SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY

DEPARTMENT OF MATERIALS & METALLURGICAL ENGINEERING

# MET 320 Hour Exam #2 Oct. 28, 2013

R = 1.987 cal•K-1•gmole-1 = 8.314 J•K-1•gmole-1 = 0.08205 L•atm•K-1•gmole-1

**No Calculators ♦ Closed Book and Notes ♦ Data Sheet and JANAF Tables for Ti Provided**

***Provide answers complete enough so that a good high school senior with a calculator could compute the numerical answers. That includes units. Five problems 20% each.***

1. Find the configurational (ideal) entropy change for the mixing of one gmole of Ag with nine gmoles of Au.

1. Write the
   1. Fundamental equation for a ***closed system*** for dH given dU = TdS - PdV

b) The Definition of Chemical potential i

1. The Criterion of Equilibrium at dT = dP = 0
2. The two ***Other Thermodynamic Relationship*** arising from dU = TdS -PdV
3. The ***Maxwell Relation*** from dU = TdS-PdV

3. Find the adiabatic flame temperature for the combustion of C2H2. With air pure O2. The oxygen and the C2H2 start at 500 K. Use the data provided below only. *Half the credit for this problem is for drawing a correct Calculation Schematic.*

C2H2 (g) + 2.5O2(g) = 2CO2 (g) + H2O(g)

Species Heats of Formation Cp

(calories/g mole at 298°K) (cal/ gmole °K)

C2H2(g) 54,190 19.0

H2O(g) -57,800 10.5

CO2(g) -94,000 13.6

O2(g) 8.6

N2(g) 7.0

4. a) Find the heat required to raise the temperature of one gram mole of CaO from 298 K to 1000 K.

b) Find the S° for the reaction Ca(s) + 0.5 O2 (g) = CaO(s) at 298 K.

c) Using the attached **JANAF** Tables, find the heat required at constant pressure to raise one gram mole of pure, solid alpha Ti from 298 K to pure, liquid Ti at 2000 K. (Provide a brief description of what you are doing so partial credit may be awarded if your numbers are incorrect but your method has merit.)

1. **Work either a or b**. Problem (a) will be graded unless it is clearly crossed out.
   * + 1. According to Table A-5 on the accompanying data sheet from the textbook, Fe and Fe are in equilibrium at one atmosphere and 1187 K. What would this equilibrium temperature be at 1000 atm? The respective densities of alpha and gamma iron are 7.88 and 8.14 g/cm3 and the molecular weight of iron is 55.85 g/gmole. (Note: molar volume = MW/density.)

-OR-

* + - 1. Calculate the heat of vaporization of liquid Hg from the vapor pressure of Hg as a function of T given in Table A-4 on the accompanying data sheet.

***Attachments:***

***Data Sheet – turn in separately with no writing on it. They are reused.***

***JANAF Tables for Ti - take with you – do not submit.***

Scratch Paper – detach and discard