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

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

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

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

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

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

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

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

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

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

$$S^\ominus = S_0^\ominus + \int_0^{T_{low}} \frac{AT^3}{T} dT + \int_{T_{low}}^{T_{melt}} \frac{Cp(s)}{T} dT + \frac{\Delta_{melt} H_m^\ominus}{T_{melt}} + \int_{T_{melt}}^{T_{bp}} \frac{Cp(l)}{T} dT + \frac{\Delta_{vap} H_m^\ominus}{T_{bp}} + \int_{T_{bp}}^{T} \frac{Cp(g)}{T} dT$$

$dS = \frac{dq}{T} + \left(\frac{P - P_{ext}}{T}\right) dV$ $dS_{univ} = \left(\frac{1}{T} - \frac{1}{T_{surr}}\right)dq + \left(\frac{P}{T} - \frac{P_{ext}}{T}\right)dV + \left(\frac{\mu_1}{T} - \frac{\mu_{1ext}}{T}\right)dn_1 + \left(\frac{\mu_2}{T} - \frac{\mu_{2ext}}{T}\right)dn_2$

$\Delta G = nRT \ln P_2/P_1$ $\left(\frac{\partial G/T}{\partial T}\right)_P = \frac{-H}{T^2}$ $\frac{\Delta_r G_2}{T_2} - \frac{\Delta_r G_1}{T_1} = \Delta_r H^\ominus \left(\frac{1}{T_2} - \frac{1}{T_1}\right)$

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

$\frac{dp}{dT} = \frac{\Delta_{tr} S_m}{\Delta_{tr} V_m} = \frac{\Delta_{tr} H_m}{T_{tr}\, \Delta_{tr} V_m}$ $d \ln p = -\frac{\Delta_{tr} H_m}{R}\, d\frac{1}{T}$ $\ln\left(\frac{p_2}{p_1}\right) = -\frac{\Delta_{tr} H_m}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$

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

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

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

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

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

$$\mu_A(l) = \mu_A^\Theta(g) + RT \ln P_A/P^\Theta \qquad \mu_A(l) = \mu_A^*(l) + RT \ln P_A/P_A^* \qquad \mu_A(l) = \mu_A^*(l) + RT \ln X_A$$

$$\mu_B(l) = \mu_B^\dagger(l) + RT \ln X_B \qquad \mu_B^\dagger(l) = \mu_B^\Theta(g) + RT \ln K_B/P^\Theta$$

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

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