淡江大學98學年度碩士班招生考試試題

67

系別：化學工程與材料工程學系　　科目：物 理 化 學

准帶項目請打「V」	
V	簡單型計算機

本試題共 1 頁，5 大題

1. For the reaction, A (g, 1 bar) + B (g, 1 bar) ↔ 2C (g, 1 bar) + D (g, 1 bar) at 25°C.

	$A_{(g)}$	$B_{(g)}$	$C_{(g)}$	$D_{(g)}$
ΔH^o_f (kJ/mole)	-300.0	-200.0	-250.0	-100.0
ΔG^o_f (kJ/mole)	-350.0	-150.0	-200.0	-80

(ΔH^o_f is the standard heat of formation at 25°C; ΔG^o_f is the standard Gibbs energy of formation at 25°C)

(a) Calculate the standard reaction enthalpy ΔHr^o (kJ/mol);

(b) Calculate the equilibrium constant K for this reaction.

(c) Assume a constant ΔHr^o value, estimate the equilibrium constant at 100°C.

2. Consider the following electrochemical cell:

$Zn_{(s)} | Zn^{2+}_{(aq)} || Cu^{2+}_{(aq)} | Cu_{(s)}$

Calculate: (a) the standard electromotive force.

(b) the equilibrium constant for the cell reaction.

$\Delta G^o_f [Zn^{2+}_{(aq)}] = -147.06$ kJmol^{-1}; $\Delta G^o_f [Cu^{2+}_{(aq)}] = 65.49$ kJmol^{-1}

3. Given the Margules equations: $ln\ \gamma_A = \beta X_B^2$; $ln\ \gamma_B = \beta X_A^2$ (X_i is the molar fraction; β is the interaction parameter) to express the activity coefficients (γ_A, γ_B) of components A and B in a regular solution,

(a) Derive the expression of Gibbs energy of mixing ΔG_{mix} for a regular solution formed from A and B. If 2.00 mol of A (saturated vapor pressure $P_A^* = 200$ kPa) is mixed with 3.00 mol of B (saturated vapor pressure $P_B^* = 300$ kPa) at 300 K to form a regular solution with $\beta = 2$.

(b) Calculate the value of activity of A, vapor pressure of A component, and ΔG_{mix}.

(c) Will A and B form a miscible liquid mixture or not?

4. The energy difference between the two quantum levels of a nucleus with I = 1/2 depends on the applied magnetic field B_o: $\Delta E = (\gamma h/2\pi)B_o$, where γ is the magnetogyric ratio (for proton, $\gamma = 2.6752 \times 10^8$ rad.T^{-1}.s^{-1}) and h is Planck's constant, 6.626×10^{-34} J.s.

(a) According to the Boltzmann distribution, how many protons would be in the ground state for every 100,000 protons in the excited state under an applied magnetic field (B_o) of 4.6972 T at 293 K?

(b) Also, calculate the frequency of radiation (in MHz) absorbed by the proton at ground state to be exited to the excited state. (Boltzmann constant $k = 1.381 \times 10^{-23}$ JK^{-1})

5. The following data have been obtained for the decomposition of A at 350 K according to the reaction: $2A \rightarrow 4\ B + C$. Determine (a) the reaction order, (b) the rate constant, and (c) the half-life time.

time (min)	0	1	2	3	4
[A] (mol/L)	1.000	0.705	0.497	0.349	0.246