**INDIAN INSTITUTE OF TECHNOLOGY, BOMBAY**

**Department of Metallurgical Engineering and Materials Science**

**MM 202: THERMODYNAMICS : 2019-20: Fall**

**Tutorial No. 7: Date: Sept27, 2019**

1. (a) From vapor pressure data 1350 K the following data has been found for the Cu- Fe liquid solution (metastable). Complete the table.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| item | data | | | | | | | |
| X\_Cu | 1.0000 | 0.9000 | 0.8000 | 0.6000 | 0.4000 | 0.2000 | 0.1000 | 0.0000 |
| p\_Cu, Pa | 55.80 | 51.50 | 49.10 | 46.87 | 44.64 | 39.06 | 30.13 | 000 |
| a\_Cu w.r.t. pure liq |  |  |  |  |  |  |  |  |
| a\_Cu w.r.t. liq/X\_Cu |  |  |  |  |  |  |  |  |
| GCu in sol – GCu, liq |  |  |  |  |  |  |  |  |
| a\_Cu w.r.t. Cu in 40at.% soln. |  |  |  |  |  |  |  |  |

(b) Can you reduce NiO(s) by Cu(l) at 1350 K to give Ni(s) and Cu2­O(s)? Use the data (Gaskell) :

4Cu(l) + O2(g) = 2Cu2O(s); ΔG0 = -376600+176.96 T, J/mol.;

NiO(s) = Ni(s) +1/2 O2(g), ΔG0 = 235600-86.0T, J/mol.

(c) Will the reduction by Cu still take pace if it is in solution in iron with atom fraction of 0.1 ?

1. (a) At 25C, water has an equilibrium vapour pressure of 0.03126 atm. at 25C (i.e., liquid water and pure steam vapour are in equilibrium with each other at this pressure and temperature). What is the free energy change when one kg of water at 1atm. is converted into steam (i) at 0.03126atm. and 25C (ii) at 1 atm. and 25C (metastable).

Assume density of water to be constant at 1000 kg/m3, and steam to be ideal gas.

(b) In a water ethanol mixture, mole fraction of water being 0.40, the vapour pressure of water has been measured to be 0.0243 atm. at 25C. What is the (i) activity and (ii) activity coefficient of water in the solution with respect to pure water (liquid)