KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2009/2010

SUPPLEMENTARY EXAMINATION FOR THE DEGREE OF MASTER OF SCIENCE

SCH 503: ADVANCED CHEMICAL THERMODYNAMICS

DATE: Friday 1st October 2010 TIME: 9.00a.m – 12.00p.m

INSTRUCTIONS: Attempt all Questions

R = 0.8205$latmk^{-1}\ mol^{-1}$

1. (a) What is an equation of state for ideal gases and how is this related to virial equations.

   (b) The Van der Waals equation of state is given as

$$\left(P+\frac{a}{v^2}\right)(v-b)=RT$$

   Show that the compressibility factor, Z may be expressed as

$$Z=\frac{PV}{RT}=1+\left(b-\frac{a}{RT}\right)\frac{P}{RT}$$

   hence

$$Z=\frac{PV}{RT}=1+\frac{B}{V}+\frac{C}{V^2}$$

2. (a) Discuss briefly any three methods of determining partial molar quantities from the integrated values.

(b) The relative molar free energy of mixing $(\Delta Gmix)$ for the system $Au - Sn_{(liq)}$ at 873k is given in the following table

XAu	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
ΔGmix	-6.28	-10.47	-13.40	-16.33	-1800	-1800	-15.49	12.56	8.3

$lkjmol^{-1}$

Evaluate the partial molar free energies *ΔG* for *Au* and *Sn* in a melt at $X_{Au} = 0.5$ at 873K

3. (a) (i) Define an ideal solution

(ii) The Gibb's – Duheim equation is given by

$$X_1 d\ln\mu_1 + X_2 d\ln\mu_1 = 0$$

Show that

$$X_1 d\ln a_1 + X_2 d\ln a_2 = 0$$

Hence prove that when Raoults law is varied for the solvent Henry's law is varied for the solute.

4. a) (i) Given a strong electrolyte $A_{V+}B_{V-}$ which dissociate completely in solution a follow $A_{V+}B_{V-} = V^+ A^+ + V^- B^-$ write down the expression for

ii) The activity of the electrolyte in idle solution

(iii) The mean activity of the electrolyte in ideal solutions

b) Calculate the activity and mean activity of ideal solutions of

(i) 0.01M $Al_2 (SO_4)_3$

(ii) 0.01Mal Cl_3 (a)

The Debye – Huckel limiting law is given by

$$\log\gamma_{\pm} = -0509|Z|Z|1^{½}$$

List the underlying principles (without necessarily giving equations) that result in the above equation.