Chem 210 – Exam 4 *Name:* _____
Summer 2010

Chemistry 210 Exam 4

Be sure to put your name on each page. This page can be removed from your exam so that you will have a Periodic Table handy throughout the exam, it does not need to be turned in. Show all your work for problems which require any sort of calculation, no credit will be given for answers without work shown. If you have shown a significant amount of work or multiple drawings for a problem, draw a box around what you consider your final answer.

Avogadro's Number = 6.022×10^{23} $^{\text{units}}/_{\text{mol}}$
$32.00^{\circ}F = 0.000^{\circ}C = 273.15K$
Density of Water = $1.000^{\text{g}}/_{\text{mL}}$
$R = 0.08206$ $^{\text{L•atm}}/_{\text{mol•K}} = 8.314$ $^{\text{J}}/_{\text{mol•K}}$
$PV=nRT$
$\Delta T_{fp/bp} = k_{fp/bp} \bullet m \bullet i$
For water, $k_{fp} = -1.86$ $^{\circ C}/_{m}$; $k_{bp} = 0.52$ $^{\circ C}/_{m}$
$P_1 = X_1 P_1^{\circ}$
$P = cRTi$
$C_1V_1 = C_2V_2$
Quadratic formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Integrated Rate Laws:

0^{th} order	$[A]_t = -kt + [A]_o$
1^{st} order	$\ln[A]_t = -kt + \ln[A]_o$
2^{nd} order	$1/[A]_t = kt + 1/[A]_o$

$k = Ae^{-Ea/RT}$

$$\ln(k) = \left(\frac{-E_a}{R}\right)\left(\frac{1}{T}\right) + \ln(A)$$

$$\ln\left(\frac{k_1}{k_2}\right) = \frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

$$pH = pK_a + \log\left(\frac{[\text{conjugate base}]}{[\text{conjugate acid}]}\right)$$

$E_{cell} = E^{\circ}_{cell} - {}^{RT}/_{nF}\, ln Q$
$E^{\circ}_{cell} = {}^{RT}/_{nF}\, ln K^{\circ}$
$K^{\circ} = e\text{^}({}^{nF}/_{RT}\, E^{\circ}_{cell})$
$F = 96485$ $^{\text{J}}/_{\text{V•mol of electrons}}$
$\Delta G^{\circ} = \Delta H^{\circ}_{system} - T\Delta S^{\circ}_{system}$
$\Delta G^{\circ} = -nFE^{\circ}_{cell} = -RT ln K^{\circ}$
$\Delta G = \Delta G^{\circ} + RT ln Q$
$F = 96485$ $^{\text{C}}/_{\text{mol electrons}}$
$1A = 1\ C / sec$

1 **H** 1.0079																	2 **He** 4.0026
3 **Li** 6.941	4 **Be** 9.0122											5 **B** 10.811	6 **C** 12.011	7 **N** 14.007	8 **O** 15.999	9 **F** 18.998	10 **Ne** 20.180
11 **Na** 22.990	12 **Mg** 24.305											13 **Al** 26.982	14 **Si** 28.086	15 **P** 30.974	16 **S** 32.066	17 **Cl** 35.453	18 **Ar** 39.948
19 **K** 39.098	20 **Ca** 40.078	21 **Sc** 44.956	22 **Ti** 47.88	23 **V** 50.942	24 **Cr** 51.996	25 **Mn** 54.938	26 **Fe** 55.847	27 **Co** 58.933	28 **Ni** 58.69	29 **Cu** 63.546	30 **Zn** 65.39	31 **Ga** 69.723	32 **Ge** 72.61	33 **As** 74.922	34 **Se** 78.96	35 **Br** 79.904	36 **Kr** 83.80
37 **Rb** 85.468	38 **Sr** 87.62	39 **Y** 88.906	40 **Zr** 91.224	41 **Nb** 92.906	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.07	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.76	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	57 **La** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.84	75 **Re** 186.21	76 **Os** 190.23	77 **Ir** 192.22	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226.03	89 **Ac** 227.03	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)	110 (269)	111 (272)	112 (277)		114		116		

58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.36	63 **Eu** 151.97	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.94	70 **Yb** 173.04	71 **Lu** 174.97
90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** 237.05	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (258)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)

Score

Multiple Choice (7pts each): Circle the letter of the most correct response.

