

§§§ New Formula XJ-7 §§§ Super Power (Batteries Sold Separately)

$$PV = nRT \quad \alpha = \frac{1}{V} \left(\frac{\partial V}{\partial T} \right)_P \quad \kappa_T = -\frac{1}{V} \left(\frac{\partial V}{\partial P} \right)_T \quad \frac{\alpha}{\kappa_T} = \left(\frac{\partial P}{\partial T} \right)_V$$

$$(P + a \frac{n^2}{V^2})(V - nb) = nRT \quad C_V = \left(\frac{\partial U}{\partial T} \right)_V \quad C_P = \left(\frac{\partial H}{\partial T} \right)_P$$

$$dU = TdS - PdV \quad \left(\frac{\partial T}{\partial V} \right)_S = - \left(\frac{\partial P}{\partial S} \right)_V \quad \left(\frac{\partial U}{\partial V} \right)_T = -P + T \left(\frac{\partial P}{\partial T} \right)_V$$

$$dH = TdS + VdP \quad \left(\frac{\partial T}{\partial P} \right)_S = \left(\frac{\partial V}{\partial S} \right)_P \quad \left(\frac{\partial H}{\partial P} \right)_T = V - T \left(\frac{\partial V}{\partial T} \right)_P = -\mu_{JT} C_P$$

$$dA = -SdT - PdV \quad \left(\frac{\partial P}{\partial T} \right)_V = \left(\frac{\partial S}{\partial V} \right)_T \quad \mu_{JT} = \left(\frac{\partial T}{\partial P} \right)_H$$

$$dG = -SdT + VdP \quad \left(\frac{\partial V}{\partial T} \right)_P = - \left(\frac{\partial S}{\partial P} \right)_T \quad C_P - C_V = \left(P + \left(\frac{\partial U}{\partial V} \right)_T \right) \left(\frac{\partial V}{\partial T} \right)_P = \frac{\alpha^2}{\kappa} VT$$

$$\xi = \frac{-w}{q_H} = \frac{q_H + q_L}{q_H} \quad \oint \frac{dq}{T} \leq 0 \quad \Delta S \geq \int \frac{dq}{T} \quad \Delta_r S_{T_2} = \Delta_r S_{T_1} + \Delta_r C_p \ln \frac{T_2}{T_1}$$

$$\left(\frac{\partial S}{\partial T} \right)_V = \frac{C_V}{T} \quad \left(\frac{\partial S}{\partial T} \right)_P = \frac{C_P}{T} \quad \Delta S = C_V \ln T_2/T_1 \quad \Delta S = C_P \ln T_2/T_1$$

$$\Delta S = \int \frac{\alpha}{\kappa_T} dV \quad \Delta S = - \int \alpha V dP \quad \Delta S = nR \ln V_2/V_1 \quad \Delta S = -nR \ln P_2/P_1$$

$$S^\circ = S^\circ_0 + \int_0^{T_{low}} \frac{AT^3}{T} dT + \int_{T_{low}}^{T_{melt}} \frac{C_{p(s)}}{T} dT + \frac{\Delta_{melt} H_m^\circ}{T_{melt}} + \int_{T_{melt}}^{T_{bp}} \frac{C_{p(l)}}{T} dT + \frac{\Delta_{vap} H_m^\circ}{T_{bp}} + \int_{T_{bp}}^T \frac{C_{p(g)}}{T} dT$$

$$\Delta G = nRT \ln P_2/P_1 \quad \left(\frac{\partial G/T}{\partial T} \right)_P = \frac{-H}{T^2} \quad \frac{\Delta_r G_{T_2}}{T_2} - \frac{\Delta_r G_{T_1}}{T_1} = \Delta_r H^\circ \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$$

$$dG = -SdT + VdP + \sum \mu_i dn_i \quad G = \mu_A n_A + \mu_B n_B \quad \left(\frac{\partial \mu}{\partial T} \right)_P = -S_m \quad \left(\frac{\partial \mu}{\partial P} \right)_T = V_m$$

$$\frac{dP}{dT} = \frac{\Delta_{tr} S_m}{\Delta_{tr} V_m} = \frac{\Delta_{tr} H_m}{T_{tr} \Delta_{tr} V_m} \quad d \ln P = - \frac{\Delta_{tr} H_m}{R} d \frac{1}{T} \quad \ln \left(\frac{P_2}{P_1} \right) = - \frac{\Delta_{tr} H_m}{R} \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$$

