Chapter 7

$$\sigma = \frac{F}{A_0}$$

$$\varepsilon = \frac{l_i - l_0}{l_0} = \frac{\Delta l}{l_0}$$

$$\tau = \frac{F}{A_0}$$

$$\sigma' = \sigma \cos^2\theta = \sigma\left(\frac{1+\cos 2\theta}{2}\right)$$

$$\tau' = \sigma \sin\theta \cos\theta = \sigma\left(\frac{\sin 2\theta}{2}\right)$$

$$\sigma = E\varepsilon$$

$$E \propto \left(\frac{dF}{dr}\right)_{r_0}$$

$$\tau = G\gamma$$

$$\nu = -\frac{\varepsilon_x}{\varepsilon_z} = -\frac{\varepsilon_y}{\varepsilon_z}$$

$$E = 2G(1+\nu)$$

$$E = slope = \frac{\Delta\sigma}{\Delta\varepsilon} = \frac{\sigma_2 - \sigma_1}{\varepsilon_2 - \varepsilon_1}$$

$$\%EL = \left(\frac{l_f - l_0}{l_0}\right)\times 100$$

$$\%RA = \left(\frac{A_0 - A_f}{A_0}\right)\times 100$$

$$U_r = \int_0^{\varepsilon_y} \sigma\, d\varepsilon$$

$$U_r = \frac{1}{2}\sigma_y \varepsilon_y = \frac{1}{2}\sigma_y\left(\frac{\sigma_y}{E}\right) = \frac{\sigma_y^2}{2E}$$

$$\sigma_T = \frac{F}{A_i}$$

$$\varepsilon_T = \ln\frac{l_i}{l_0}$$

$$\sigma_T = \sigma(1+\varepsilon)$$

$$\varepsilon_T = \ln(1+\varepsilon)$$

$$\sigma_T = K\varepsilon_T^n$$

$$\sigma_{fs} = \frac{3F_f L}{2bd^2}$$

$$\sigma_{fs} = \frac{F_f L}{\pi R^3}$$

$$E = E_0(1 - 1.9P + 0.9P^2)$$

$$\sigma_{fs} = \sigma_0 \exp(-nP)$$

$$E_r(t) = \frac{\sigma(t)}{\varepsilon_0}$$

$$E_c(t) = \frac{\sigma_0}{\varepsilon(t)}$$

$$TS(MPa) = 3.45 \times HB$$

$$TS(psi) = 500 \times HB$$

Chapter 8

$$\tau_R = \sigma \cos\phi \cos\lambda$$

$$\tau_R(\max) = \sigma(\cos\phi\cos\lambda)_{\max}$$

$$\sigma_y = \frac{\tau_{crss}}{(\cos\phi\cos\lambda)_{\max}}$$

$$\sigma_y = 2\tau_{crss}$$

$$\theta = \cos^{-1}\left[\frac{u_1u_2 + v_1v_2 + \omega_1\omega_2}{\sqrt{(u_1^2 + v_1^2 + \omega_1^2)(u_2^2 + v_2^2 + \omega_2^2)}}\right]$$

