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Useful equations:

$$E_N = E_A + E_R \quad E_{total} = -\frac{A}{r} + \frac{B}{r^n} \quad A = \frac{z_1 z_2 e^2}{4\pi\varepsilon_o} \quad E = \int F dr \quad F = \frac{dE}{dr}$$

$$Density = \frac{mass}{volume}; \quad \rho = \frac{nA}{V_c N_A}; \quad APF = \frac{V_{atoms}}{V_{unit\ cell}};$$

$$Volume\ of\ a\ sphere = \frac{4}{3}\pi r^3 \quad \%\ ionic\ character = \left(1 - e^{-\frac{(X_A - X_B)^2}{4}}\right) x\ 100\%$$

$$N_v = Nexp\left(-\frac{Q_v}{kT}\right); \quad N = \frac{N_A \rho}{A}; \quad J = -D\frac{dC}{dx} \quad \frac{\Delta C}{\Delta x} = \frac{C_2 - C_1}{x_2 - x_1}$$

$$D = D_o exp\left(-\frac{Q_d}{RT}\right); \quad \frac{\partial C}{\partial t} = D\frac{\partial^2 C}{\partial x^2}; \quad \frac{C(x,t) - C_o}{C_s - C_o} = 1 - erf\left(\frac{x}{2\sqrt{Dt}}\right) \quad x \approx \sqrt{Dt}$$

$$\sigma = \frac{F}{A_0} \quad \sigma = \mathrm{E}\varepsilon \quad \varepsilon = \frac{\delta}{L_0} \quad \nu = -\frac{\varepsilon_l}{\varepsilon} \quad \varepsilon_L = \frac{-\delta L}{Wo} \quad U_r \cong \frac{1}{2}\sigma_y \varepsilon_y \quad \tau = G\,\gamma$$

$$\%EL = \frac{L_f - L_o}{L_o} \times 100 \quad \%RA = \frac{A_o - A_f}{A_o} \times 100 \quad W_L = \frac{M_L}{M_L + M_\alpha} = \frac{S}{R+S} = \frac{C_\alpha - C_0}{C_\alpha - C_L} \quad W_\alpha = \frac{R}{R+S} = \frac{C_0 - C_L}{C_\alpha - C_L}$$

$$DP_n = \sum x_i n_i = \frac{\overline{M_n}}{m} \quad DP_w = \sum w_i n_i = \frac{\overline{M_w}}{m} \quad \mathrm{m} = \Sigma f_i m_i \quad \rho = \frac{n'(\Sigma A_C + \Sigma A_A)}{V_C N_A}$$

$$\rho = \frac{(\#\text{ of cations/UC})(\text{atomic wt. of cation}) + (\#\text{ of anions/UC})(\text{atomic wt. of anion})}{V_C N_A}$$

$$\Delta V = V_2^\circ - V_1^\circ - \frac{RT}{nF}\ln\frac{[M_1^{n+}]}{[M_2^{n+}]} \quad \Delta V = V_2^\circ - V_1^\circ - \frac{0.0592}{n}\log\frac{[M_1^{n+}]}{[M_2^{n+}]}$$

$$\mathrm{CPR} = \frac{\mathrm{KW}}{\rho \mathrm{At}} \quad J = \sigma \mathrm{E} \quad J = ev_d n \quad v_d = \mu_e \mathrm{E} \quad \sigma_{\mathrm{undoped}} \propto e^{-\frac{-E_{gap}}{kT}}$$

$$\sigma = n|e|\mu_e + p|e|\mu_h$$

Useful constants:

Avogadro's #: 6.023 x 10^{23} atoms/mol. Electronic charge: e = -1.602 x 10^{-19} C

Boltzmann's constant: k = 1.38 x 10^{-23} J/atom-K = 8.62 x 10^{-5} eV/atom-K

Planck's constant: h = 6.625 x 10^{-34} J-s Bohr Magneton: m_B = 9.27 x 10^{-24} A-m^2

Gas Constant: R = 8.31 J/mol-K = 1.987 cal/mol-K

Gravitational constant: g = 9.81 m/s^2 Faraday Constant: F = 96,487 C/mol

Useful constants and tabels:

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Table 17.2 The Galvanic Series

