

# มหาวิทยาลัยสงขลานครินทร์

## คณะวิศวกรรมศาสตร์

การสอบปลายภาค ประจำปีการศึกษาที่ 2

ประจำปีการศึกษา 2549

วันที่ 14 กุมภาพันธ์ 2549

เวลา 9:00 – 12:00

วิชา 237-503 :Advanced Thermodynamic of Materials

ห้อง ME110C

### คำสั่ง

1. ข้อสอบมีทั้งหมด 3 ข้อ ให้ทำทุกข้อ
2. ห้ามนำเอกสารใดๆ เข้าห้องสอบ
3. สามารถใช้เครื่องคิดเลข และ คินสอได้

กำหนดให้:  $R=8.3145 \text{ J/mole/K}$

$F=23060 \text{ Cal/Volt}$

$1 \text{ Cal} = 4.1868 \text{ J}$

Debye-Huckel limiting equation (for water as a solvent):  $\ln \gamma_{\pm} = -1.171 I^{0.5}$

ผศ.ดร.สุธรรม นียมวาส

ผู้ออกข้อสอบ

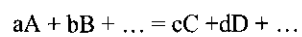
ข้อ	คะแนนเต็ม	คะแนน
1	25	
2	25	
3	20	
คะแนนรวม	70	

ชื่อ-สกุล.....

รหัส.....

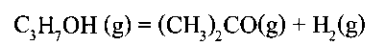
Q.1

(10 pts) a. For chemical reaction,



Show that  $\Delta G = \Delta G^\circ + RT \ln J$

(15pts) b. Calculate  $\Delta_r H_{298}^\circ$  by the simple second law method for the following reaction;



By using  $K_p = 0.151$  at 422.0 K and  $K_p = 1.58$  at 491.6 K

Q.2

(10 pts) a. Explain the following:

1. The mean activity,  $a_{\pm}$
2. Debye-Huckel Theory
3. Temkin Rule

(15 pts) b. Assume that  $1.76 \times 10^{-4}$  mole of  $\text{AgIO}_3$  is soluble in water at  $25^\circ\text{C}$ . Calculate the equilibrium constant,  $K_p$ , and  $\Delta G^\circ$  for  $\text{AgIO}_3(\text{s}) = \text{Ag}^+ + \text{IO}_3^-$

Q.3

(5 pts) a. Explain Galvanic cell.

(15 pts) b. Construct a cell for  $\text{Ag} + \text{Fe}^{3+} = \text{Ag}^+ + \text{Fe}^{2+}$  at  $25^\circ\text{C}$  using the nitrate salts and calculate (a)  $E^\circ$  from the given Table and (b)  $K_i = \frac{(m_+)(m_{++})}{(m_{3+})}$  at finite dilution.

**Table 14.1** Selected values of standard emf of half-cells,  $E^\circ$ , at 25°C;  $E^\circ$  is also called oxidation potential. Selected values from a table by P. Vanysek in Gen. Ref. (25) for one atm, corrected below to one bar by using (14.23). All metals and salts are in solid state except as indicated, the solvent is water.

