Name: _____ Test 2

150 points Chemistry 261

Dr. Jay H. Baltisberger April 6, 1998

Answer three of the following four multiple choice questions for 15 points each:

1. How many degrees of freedom are present in an alloy of copper and zinc (only a single homogenous solid phase) .

A) 0 **B)** 1 **C)** 2 **D)** 3 **E)** 4

2. What is the equilibrium constant (K°_p) for the reaction $N_2 + O_2 \text{ <—> } 2\ NO$ given the free energy of formation of NO, $\Delta G^\circ_f = 86.55$ kJ/mol?

A) 4.56×10^{-31} **B)** 6.75×10^{-16} **C)** 86.55 **D)** 1.48×10^{15} **E)** 2.19×10^{30}

3. Calculate the ΔH_f (in kcal/mol) for FeO given the following equations:

$FeO\ (s) + C\ (s) \text{ —> } Fe\ (s) + CO\ (g)$	37.0 kcal/mol
$2CO\ (g) + O_2\ (g) \text{ —> } 2CO_2\ (g)$	–135.0 kcal/mol
$C\ (s) + O_2\ (g) \text{ —> } CO_2\ (g)$	–94.0 kcal/mol

A) –192.0 **B)** –127.0 **C)** –63.5 **D)** –33.0 **E)** +33.0

4. What is the entropy change when 180.2 g (10.00 mol) of liquid water is pressurized from 1.00 atm to 21.00 atm at 298 K. For water, assume $\alpha = 3.04 \times 10^{-4}\ K^{-1}$ and $\rho = 1.00\ g/cm^3$ over the entire pressure range of this problem.

A) –0.111 J / K **B)** –0.00337 J / K **C)** 0.00 J / K **D)** 0.00337 J / K **E)** 0.111 J / K

Choose three of the following four problems for 35 points each:

5. Calculate ΔG for the isothermal compression of 30.0 g of water from 1.0 atm to 100.0 atm at 25˚C; neglect the variation of V with P.

6. For the gas-phase reaction

$$I_2 + \text{cyclopentene} \text{ <—> } \text{cyclopentadiene} + 2HI$$

measured K°_p values in the range of 450 to 700K are fitted by:

$$\ln K^\circ_p = a + b / T$$

where a = 7.55 and $b = -4.83 \times 10^3$ K. Calculate ΔG°, ΔH°, and ΔS° for this reaction at 500K. Assume ideal gases.

7. The normal melting point of Ni is 1452˚C. The vapor pressure of liquid Ni is 0.100 torr at 1606˚C and 1.00 torr at 1805˚C. The molar heat of fusion of Ni is 4.2 kcal/mol. Making reasonable approximations, estimate the triple point and vapor pressure of solid Ni at 1200 ˚C.

8. For CH_3OH (l) at 25˚C, the vapor pressure is 125 torr, ΔH_m of vaporization is 37.9 kJ/mol, ΔH_f is –238.7 kJ/mol, and S°_m is 126.8 J/mol K. Making reasonable approximations, find ΔH°_f and S_m of CH_3OH (g).