$$\sigma_y = \sigma_0 + k_y d^{-1/2}$$

$$\%CW = \left(\frac{A_0 - A_d}{A_0}\right)\times 100$$

$$d^n - d_0^n = Kt$$

$$\eta = \frac{\tau}{dv/dy} = \frac{F/A}{dv/dy}$$

$$TS = TS_\infty - \frac{A}{M_n}$$

Chapter 9

$$\sigma_m = \sigma_0\left[1 + 2\left(\frac{a}{\rho_t}\right)^{1/2}\right]$$

$$\sigma_m = 2\sigma_0\left(\frac{a}{\rho_t}\right)^{1/2}$$

$$K_t = \frac{\sigma_m}{\sigma_0} = 2\left(\frac{a}{\rho_t}\right)^{1/2}$$

$$\sigma_c = \left(\frac{2E\gamma_s}{\pi a}\right)^{1/2}$$

$$\sigma_c = \left(\frac{2E(\gamma_s + \gamma_p)}{\pi a}\right)^{1/2}$$

$$\sigma_c = \left(\frac{2E\gamma_p}{\pi a}\right)^{1/2}$$

$$\zeta_c = 2(\gamma_s + \gamma_p)$$

$$\zeta_c = \frac{\pi\sigma^2 a}{E}$$

$$\sigma_x = \frac{K}{\sqrt{2\pi r}} f_x(\theta)$$

$$\sigma_y = \frac{K}{\sqrt{2\pi r}} f_y(\theta)$$

$$\sigma_{xy} = \frac{K}{\sqrt{2\pi r}} f_{xy}(\theta)$$

$$K = Y\sigma\sqrt{\pi a}$$

$$K_c = Y(a/W)\sigma_c\sqrt{\pi a}$$

$$Y(a/W) = \left(\frac{W}{\pi a}\tan\frac{\pi a}{W}\right)^{1/2}$$

$$K_{Ic} = Y\sigma\sqrt{\pi a}$$

$$B \geq 2.5\left(\frac{K_{Ic}}{\sigma_y}\right)^2$$

$$\sigma_c \leq \frac{K_{Ic}}{Y\sqrt{\pi a}}$$

$$a_c = \frac{1}{\pi}\left(\frac{K_{Ic}}{\sigma Y}\right)^2$$

$$\sigma_m = \frac{\sigma_{\max} + \sigma_{\min}}{2}$$

$$\sigma_r = \sigma_{\max} - \sigma_{\min}$$

$$\sigma_a = \frac{\sigma_r}{2} = \frac{\sigma_{\max} - \sigma_{\min}}{2}$$

$$R = \frac{\sigma_{\min}}{\sigma_{\max}}$$

$$N_f = N_i + N_p$$

$$\sigma = \alpha_l E \Delta T$$

$$\dot{\varepsilon}_s = K_1\sigma^n$$

$$\dot{\varepsilon}_s = K_2\sigma^n \exp\left(-\frac{Q}{RT}\right)$$

Chapter 2

$$F_N = F_A + F_R \quad E = \int F dr \quad E_N = \int_\infty^r F_A dr + \int_\infty^r F_R dr \quad E_N = E_A + E_R$$

$$E_A = -\frac{A}{r} \quad E_R = \frac{B}{r^n} \quad \%\,ionic\ character = \left\{1 - \exp\left[-(0.25)(X_A - X_B)^2\right]\right\} \times 100$$

Chapter 3

$$APF = \frac{volume\ of\ atoms\ in\ a\ unit\ cell}{total\ unit\ cell\ volume} \quad LD = \frac{number\ of\ atoms\ centered\ on\ direction\ vector}{length\ of\ direction\ vector}$$

$$\rho = \frac{nA}{V_C N_A} \quad \rho = \frac{n'(\sum A_C + \sum A_A)}{V_C N_A} \quad PD = \frac{number\ of\ atoms\ centered\ on\ a\ plane}{area\ of\ plane}$$

$$n\lambda = 2d_{hkl}\sin\theta \quad d_{hkl} = \frac{a}{\sqrt{h^2 + k^2 + l^2}}$$

Chapter 4

$$\overline{M}_n = \sum x_i M_i \quad \overline{M}_w = \sum w_i M_i \quad n_n = \frac{\overline{M}_n}{\overline{m}} \quad n_w = \frac{\overline{M}_w}{\overline{m}} \quad \overline{m} = \sum f_j m_j \quad \%\,crystallinity = \frac{\rho_c(\rho_s - \rho_a)}{\rho_s(\rho_c - \rho_a)} \times 100$$

