Equations & Constants

$$[A] = -kt + [A]_0 \quad \frac{1}{[A]} = kt + \frac{1}{[A]_0} \quad \ln[A] = -kt + \ln[A]_0 \quad t_{1/2} = \frac{0.693}{k}$$

$$t_{1/2} = \frac{[A]_0}{2k} \quad t_{1/2} = \frac{1}{k[A]_0} \quad k = Ae^{-E_a/RT} \quad \ln(k) = -\frac{E_a}{R}\left(\frac{1}{T}\right) + \ln(A) \quad K_P = K(RT)^{\Delta n}$$

$$F = ma \quad P = F/A \quad P_1V_1 = P_2V_2 \text{ or } P_iV_i = P_fV_f \quad \frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \quad PV = nRT$$

$$D = \frac{MP}{RT} \quad P_{total} = P_1 + P_2 + \cdots \quad X_x = \frac{n_x}{n_{total}} \quad P_x = X_x P_{total} \quad P_{\text{total}} = \sum_i X_i P_i$$

$$C_{gas} = k_H P_{gas} \quad u_{rms} = \sqrt{\frac{3RT}{M}} \quad \frac{u_x}{u_y} = \sqrt{\frac{M_y}{M_x}} \quad \frac{r_x}{r_y} = \sqrt{\frac{M_y}{M_x}} \quad P = \frac{nRT}{V - nb} - \frac{n^2 a}{V^2}$$

$$\pi = iMRT \qquad \Delta T_b = iK_b m \qquad \Delta T_f = iK_f m \quad 8.314 \frac{J}{mol \cdot K} \quad 0.0821 \frac{L \cdot atm}{mol \cdot K}$$

$$\Delta S_{univ} = \Delta S_{sys} + \Delta S_{surr} \qquad \Delta S_{surr} = -\frac{\Delta H}{T} \qquad \Delta G = \Delta H - T\Delta S \qquad \Delta G^\circ = -RT \ln K$$

$$\Delta G = \Delta G^\circ + RT \ln Q \qquad \Delta G = -nFE_{cell} \qquad \Delta G^\circ = -nFE^\circ_{cell} \qquad E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$$

$$E_{cell} = E^\circ_{cell} - \frac{0.0592}{n} \log Q$$

1 H 1.008																	2 He 4.003
3 Li 6.941	4 Be 9.012											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 47.867	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.933	28 Ni 58.693	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.59	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.30
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 102.906	46 Pd 106.42	47 Ag 107.868	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.904	54 Xe 131.29
55 Cs 132.902	56 Ba 137.327	57 La 138.906	72 Hf 178.49	73 Ta 180.948	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.967	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.980	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (268)	110 Ds (271)	111 Rg (272)	112 Uub	113 Uut	114 Uuq	115 Uup			

58 Ce 140.116	59 Pr 140.908	60 Nd 144.908	61 Pm (145)	62 Sm 150.36	63 Eu 151.964	64 Gd 157.25	65 Tb 158.925	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04	71 Lu 174.967
90 Th 232.038	91 Pa 231.036	92 U 238.029	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)	103 Lr (262)

Chemistry 1212 Name_____
April 16, 2012
Exam #4

Write very clearly and **show all of your work** for partial credit. A list of equations and constants as well as a periodic table are on the last two pages of your exam.

1. (20 points) Place a correct response in each blank.

(a.) What is K if $\Delta G^\circ = 1.2\times10^{-2}$? _____

(b.) If $\Delta H^\circ_{rxn} = -84.9\,kJ$, what is ΔS°_{surr} in $\frac{J}{K}$? _____

(c.) Which law is related to ΔE, q, and w? _____

(d.) Is the S_f^0 for graphite zero (yes or no)? _____

(e.) Write the line/short notation for the redox reactions given below.

i.) $Sn^{4+}_{(aq)} + Tl_{(s)} \rightleftharpoons Sn^{2+}_{(aq)} + Tl^{+}_{(aq)}$ _____

ii.) $Au^{3+}_{(aq)} + Hg_{(l)} \rightleftharpoons Au^{+}_{(aq)} + Hg^{+}_{(aq)}$ _____

(f.) What conditions for Gibbs and cell potential will never give a spontaneous process?

_____

(g.) What do we call the cell described in f.)?

_____

(h.) What do we call the process in f.)?

_____

(i.) What is the n for the cell given in (e.) ii.)?

_____

(j.) For electrons to flow nonspontaneously is the potential positive or negative?

_____

2. (20 points) Balance the following redox reaction under <u>acidic</u> conditions. Identify which reagent is the oxidizing agent and which is the reducing agent.

$$H_2C_2O_{4(aq)} + BrO_{3(aq)} \rightarrow CO_{2(g)} + Br_{2(l)}$$

3.(25 points) Consider the following reaction and corresponding thermodynamic data

$$2H_2S_{(g)} + SO_{2(g)} \rightarrow 3S_{(s)} + 2H_2O_{(g)} \quad \Delta H^\circ_{rxn} = -154.6\ kJ$$

$S^\circ\left(\frac{J}{mol \cdot K}\right)$	20.5	264.1	64.8	89.9
$\Delta_f H^\circ\left(\frac{kJ}{mol}\right)$		-256.8	0	-214.8

(a) Determine the heat of formation for $H_2S_{(g)}$. (*5pts*)

(b) Determine the entropy change for the above reaction. (*5pts*)

(c) Determine ΔG^0 for the above reaction. (*5pts*)

(d) Determine the equilibrium constant for the above reaction. (*5pts*)
{R = 8.314 J/K·mol and F = 96485 C/mol}

(e) Is the reaction spontaneous? Why or why not? (*5pts*)

4. (35 points) Given the data below:

$$BiO^{+}_{(aq)} + 2H^{+}_{(aq)} + 3e^{-} \rightarrow Bi_{(s)} + H_2O_{(l)} \qquad E^o = 0.32\,V$$

$$PbO_{2(s)} + 3H^{+}_{(aq)} + HSO^{-}_{4(aq)} + 2e^{-} \rightarrow PbSO_{4(s)} + 2H_2O_{(l)} \qquad E^o = 1.628\,V$$

a.) Write the balanced equation for a galvanic cell. (*5pts*)

b.) State which half reaction is the cathode and the anode. (*5pts*)

c.) State the species which is oxidized and reduced. (*5pts*)

d.) State the species which is the oxidizing and reducing agent. (*5pts*)

e.) Determine the standard emf, E°_{cell}. (*5pts*)

f.) Is the reaction spontaneous? Why? (*5pts*)

g.) Determine the emf, E_{cell}, given: $\left[HSO^{-}_{4}\right] = 0.500M$, $\left[Bi^{3+}\right] = 0.250M$, $pH = 5$ (*5pts*)