FORMULA SHEET (tear off)

1A												3A	4A	5A	6A	7A	8A
1 H 1.01	2A																2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.41	31 Ga 69.72	32 Ge 72.64	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc [98]	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	71 Lu 175.0	72 Hf 178.5	73 Ta 181.0	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po [209]	85 At [210]	86 Rn [222]
87 Fr [223]	88 Ra [226]	103 Lr [262]	104 Rf [261]	105 Db [262]	106 Sg [266]												

57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm [145]	62 Sm 150.4	63 Eu 152.0	64 Gd 157.2	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0
89 Ac [227]	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np [237]	94 Pu [244]	95 Am [243]	96 Cm [247]	97 Bk [247]	98 Cf [251]	99 Es [252]	100 Fm [257]	101 Md [258]	102 No [259]

$N_A = 6.022 \times 10^{23}$ $\quad$ $°C = (5/9)(°F - 32)$ $\quad$ $°F = (9/5)(°C) + 32$

1 amu = 1.661×10^{-27} kg $\quad$ $°C = K - 273.15$ $\quad$ $K = °C + 273.15$

1 atm = 760 torr = 760 mm Hg $\quad$ 1 atm = 1.013 bar $\quad$ $pV = nRT$

$R = 0.08206$ L·atm/mol·K $\quad$ 1 L·atm = 101.3 J

$R = 8.314$ J/mol·K $\quad$ 1 J= 1 kg·m^2/s^2

$$\ln(p) = -\frac{\Delta H°_{vap}}{T} + C \qquad \ln(p_2/p_1) = -(\Delta H°_{vap}/R)\{(1/T_2) - (1/T_1)\}$$

$p_A = X_A\, p_A°$ $\quad$ $[B] = k\, p_B$ $\quad$ $\Delta p_A = X_B p_A°$

$\Delta T_b = K_b\, m_B$ $\quad$ $\Delta T_f = K_f\, m_B$ $\quad$ $\Pi = [B]RT$

$H = U + pV$ $\quad$ $G = H - TS$

GENERAL CHEMISTRY 2
FIRST EXAM (Sample)

Name _____

Panthersoft ID _____

Signature _____

Part 1 _____ **(24 points)**

Part 2 _____ **(44 points)**

Part 3 _____ **(32 points)**

TOTAL_____ **(100 points)**

Do all of the following problems. <u>Show your work.</u>

Part 1. Multiple choice. Circle the letter corresponding to the correct answer. There is one and only one correct answer per problem. [4 points each]

1) Which of the following states of matter is classified as a fluid?

a) The solid state
b) The liquid state
c) The gas state
d) Both a and b
e) Both b and c

2) 10.0 grams of glucose (MW = 180.2 g/mol), 40.0 g of isopropyl alcohol (MW = 60.1 g/mol), and 400.0 g of water (MW = 18.0 g/mol) are mixed together to form a solution. We may say

a) water is the solvent in the above solution
b) glucose is the solvent in the above solution
c) isopropyl alcohol is the solvent in the above solution
d) both glucose and isopropyl alcohol are solvents in the above solution
e) none of the components of the solution can be considered a solvent

3) A solution is prepared by dissolving 20.0 g of naphthalene (a non-volatile solute) in 150.0 g of benzene (a volatile solvent). Which of the following statements about this solution is correct?

a) The normal boiling point of the solution is higher than the normal boiling point of pure benzene
b) The normal boiling point of the solution is lower than the normal boiling point of pure benzene
c) The normal freezing point of the solution is higher than the normal freezing point of pure benzene
d) Both a and c
e) Both b and c

4) For a chemical reaction to be spontaneous which of the following must be true?

a) $\Delta S_{syst} > 0$
b) $\Delta S_{surr} > 0$
c) $\Delta S_{univ} > 0$
d) Both a and b
e) Both a and b and c

5) For 1.000 mol of which of the following substances will S°, the absolute entropy, be exactly zero at T = 25. °C?

a) Cu(s)
b) $O_2(g)$
c) $O_3(g)$
d) Both a and b
e) None of the above

6) For a particular chemical reaction we find that $\Delta H°_{rxn} < 0$ and $\Delta S°_{rxn} < 0$. Based on this information, we expect that for standard conditions

a) the reaction will always be spontaneous
b) the raction will never be spontaneous
c) the reaction will be spontaneous at high temperatures, but not at low temperatures
d) the reaction will be spontaneous at low temperatures, but not at high temperatures
e) cannot tell from the information given in the problem

Part 2. Short answer.

1) Define the following terms [4 points each]

colloid

miscible

state function

sublimation

2) Give the following [4 points each]

a) The formation reaction for chlorobenzene ($C_6H_5Cl(\ell)$).

b) The Third Law of thermodynamics

3) A solution is prepared by dissolving 1.200 g of potassium iodide (KI, MW = 166.0 g/mol) in 25.00 g water (H_2O, MW = 18.0 g/mol). What is the freezing point for the solution? Note that K_f = 1.86 kg•°C/mol, and that the normal freezing point for pure water is T_f = 0.00 °C. [10 points]

4) The vapor pressure of a particular pure liquid is p = 48.2 torr at T = 20.0 °C, and p = 247. torr at T = 50.0 °C. What is the numerical value for $\Delta H°_{vap}$, the enthalpy of vaporization, for the liquid? [10 points]

Part 3. Problems.

1) A solution is prepared by dissolving 48.43 g of potassium bromide (KBr, MW = 119.01 g/mol) in water (H_2O, MW = 18.02 g/mol) to form a solution with final volume and density V = 500.0 mL and D = 1.068 g/mL. What are the molarity of KBr in the solution and the mole fraction of KBr in the solution? [16 points]

2) Thermodynamic data are given below (at T = 25.0 °C and p = 1.00 atm) and may be of use in doing this problem.

Substance	$\Delta H°_f$ (kJ/mol)	$\Delta G°_f$ (kJ/mol)	S° (J/mol·K)
$N_2(g)$	0.0	0.0	191.5
NO(g)	90.4	86.7	210.6
$N_2O(g)$	81.6	103.6	220.0

a) What are the numerical values for $\Delta H°_{rxn}$ and $\Delta S°_{rxn}$ for the process [8 points]

$$2\ N_2O(g) \rightarrow N_2(g) + 2\ NO(g)$$

b) What is the numerical value for $\Delta S°_{univ}$ for the above process? [8 points]