Potentially Useful Information

Periodic Table of the Elements

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 47.88	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 121.75	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 183.85	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)	89 Ac** (227)	104 Rf (261.1)	105 Db (262.1)	106 Sg (263.1)	107 Bh (262.1)	108 Hs (265)	109 Mt (266)	110 Ds (271)	111 Rg (272)	112 ? (?)	113 ? (?)	114 ? (?)	115 ? (?)	116 ? (?)		

Standard Thermodynamic Values

Compound	ΔG_f° $\frac{kJ}{mole}$	ΔH_f° $\frac{kJ}{mole}$	S° $\frac{J}{mole \bullet K}$
$CH_{4\,gas}$	-50.81	-74.87	186.1
$CO_{2\,gas}$	-394.4	-393.5	213.7
CH_3OH_{gas}	-161.9	-201.2	238
CH_3OH_{liquid}	-166.2	-238.6	127
$O_{2\,gas}$	0	0	205.0
H_2O_{gas}	-228.6	-241.8	188.7
H_2O_{liquid}	-237.2	-285.8	69.9

Standard Reduction Potentials	
Half Reaction	**E° (Volts)**
$F_2 + 2\,e^- \longrightarrow 2\,F^-$	+2.87
$Cu^{+2} + 2\,e^- \longrightarrow Cu$	+0.34
$2\,H^+ + 2\,e^- \longrightarrow H_2$	+0.00
$Fe^{+2} + 2\,e^- \longrightarrow Fe$	-0.44
$Zn^{+2} + 2\,e^- \longrightarrow Zn$	-0.76
$Al^{+3} + 3\,e^- \longrightarrow Al$	-2.37
$Na^+ + e^- \longrightarrow Na$	-2.87

Thermodynamic Properties of Water (H_2O)

Heat capacity $C_{solid} = 37.6\ \frac{J}{mol\,C^\circ}$ Heat capacity $C_{liquid} = 75.4\ \frac{J}{mol\,C^\circ}$ Heat capacity $C_{gas} = 33.1\ \frac{J}{mol\,C^\circ}$

$\Delta H_{fusion} = 6.02\ \frac{kJ}{mol}$ $\Delta H_{vaporization} = 40.7\ \frac{kJ}{mol}$

$K_f = 1.862\ \frac{C^\circ}{m}$ $K_b = 0.512\ \frac{C^\circ}{m}$ $H_2O = 18.02\ \frac{grams}{mole}$

Thermodynamic Properties of Ethanol (C_2H_5OH)

Heat capacity $C_{liquid} = 112\,\frac{J}{mol\,C^\circ}$ Heat capacity $C_{gas} \approx 76\,\frac{J}{mol\,C^\circ}$

$\Delta H_{fusion} = 5.0\,\frac{kJ}{mol}$ $\Delta H_{vaporization} = 38.6\,\frac{kJ}{mol}$

$T_{mp} = -114°C$ $T_{bp} = 78°C$ $C_2H_5OH = 46.07\ \frac{grams}{mole}$

Formulas

Phase Changes

$\ln\left(\frac{P_2}{P_1}\right) = \frac{-\Delta H_{vap}}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$

$R = 8.314 \frac{J}{mol\,K}$

$^\circ K = {}^\circ C + 273$

$q = n\,\Delta H$ $\quad$ $q = n\,C\,\Delta T$

$\Delta H_{solution} = -\Delta H_{lattice} + \Delta H_{hydration}$

$\Delta H_{solution} = \Delta H_{solute} + \Delta H_{solvent} + \Delta H_{mix}$

Solutions

Molarity (M) $= \frac{moles\,solute}{liters\,solution}$

Molality (m) $= \frac{moles\,solute}{kg\,solvent}$

Mole fraction (χ) $= \frac{moles\,solute}{moles\,solute + moles\,solvent}$

$\Delta T_{b.p.} = i\,K_b\,m$

$\Delta T_{f.p.} = i\,K_f\,m$

$P_{solvent} = \chi_{solvent}\,P^\circ_{solvent}$

$S_{gas} = k_H\,P_{gas}$

Kinetics

rate $= \frac{\Delta Concentration}{\Delta time}$

$t_{\frac{1}{2}} = \frac{0.693}{k}$ *(1^{st} order only)*

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

Integrated Rate Laws

0^{th}: $[A]_t = -kt + [A]_0$

1^{st}: $\ln([A]_t) = -kt + \ln([A]_0)$

2^{nd}: $\frac{1}{[A]_t} = kt + \frac{1}{[A]_0}$

Acid-Base

$pH = -\log_{10}([H_3O^+])$

$pH + pOH = 14$

$pK_a + pK_b = 14$

$K_w = [H_3O^+]\,[OH^-] = 1.0 \times 10^{-14}$

$K_a \bullet K_b = K_w$

$pH = pK_a + \log_{10}\left(\frac{[Base]}{[Acid]}\right)$

% dissociation $= \frac{moles\,H^+}{moles\,HA} \times 100\%$

Thermochemistry

$\Delta G^\circ = \Delta H^\circ - T\,\Delta S^\circ$

$\Delta S^\circ_{reaction} = \sum n\Delta S^\circ_{products} - \sum n\Delta S^\circ_{reactants}$

$\Delta G = \Delta G^\circ + RT\ln(Q)$

$\Delta G^\circ = -RT\ln(K_{eq})$

$F = 96{,}485\ \frac{Coulombs}{mole \bullet e^-}$

$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

$\Delta G^\circ = -nFE^\circ_{cell}$

$E_{cell} = E^\circ_{cell} - \frac{RT}{nF}\ln(Q) = E^\circ_{cell} - \frac{0.0257}{n}\ln(Q)$