Chapter 5

$$N_v = N\exp(-\frac{Q_v}{kT}) \quad N = \frac{N_A \rho}{A_{Cu}}$$

$$C_1 = \frac{m_1}{m_1 + m_2} \times 100 \quad n_{m1} = \frac{m_1'}{A_1} \quad C_1' = \frac{n_{m1}}{n_{m1} + n_{m2}} \times 100 \quad C_1' = \frac{C_1 A_2}{C_1 A_2 + C_2 A_1} \times 100$$

$$C_1 = \frac{C_1' A_1}{C_1' A_1 + C_2' A_2} \times 100 \quad C_1 + C_2 = 100 \quad C_1' + C_2' = 100$$

Chapter 6

$$J = \frac{M}{At} \quad J = \frac{1}{A}\frac{dM}{dt} \quad concentration\ gradient = \frac{\Delta C}{\Delta x} = \frac{C_A - C_B}{x_A - x_B} \quad J = -D\frac{dC}{dx} \quad \frac{\partial C}{\partial t} = \frac{\partial}{\partial x}(D\frac{\partial C}{\partial x}) \quad \frac{\partial C}{\partial t} = D\frac{\partial^2 C}{\partial x^2}$$

$$\frac{C_x - C_0}{C_s - C_0} = 1 - erf(\frac{x}{2\sqrt{Dt}}) \quad \frac{x}{2\sqrt{Dt}} = z \quad D = D_0\exp(-\frac{Q_d}{RT}) \quad \ln D = \ln D_0 - \frac{Q_d}{R}(\frac{1}{T}) \quad \log D = \log D_0 - \frac{Q_d}{2.3R}(\frac{1}{T})$$

Chapter 10

$$W_L = \frac{S}{R+S} \quad W_L = \frac{C_\alpha - C_0}{C_\alpha - C_L} \quad W_\alpha = \frac{R}{R+S} \quad W_\alpha = \frac{C_0 - C_L}{C_\alpha - C_L}$$

Chapter 11

$$\Delta G = \frac{4}{3}\pi r^3 \Delta G_v + 4\pi r^2 \gamma \quad r^* = -\frac{2\gamma}{\Delta G_v} \quad \Delta G^* = \frac{16\pi\gamma^3}{3(\Delta G_v)^2} \quad \Delta G_v = \frac{\Delta H_f (T_m - T)}{T_m} \quad r^* = (-\frac{2\gamma T_m}{\Delta H_f})(\frac{1}{T_m - T})$$

$$\Delta G^* = (\frac{16\pi\gamma^3 T_m^2}{3\Delta H_f^2})\frac{1}{(T_m - T)^2} \quad n^* = K_1\exp(-\frac{\Delta G^*}{kT}) \quad v_d = K_2\exp(-\frac{Q_d}{kT}) \quad \dot{N} = K_3 n^* v_d = K_1 K_2 K_3\left[\exp(-\frac{\Delta G^*}{kT})\exp(-\frac{Q_d}{kT})\right]$$

$$\gamma_{IL} = \gamma_{SI} + \gamma_{SL}\cos\theta \quad r^* = -\frac{2\gamma_{SL}}{\Delta G_v} \quad \Delta G^* = (\frac{16\pi\gamma_{SL}^3}{3\Delta G_v^2})S(\theta) \quad \dot{G} = C\exp(-\frac{Q}{kT}) \quad y = 1 - \exp(-kt^n) \quad rate = \frac{1}{t_{0.5}}$$

Chapter 12

$$V = IR \quad \rho = \frac{RA}{l} \quad \sigma = \frac{1}{\rho} \quad J = \sigma E \quad E = \frac{V}{l} \quad v_d = \mu_e E \quad \sigma = n|e|\mu_e$$

$$\rho_{total} = \rho_t + \rho_i + \rho_d \quad \rho_t = \rho_0 + aT \quad \rho_i = Ac_i(1 - c_i) \quad \rho_i = \rho_\alpha V_\alpha + \rho_\beta V_\beta \quad \sigma = n|e|\mu_e + p|e|\mu_h \quad n = p = n_i \quad p = qd$$

$$D_0 = \varepsilon_0 E \quad D = \varepsilon E \quad D = \varepsilon_0 E + P \quad P = P_e + P_i + P_o$$