1. A large negative change in free energy means:
   a. The reaction is exothermic
   b. The reaction is spontaneous
   c. The system is becoming less disordered
   d. The reaction is very fast
   e. The reaction is non-spontaneous

2. For a reaction with a large positive ΔS:
   a. Heat is required to make the reaction proceed
   b. The system is becoming much more ordered
   c. The reaction is not spontaneous
   d. The disorder of the system is increasing
   e. The reaction proceeds very slowly

3. If the change in enthalpy for a reaction is positive and the change in entropy is negative:
   a. The system is becoming more disordered
   b. The reaction releases heat
   c. The reaction will be spontaneous at all temperatures
   d. The reaction will be non-spontaneous at all temperatures
   e. The reaction will be spontaneous only at low temperatures

4. How are the change in Gibb's Free Energy and the equilibrium constant for a reaction related?
   a. As K approaches zero, ΔG approaches zero
   b. They're not.
   c. The value of ΔG is equal to (-logK)
   d. As ΔG gets more positive, K approaches 1
   e. As ΔG gets more negative, K gets very large

5. The volume of a gas:
   a. Increases as the temperature increases
   b. Remains constant as the amount of gas is increased
   c. Is always a constant
   d. Increases as the pressure increases
   e. Decreases as the kinetic energy increases

6. Ammonia, $NH_3(g)$, burns in oxygen to form nitrogen dioxide and water. How much energy is released during the formation of 34.97g of nitrogen dioxide by this reaction? (20pts)

Score

7. For each of the following reactions, predict whether the sign if ΔS^o will be positive or negative and explain your answer. (18pts)

$$Pb(NO_3)_2(aq) + 2\ NaCl(aq) \leftrightarrows PbCl_2(s) + 2\ NaNO_3(aq)$$

$$N_2(g) + 3\ H_2(g) \leftrightarrows 2\ NH_3(g)$$

$$C_5H_{12}(l) + 8\ O_2(g) \leftrightarrows 5\ CO_2(g) + 6\ H_2O(g)$$

8. You are studying the reaction of histidine with diethylsulfite. The temperature in your laboratory is 17.71ºC and you find that ΔG for this reaction is -4.661 $^{kJ}/_{mol}$. You have also determined that for this reaction ΔH = +21.61 $^{kJ}/_{mol}$ (20pts)
   a. Is the reaction becoming more or less disordered? (*Explain your answer with explicit calculations.*)
   b. Over what temperature range is this reaction spontaneous?

9. You have a 11.64L of an ideal gas at 1.73atm and 15.15°C. How much volume will the gas occupy at 0.837atm and 34.93°C? (18pts)

Score

10. You have burned 65.95g of ethene {$C_2H_4(g)$} in oxygen to form carbon dioxide and water. If all of the Gibb's Free Energy liberated by this reaction is used to decompose lead(II) iodide to lead metal and iodine solid, how many grams of iodine solid will be formed? (30pts)

Thermodynamic Values at 25°C:

Substance	**ΔH^o_f ($^{kJ}/_{mol}$)**	**S^o ($^{J}/_{mol \cdot K}$)**	**ΔG^o_f ($^{kJ}/_{mol}$)**
$NH_3(g)$	-45.9	192.8	-16.4
$O_2(g)$	0	205.138	0
$NO_2(g)$	33.2	240.1	51.3
$H_2O(l)$	-285.83	69.91	-237.129
$H_2O(g)$	-241.818	188.825	-228.572
$C_2H_4(g)$	52.4	219.3	68.4
$CO_2(g)$	-393.509	213.74	-394.359
$PbI_2(s)$	-175.5	174.9	-173.6
Pb(s)	0	64.8	0
$I_2(s)$	0	116.14	0

Score