5.111 Principles of Chemical Science

Fall 2008

Equations and constants for Exam 3

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

$R = 8.315\ J\ K^{-1}mol^{-1}$

$\Im$ (Faraday's constant) = $96{,}485\ C\ mol^{-1}$

$1V = 1\ J/C$

$1A = 1C/s$

$K_w = 1.00 \times 10^{-14}$ at 25°C

$14.00 = pH + pOH$ at 25°C

$\Delta G° = - RT \ln K$

$\Delta G = \Delta G° + RT \ln Q$

$\Delta G° = \Delta H° - T\Delta S°$

$$\ln\left(\frac{K_2}{K_1}\right) = -\left(\frac{\Delta H°}{R}\right)\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

$K_w = K_a K_b$

$pK_a = -\log [K_a]$

$pOH = -\log [OH^-]$

$pH = -\log [H_3O^+]$

$$pH \cong pK_a - \log\left(\frac{[HA]}{[A^-]}\right)$$

$\Delta E°(cell) = E°(cathode) - E°(anode)$

$RT/\Im = 0.025693$ V at 25.00 °C

$\Im/RT = 38.921\ V^{-1}$ at 25.00 °C

$\Delta E_{cell} = E°_{cell} - (RT/\Im\ n) \ln Q$

$\ln K = (n\Im/RT)\ \Delta E°$

$E_3° = [n_1E_1°(\text{reduction}) - n_2E_2°(\text{oxidation})]/n_3$

$\Delta G°_{cell} = -(n)(\Im)\ \Delta E°_{cell}$

$Q = It$

Standard Reduction Potentials at 25°C

Half-Reactions	$E°$(volts)
$Au^+(aq) + e^- \Rightarrow Au(s)$	1.69
$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)$	1.51
$Ag^+(aq) + 1e^- \rightarrow Ag(s)$	0.80
$Cu^{2+}(aq) + 2e^- \Rightarrow Cu(s)$	0.34
$AgCl(s) + 1e^- \rightarrow Ag(s) + Cl^-(aq)$	0.22
$Sn^{4+}(aq) + 2e^- \rightarrow Sn^{2+}(aq)$	0.15
$2H^+(aq) + 2e^- \Rightarrow H_2$	0
$Pb^{2+}(aq) + 2\ e^- \Rightarrow Pb(s)$	-0.13
$Sn^{2+}(aq) + 2\ e^- \Rightarrow Sn(s)$	-0.14
$Ni^{2+}(aq) + 2\ e^- \Rightarrow Ni(s)$	-0.23
$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$	-0.44
$Cr^{3+}(aq) + 3e^- \Rightarrow Cr(s)$	-0.74
$Zn^{2+}(aq) + 2e^- \Rightarrow Zn(s)$	-0.76

1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18[a] VIIIA[b]
The Active Metals																	Noble Gases
1 H 1.008												The Nonmetals					2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.179
11 Na 22.990	12 Mg 24.305	Transition Elements										13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.06	17 Cl 35.453	18 Ar 39.948
19 K 39.098	20 Ca 40.08	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 65.38	31 Ga 69.72	32 Ge 72.59	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 102.906	46 Pd 106.42	47 Ag 107.868	48 Cd 112.41	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.904	54 Xe 131.29
55 Cs 132.905	56 Ba 137.33	57 La 138.905	* 72 Hf 178.49	73 Ta 180.948	74 W 183.85	75 Re 186.21	76 Os 190.2	77 Ir 192.22	78 Pt 195.08	79 Au 196.966	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 226.025	89 Ac 227.028	† 104 Unq (261)	105 Unp (262)	106 Unh (263)												

Inner Transition Metals

* Lanthanides	58 Ce 140.12	59 Pr 140.908	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	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
† Actinides	90 Th 232.038	91 Pa 231.036	92 U 238.029	93 Np 237.048	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 (260)