

Appendix D: Information Sheet

Fundamental Constants

Avogadro's number (N_a) $6.022 \times 10^{23}/\text{mol}$	Mass of electron	$9.11 \times 10^{-31} \text{ kg}$
Faraday's constant (F) $96,500 \text{ C/mol e-}$	Mass of neutron	$1.67 \times 10^{-27} \text{ kg}$
Gas constant (R) $0.08205 \text{ (L}\cdot\text{atm)/(mol}\cdot\text{K)}$	Mass of proton	$1.67 \times 10^{-27} \text{ kg}$
	Speed of light (c)	$3.00 \times 10^8 \text{ m/s}$
Planck's constant (h) $6.63 \times 10^{-34} \text{ J}\cdot\text{s}$	Rydberg's constant (R_H)	$2.18 \times 10^{18} \text{ J}$

Conversion Factors

1 atm = 760 mmHg (torr) = 101,325 N/m ² (Pa)	giga (G) = 10 ⁹
1 Faraday = 96,500 coulombs = 1 mole electrons = 96.5 kJ/volt	mega (M) = 10 ⁶
1 eV = $1.6 \times 10^{-19} \text{ J}$	1 liter = $1 \times 10^3 \text{ cm}^3$
1 MeV = $1.6 \times 10^{-13} \text{ J}$	kilo (k) = 10 ³
$^{\circ}\text{C} = (^{\circ}\text{F} - 32) \times 5/9$	deci (d) = 10 ⁻¹
0 $^{\circ}\text{C} = 273.15 \text{ K}$	centi (c) = 10 ⁻²
1 amu = $1.66 \times 10^{-24} \text{ g}$	milli (m) = 10 ⁻³
1 cal = 4.184 J	micro (μ) = 10 ⁻⁶
1 J = 1 N \cdot m = 1 kg \cdot m ² /s ²	nano (n) = 10 ⁻⁹
1 kg = 2.20 lbs	pico (p) = 10 ⁻¹²
1 in = 2.54 cm	femto (f) = 10 ⁻¹⁵
1 gal = 3.79 L	1 mL = 1 cm ³
1 mile = 1.61 km	1 hr = 3600 sec
1 Amp = 1 coulomb/sec	

Formulas

$$\ln\left(\frac{[A]_t}{[A]_o}\right) = -kt \quad t_{1/2} = \frac{0.693}{k} \quad \frac{1}{[A]_t} = kt + \frac{1}{[A]_o} \quad t_{1/2} = \frac{1}{k[A]_o} \quad \Delta G = \Delta H - T\Delta S$$

$$\ln\left(\frac{k_1}{k_2}\right) = \left(\frac{E_a}{R}\right)\left(\frac{1}{T_2} - \frac{1}{T_1}\right) \quad \ln\left(\frac{P_2}{P_1}\right) = \left(\frac{\Delta H_{vap}}{R}\right) * \left(\frac{1}{T_1} - \frac{1}{T_2}\right) \quad \Delta H_{rxn} = \sum n\Delta H_f^{\circ}(\text{products}) - \sum m\Delta H_f^{\circ}(\text{reactants})$$

$$\Delta U = q + w \quad E_{cell}^{\circ} = \frac{.0592}{n} \log K \quad \Delta G^{\circ} = -RT \ln K \quad \Delta G = \Delta G^{\circ} + RT \ln Q \quad w_{max} = -nFE_{cell}$$

$$\Delta G^{\circ} = -nFE_{cell}^{\circ} \quad E_{cell} = E_{cell}^{\circ} - \frac{0.0592}{n} \log Q \text{ at } 25^{\circ}\text{C} \quad \Delta E = (\Delta m)c^2 \quad pH = -\log[H_3O^+]$$

$$K_c = \frac{[C]^c [D]^d}{[A]^a [B]^b} \quad Q_c = \frac{[C]^c [D]^d}{[A]^a [B]^b} \quad K_w = [H_3O^+][OH^-] = 1.0 \times 10^{-14} \text{ at } 25^{\circ}\text{C} \quad pH + pOH = 14$$

$$K_a = \frac{[H_3O^+][A^-]}{[HA]} \quad K_b = \frac{[HB^+][OH^-]}{[B]} \quad K_a K_b = K_w \quad pH = pK_a + \log\left(\frac{[conj. base]}{[acid]}\right)$$

$$K_p = K_c (RT)^{\Delta n} \quad w = -P\Delta V \quad \text{Coulomb} = \text{Amp} \times \text{Sec.} \quad pOH = pK_b + \log\left(\frac{[conj. acid]}{[base]}\right)$$

Solubility Guidelines for Common Ionic Compounds in Water

These ions are soluble	Exceptions
$\text{Li}^+, \text{Na}^+, \text{K}^+, \text{Rb}^+, \text{Cs}^+$	none
NH_4^+	none
$\text{C}_2\text{H}_3\text{O}_2^-, \text{NO}_3^-$	none
$\text{Cl}^-, \text{Br}^-, \text{I}^-$	Compounds with $\text{Ag}^+, \text{Hg}_2^{2+}$, and Pb^{2+}
SO_4^{2-}	Compounds with $\text{Ca}^{2+}, \text{Sr}^{2+}, \text{Ba}^{2+}, \text{Ag}^+, \text{Hg}_2^{2+}$, and Pb^{2+}
These ions are insoluble	Exceptions
CO_3^{2-}	Compounds with Group 1A ions, and NH_4^+
PO_4^{3-}	Compounds with Group 1A ions, and NH_4^+
S^{2-}	Compounds with Group 1A ions, and NH_4^+
OH^-	Compounds with Group 1A ions, $\text{Ca}^{2+}, \text{Sr}^{2+}, \text{Ba}^{2+}$, and NH_4^+