Electrode Reaction	$E^\circ$ , Volts	Electrode Reaction	$E^\circ$ , Volts
$\text{Li} = \text{Li}^+ + e^-$	3.0403	$\text{Ag} + \text{Br}^- = \text{AgBr} + e^-$	-0.07116
$\text{K} = \text{K}^+ + e^-$	2.931	$\text{Cu}^+ = \text{Cu}^{2+} + 2e^-$	-0.153
$\text{Ca} = \text{Ca}^{2+} + 2e^-$	2.868	$\text{Ag} + \text{Cl}^- = \text{AgCl} + e^-$	-0.22216
$\text{Na} = \text{Na}^+ + e^-$	2.71	$2\text{Hg}(\text{l}) + 2\text{Cl}^- = \text{Hg}_2\text{Cl}_2 + 2e^-$	-0.26791
$\text{La} = \text{La}^{3+} + 3e^-$	2.379	$\text{Cu} = \text{Cu}^{2+} + 2e^-$	-0.3417
$\text{Mg} = \text{Mg}^{2+} + 2e^-$	2.372	$2\text{OH}^- = \text{H}_2\text{O} + 0.5\text{O}_2(\text{g}) + 2e^-$	-0.401
$\text{Al} = \text{Al}^{3+} + 3e^-$	1.662	$2\text{I}^- = \text{I}_2 + 2e^-$	-0.5353
$0.5\text{H}_2(\text{g}) + \text{OH}^- = \text{H}_2\text{O} + e^-$	0.82877	$2\text{Hg}(\text{l}) + \text{SO}_4^{2-} = \text{Hg}_2\text{SO}_4 + 2e^-$	-0.6123
$\text{Zn} = \text{Zn}^{2+} + 2e^-$	0.7620	$\text{Fe}^{2+} = \text{Fe}^{3+} + e^-$	-0.771
$\text{Fe} = \text{Fe}^{2+} + 2e^-$	0.447	$2\text{Hg}(\text{l}) = \text{Hg}_2^{2+} + 2e^-$	-0.7971
$\text{Cd} = \text{Cd}^{2+} + 2e^-$	0.4031	$\text{Ag} = \text{Ag}^+ + e^-$	-0.7994
$\text{Co} = \text{Co}^{2+} + 2e^-$	0.28	$\text{Hg}_2^{2+} = 2\text{Hg}^{2+} + 2e^-$	-0.920
$\text{Ni} = \text{Ni}^{2+} + 2e^-$	0.257	$2\text{Br}^- = \text{Br}_2(\text{l}) + 2e^-$	-1.066
$\text{Ag} + \text{I}^- = \text{AgI} + e^-$	0.15241	$2\text{H}_2\text{O} = \text{O}_2(\text{g}) + 4\text{H}^+ + 4e^-$	-1.229
$\text{Sn}(\text{white}) = \text{Sn}^{2+} + 2e^-$	0.1377	$2\text{Cl}^- = \text{Cl}_2(\text{g}) + 2e^-$	-1.35810
$\text{Pb} = \text{Pb}^{2+} + 2e^-$	0.1260	$2\text{F}^- = \text{F}_2(\text{g}) + 2e^-$	-2.866
$\text{H}_2(\text{g}) = 2\text{H}^+ + 2e^-$	0.000		

**Table 1.1** Fundamental constants, derived constants, and conversion factors.\*

Name	Symbol	Value and Units
<i>Fundamental constants:</i>		
(Ice + water + vapor) point		273.1600 Kelvin
Molar volume of perfect gas (0°C, 1 bar)	$V^0$	0.02271108 m <sup>3</sup> mol <sup>-1</sup> 22.71044 L mol <sup>-1</sup>
Avogadro Number	$N_A$	$6.022137 \times 10^{23}$ mol <sup>-1</sup>
Gas constant	$R$	8.31451 J mol <sup>-1</sup> K <sup>-1</sup> 1.987216 cal mol <sup>-1</sup> K <sup>-1</sup> 0.083143 L bar K <sup>-1</sup> mol <sup>-1</sup> 82.058 cm <sup>3</sup> atm mol <sup>-1</sup> K <sup>-1</sup>
Boltzmann constant	$k = R/N_A$	$1.380658 \times 10^{-23}$ J K <sup>-1</sup>
Faraday constant	$F$	96485.31 C mol <sup>-1</sup> 23,060.54 cal mol <sup>-1</sup> Volt <sup>-1</sup>
Velocity of light in vacuum	$c$	299,792,458 m s <sup>-1</sup>
Planck constant	$h$	$6.626076 \times 10^{-34}$ J s
Proton charge (-electronic charge)	$e^+$	$1.60217733 \times 10^{-19}$ C
Permittivity of vacuum	$\epsilon_0 = 10^7/(4\pi c^2)$	$8.854188 \times 10^{-12}$ F m <sup>-1</sup>
<i>Defined constants and conversion factors:</i>		
Thermochemical calorie	cal	4.1840 Joules (J)
Standard gravity	$g^\circ$	9.80665 m s <sup>-2</sup>
Standard pressure	bar	10 <sup>5</sup> Pa
Atmosphere of pressure	atm	101325 Pa (Newton m <sup>-2</sup> )
Newton	N	10 <sup>5</sup> dynes
Joule	J	10 <sup>7</sup> ergs
Liter	L	1000.028 cm <sup>3</sup>
Electron volt	eV	96485.31 J mol <sup>-1</sup> 23060.54 cal mol <sup>-1</sup>
Kelvin	K	273.1500 + °C

Fixed points (1990 scale), freezing points of pure elements in K: (In, 429.7485), (Sn, 505.078), (Zn, 692.677), (Al, 933.473), (Ag, 1234.93), (Au, 1337.33), (Cu, 1357.77).\*\*