$$\Delta T_{melt} = \frac{T \Delta V_m}{\Delta_{melt} H_m} \Delta P \quad C_{p,m} = T \left(\frac{\partial S_m}{\partial T} \right)_P \quad \Delta_{tr} S_m = - \left(\frac{\partial \Delta_{tr} \mu}{\partial T} \right)_P$$

$$\Delta_{tr} V_m = \left(\frac{\partial \Delta_{tr} \mu}{\partial P} \right)_T = \left(\frac{\partial \mu_\beta}{\partial P} \right)_T - \left(\frac{\partial \mu_\alpha}{\partial P} \right)_T$$

$$V = V_A n_A + V_B n_B \quad dV_A = \frac{-X_B}{1-X_B} dV_B \quad \Delta_{mix} G = n_A (\mu_A(l) - \mu_A^*(l)) + n_B (\mu_B(l) - \mu_B^*(l))$$

$$\Delta_{mix} S = -nR \sum X_i \ln X_i \quad \Delta_{mix} G = nRT \sum X_i \ln X_i$$

$$\mu(g) = \mu^\circ(g) + RT \ln P/P^\circ \quad \mu_A(g) = \mu_A^\circ(g) + RT \ln P_A/P^\circ \quad \mu_A^*(l) = \mu_A^\circ(g) + RT \ln P_A^*/P^\circ$$

$$\mu_A(l) = \mu_A^{\circ}(g) + RT \ln P_A/P^{\circ} \quad \mu_A(l) = \mu_A^*(l) + RT \ln P_A/P_A^* \quad \mu_A(l) = \mu_A^*(l) + RT \ln X_A$$

$$\mu_B(l) = \mu_B^{\dagger}(l) + RT \ln X_B \quad \mu_B^{\dagger}(l) = \mu_B^{\circ}(g) + RT \ln K_B/P^{\circ}$$

$$\ln X_A = \frac{\Delta_{\text{vap}}H_m}{R} \left(\frac{1}{T} - \frac{1}{T_b^*} \right) \quad T = T^* + \frac{RT^{*2}}{\Delta_{\text{melt}}H_A} \ln X_A \quad \Delta T = \left(\frac{RT_b^2 \mathcal{M}_A}{1000 \Delta H_{v,m}} \right) m_B$$

$$\pi V_{A,m}^* = -RT \ln X_A \quad \pi V_{A,m}^* = X_B RT \quad \pi = c_B RT$$

$$K_p = K_c RT^{\Delta \text{ng}} \quad K_p = K_x P^{\Delta \text{ng}} \quad K_p = \frac{n_o^2}{n_o^2 - \xi^2} P \quad \ln \left(\frac{K_p(T_2)}{K_p(T_1)} \right) = -\frac{\Delta_r H^{\circ}}{R} \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$$

$$\ln \left(\frac{K_p(T_2)}{K_p(T_1)} \right) = -\frac{\Delta_r H_o^{\circ}}{R} \left(\frac{1}{T_2} - \frac{1}{T_1} \right) + \frac{\Delta a}{R} \ln \frac{T_2}{T_1} + \frac{\Delta b}{2R} (T_2 - T_1) + \frac{c}{6R} (T_2^2 - T_1^2)$$

$$\ln K_p = \ln K_p(0) - \frac{\Delta_r H_o^{\circ}}{RT} + \frac{\Delta a}{R} \ln T + \frac{\Delta b}{2R} T + \frac{\Delta c}{6R} T^2$$

$$\Delta_{\text{dilution}}G = RT \ln a_2/a_1 \quad \Delta_r G^{\circ'} = \Delta_r G^{\circ} + RT \ln 10^{-7}$$

$$\mu(M_p X_q) = \mu^{\circ}(M_p X_q) + RT \ln \left(\frac{\gamma_{\pm}^n m_+^p m_-^q}{m^{\theta^n}} \right) \quad \gamma_{\pm} = (\gamma_+^p \gamma_-^q)^{1/n} \quad I = \frac{1}{2} \sum z_i^2 \frac{m_i}{m^{\circ}}$$

$$\Delta_{\text{sol}}G = \Delta_{\text{vdw}}G + \Delta_{\text{cav}}G + \Delta_{\text{elec}}G \quad V(r) = \frac{q_i q_j}{4\pi\epsilon_0\epsilon_r r} \quad V(r) = \phi_i q_i \quad w_{\text{elec}} = \int_0^{z_i e} \phi_i dq$$

$$\log \gamma_{\pm} = -1.825 \times 10^6 |z_+ z_-| \left(\frac{d}{\epsilon^3 T^3} \right)^{1/2} (I/m^{\circ})^{1/2} \quad \log \gamma_{\pm} = -0.509 |z_+ z_-| I^{1/2}$$