and C, at const. T and P, $G^E / RT = x_B x_C[2.0 + 0.2(x_B - x_C) - 0.8(x_B - x_C)^2]$ Determine the composition limits of essential stability of the mixture. **[x_B = 0.35, 0.7]**

3. A solute 'A' dissolves to partition into two fully immiscible liquids 'B' and 'C'. Phase I contains only 'A' and 'B' and is equimolar, while phase II contains 95mole % 'C'. The liquid phase coefficient model is of the form: $G^E / RT = \beta x_i x_j$. If $\beta = 1$ for phase I, compute that for phase II. **[2.83]**

4. The solubility (mole fraction) of a substance A (solid) in water is $3.37x10^{-10}$ at 25C. The melting point of the solid is 178.1C, and its heat of fusion 15.1kJ/mole. Estimate the acitivity coefficient of A in water. What does the value suggest in terms of interaction of the two? **[$3.8x10^8$]**

5. A liquid solution at 400^{0}K and 1 atm, contains 5mol% of '1' and 95mol% of '2'. The mixture is cooled isobarically. By how much does the temperature drop before just the first *solid* particle appears? Assume that both the phases form ideal solution. The melting point and fusion enthalpies (constant) are: $T_{m1} = 353.4K; T_{m2} = 278.7K$; $\Delta H_{fus,1}(J/mol) = 19008; \Delta H_{fus,2}(J/mol) = 9843$ **[125^{0}K]**

6. *A pure* solid (1) exists in equilibrium with a mixture of its vapour and a gas (2) at 400^{0}K. The vapour mixture contains 0.1 mol% of the solute (1) and forms a*n ideal solution*. Calculate the pressure of the system. The molar volume of solid at 400^{0}K is 200.0 cm^3/mol. Data: $\log_{10} P^{sub}(bar) = 2.0 - \frac{1600}{T(^0K)}$ The second virial coefficients at 400^{0}K are: $B_{11} = -565,\ B_{22} = -400,\ B_{12} = -350 cm^3 / mole.$