

$$\left(P+a\frac{n^2}{V^2}\right)(V-bn)=nRT$$

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

$$T_R=\frac{T}{T_K}\quad P_R=\frac{P}{P_K}\quad z=\frac{PV}{nRT}$$

$$\overline{M}=\sum_i^kX_i\,M_i\quad P_i=X_iP$$

$$dU=\mathop{}\!\mathrm{d}Q+\mathop{}\!\mathrm{d}W\quad W=-\int_{V_1}^{V_2}P_0\,dV\quad \Delta H=\int_{T_1}^{T_2}n\,\overline{c_P}dT\quad \Delta U=\int_{T_1}^{T_2}n\,\overline{c_V}dT$$

$$W=-nRT\ln\frac{V_2}{V_1}\quad W=n\overline{c_V}T_1\left[\left(\frac{V_1}{V_2}\right)^{\gamma-1}-1\right]\quad \gamma=\frac{\overline{c_P}}{\overline{c_V}}\quad \overline{c_P}=\overline{c_V}+R$$

$$c_P-c_V=\left[P+\left(\frac{\partial U}{\partial V}\right)_T\right]\left(\frac{\partial V}{\partial T}\right)_P$$

$$dS\geq \frac{\mathop{}\!\mathrm{d}Q}{T}$$

$$\Delta S=n\int_{T_1}^{T_2}\frac{\overline{c_P}}{T}dT\quad \Delta S=\frac{n\Delta\overline{H}(izp)}{T_V}$$

$$dS=n\overline{c_V}d\ln T+nRd\ln V\qquad dS=n\overline{c_P}d\ln T-nRd\ln P$$

$$\Delta S_m=-R\sum_{i=1}^kn_i\ln X_i$$

$$A=U-TS\quad G=A+PV\quad H=U+PV$$

$$\left(\frac{\partial U}{\partial V}\right)_T=T\left(\frac{\partial P}{\partial T}\right)_V-P\quad \mu_{JT}=\frac{V(\alpha T-1)}{c_P}$$

$$\left[\frac{\partial\left(\frac{\Delta A}{T}\right)}{\partial T}\right]_V=-\frac{\Delta U}{T^2}\qquad\left[\frac{\partial\left(\frac{\Delta G}{T}\right)}{\partial T}\right]_P=-\frac{\Delta H}{T^2}$$

$$\ln\frac{P_2}{P_1}=-\frac{\overline{\Delta H_{izp}}}{R}\Big(\frac{1}{T_2}-\frac{1}{T_1}\Big)\quad \frac{dP}{dT}=\frac{\Delta H_{tal}}{T\Delta V_{tal}}$$

$$s=2+k-f$$

$$X_A=\frac{P_A}{P_A^0}\quad X_B=\frac{P_B}{K_B}$$