Activity Series of Metals in Aqueous Solutions

Metal	Oxidation Reaction
Lithium	$\text{Li} \longrightarrow \text{Li}^+ + \text{e}^-$
Potassium	$\text{K} \longrightarrow \text{K}^+ + \text{e}^-$
Barium	$\text{Ba} \longrightarrow \text{Ba}^{2+} + 2 \text{e}^-$
Calcium	$\text{Ca} \longrightarrow \text{Ca}^{2+} + 2 \text{e}^-$
Sodium	$\text{Na} \longrightarrow \text{Na}^+ + \text{e}^-$
Magnesium	$\text{Mg} \longrightarrow \text{Mg}^{2+} + 2 \text{e}^-$
Aluminum	$\text{Al} \longrightarrow \text{Al}^{3+} + 3 \text{e}^-$
Manganese	$\text{Mn} \longrightarrow \text{Mn}^{2+} + 2 \text{e}^-$
Zinc	$\text{Zn} \longrightarrow \text{Zn}^{2+} + 2 \text{e}^-$
Chromium	$\text{Cr} \longrightarrow \text{Cr}^{3+} + 3 \text{e}^-$
Iron	$\text{Fe} \longrightarrow \text{Fe}^{2+} + 2 \text{e}^-$
Cobalt	$\text{Co} \longrightarrow \text{Co}^{2+} + 2 \text{e}^-$
Nickel	$\text{Ni} \longrightarrow \text{Ni}^{2+} + 2 \text{e}^-$
Tin	$\text{Sn} \longrightarrow \text{Sn}^{2+} + 2 \text{e}^-$
Lead	$\text{Pb} \longrightarrow \text{Pb}^{2+} + 2 \text{e}^-$
Hydrogen	$\text{H}_2 \longrightarrow 2 \text{H}^+ + 2 \text{e}^-$
Copper	$\text{Cu} \longrightarrow \text{Cu}^{2+} + 2 \text{e}^-$
Silver	$\text{Ag} \longrightarrow \text{Ag}^+ + \text{e}^-$
Mercury	$\text{Hg} \longrightarrow \text{Hg}^{2+} + 2 \text{e}^-$
Platinum	$\text{Pt} \longrightarrow \text{Pt}^{2+} + 2 \text{e}^-$
Gold	$\text{Au} \longrightarrow \text{Au}^{3+} + 3 \text{e}^-$

↑
Ease of oxidation increases

Appendix E:

Periodic Classification of the Elements

IA																VIIA		VIII A	
1 H 1.0080	IIA											III A		IVA	VA	VIA	1 H 1.0080	2 He 4.003	
3 Li 6.940	4 Be 9.013											5 B 10.82	6 C 12.011	7 N 14.006	8 O 16.000	9 F 19.00	10 Ne 20.183		
11 Na 22.991	12 Mg 24.32	III B	IV B	VB	VIB	VII B	↓	VIII B	↘	IB	II B	13 Al 26.98	14 Si 28.09	15 P 30.975	16 S 32.066	17 Cl 35.457	18 Ar 39.944		
19 K 39.100	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.95	24 Cr 52.01	25 Mn 54.94	26 Fe 55.85	27 Co 58.94	28 Ni 58.71	29 Cu 63.54	30 Zn 65.38	31 Ga 69.72	32 Ge 72.60	33 As 74.91	34 Se 78.96	35 Br 79.90	36 Kr 83.80		
37 Rb 85.48	38 Sr 87.63	39 Y 88.92	40 Zr 91.22	41 Nb 92.91	42 Mo 95.95	43 Tc (98)	44 Ru 101.1	45 Rh 102.91	46 Pd 106.04	47 Ag 107.88	48 Cd 112.41	49 In 114.82	50 Sn 118.70	51 Sb 121.70	52 Te 127.61	53 I 126.91	54 Xe 131.30		
55 Cs 132.91	56 Ba 137.36	57-71 see La Series	72 Hf 178.50	73 Ta 180.95	74 W 183.86	75 Re 186.22	76 Os 190.2	77 Ir 192.2	78 Pt 195.09	79 Au 197.0	80 Hg 200.61	81 Tl 204.39	82 Pb 207.21	83 Bi 209.00	84 Po (210)	85 At (210)	86 Rn (222)		
87 Fr (223)	88 Ra 226.05	89-103 see Ac Series	104 Unq (257)	105 Unp (260)	106 Unh (263)	107 Uns (262)	108 Uno (265)	109 Une (266)											

Lanthanide Series	57 La 138.92	58 Ce 140.13	59 Pr 140.92	60 Nd 144.27	61 Pm (147)	62 Sm 150.35	63 Eu 152.0	64 Gd 157.26	65 Tb 158.93	66 Dy 162.51	67 Ho 164.94	68 Er 167.27	69 Tm 168.94	70 Yb 173.04	71 Lu 174.99
	Actinide Series	89 Ac 227	90 Th 232.05	91 Pa (231)	92 U 238.07	93 Np (237)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (251)	100 Fm (253)	101 Md (256)	102 No (254)