	Platinum
	Gold
	Graphite
	Titanium
	Silver
	316 Stainless steel (passive)
	304 Stainless steel (passive)
↑	Inconel (80Ni–13Cr–7Fe) (passive)
	Nickel (passive)
	Monel (70Ni–30Cu)
Increasingly inert (cathodic)	Copper–nickel alloys
	Bronzes (Cu–Sn alloys)
	Copper
	Brasses (Cu–Zn alloys)
	Inconel (active)
	Nickel (active)
	Tin
	Lead
Increasingly active (anodic)	316 Stainless steel (active)
	304 Stainless steel (active)
↓	Cast iron
	Iron and steel
	Aluminum alloys
	Cadmium
	Commercially pure aluminum
	Zinc
	Magnesium and magnesium alloys

Table 17.1 The Standard emf Series

	Electrode Reaction	*Standard Electrode Potential, V^0 (V)*
↑	$Au^{3+} + 3e^- \longrightarrow Au$	+1.420
	$O_2 + 4H^+ + 4e^- \longrightarrow 2H_2O$	+1.229
	$Pt^{2+} + 2e^- \longrightarrow Pt$	~ +1.2
	$Ag^- + e^- \longrightarrow Ag$	+0.800
Increasingly inert (cathodic)	$Fe^{3+} + e^- \longrightarrow Fe^{2+}$	+0.771
	$O_2 + 2H_2O + 4e^- \longrightarrow 4(OH^-)$	+0.401
	$Cu^{2+} + 2e^- \longrightarrow Cu$	+0.340
	$2H^+ + 2e^- \longrightarrow H_2$	0.000
	$Pb^{2+} + 2e^- \longrightarrow Pb$	−0.126
	$Sn^{2+} + 2e^- \longrightarrow Sn$	−0.136
	$Ni^{2+} + 2e^- \longrightarrow Ni$	−0.250
	$Co^{2+} + 2e^- \longrightarrow Co$	−0.277
	$Cd^{2+} + 2e^- \longrightarrow Cd$	−0.403
	$Fe^{2+} + 2e^- \longrightarrow Fe$	−0.440
Increasingly active (anodic)	$Cr^{3+} + 3e^- \longrightarrow Cr$	−0.744
	$Zn^{2+} + 2e^- \longrightarrow Zn$	−0.763
	$Al^{3+} + 3e^- \longrightarrow Al$	−1.662
	$Mg^{2+} + 2e^- \longrightarrow Mg$	−2.363
	$Na^+ + e^- \longrightarrow Na$	−2.714
↓	$K^+ + e^- \longrightarrow K$	−2.924

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Table 12.3 Ionic Radii for Several Cations and Anions (for a Coordination Number of 6)

Cation	*Ionic Radius (nm)*	*Anion*	*Ionic Radius (nm)*
Al^{3+}	0.053	Br^-	0.196
Ba^{2+}	0.136	Cl^-	0.181
Ca^{2+}	0.100	F^-	0.133
Cs^+	0.170	I^-	0.220
Fe^{2+}	0.077	O^{2-}	0.140
Fe^{3+}	0.069	S^{2-}	0.184
K^+	0.138		
Mg^{2+}	0.072		
Mn^{2+}	0.067		
Na^+	0.102		
Ni^{2+}	0.069		
Si^{4+}	0.040		
Ti^{4+}	0.061		

Table 5.1 Tabulation of Error Function Values

z	$erf(z)$	z	$erf(z)$	z	$erf(z)$
0	0	0.55	0.5633	1.3	0.9340
0.025	0.0282	0.60	0.6039	1.4	0.9523
0.05	0.0564	0.65	0.6420	1.5	0.9661
0.10	0.1125	0.70	0.6778	1.6	0.9763
0.15	0.1680	0.75	0.7112	1.7	0.9838
0.20	0.2227	0.80	0.7421	1.8	0.9891
0.25	0.2763	0.85	0.7707	1.9	0.9928
0.30	0.3286	0.90	0.7970	2.0	0.9953
0.35	0.3794	0.95	0.8209	2.2	0.9981
0.40	0.4284	1.0	0.8427	2.4	0.9993
0.45	0.4755	1.1	0.8802	2.6	0.9998
0.50	0.5205	1.2	0.9103	2.8	0.9999