Useful Equations and Constants:

K.E. = $\frac{1}{2}mu^2$

P.E. = mgh

$PV = nRT$

$\overline{u^2} = \frac{3k_BT}{m}$

$\bar{u} = \sqrt{\frac{8k_BT}{\pi m}}$

$u_{mp} = \sqrt{\frac{2k_BT}{m}}$

$\bar{\varepsilon} = \frac{3}{2}k_BT$

$\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$

$\frac{dN}{N} = 4\pi\left(\frac{m}{2\pi k_BT}\right)^{3/2} e^{-mu^2/2k_BT}u^2du$

$Z = \frac{PV}{nRT} = \frac{PV_m}{RT}$

$\left(P_r + \frac{3}{V_r^2}\right)\left(V_r - \frac{1}{3}\right) = \frac{8}{3}T_r$

$P_t = \frac{RT}{V}\sum_i n_i$

$\Delta U = q + w$

$w = -\int_{V_i}^{V_f} P_{ext}dV$

$\Delta H_m(T_2) = \Delta H_m(T_1) + \int_{T_1}^{T_2} \Delta C_p dT$

$w = -P_{ext}\Delta V$

$w = -nRT\ln\left(\frac{V_2}{V_1}\right)$

$H = U + PV$

$\Delta H = \Delta U + \Delta(PV)$

$\Delta H = \Delta U + \Delta nRT$

$\Delta U = nC_{v,m}(T_2 - T_1)$

$\Delta H = nC_{p,m}(T_2 - T_1)$

$\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{\gamma-1}$

$\frac{P_2}{P_1} = \left(\frac{V_1}{V_2}\right)^{\gamma}$

$\gamma = \frac{C_{p,m}}{C_{v,m}}$

$C_{p,m} - C_{v,m} = R$

$\Delta U = -n^2a\left(\frac{1}{V_2} - \frac{1}{V_1}\right)$

$w = -nRT\ln\left(\frac{V_2 - nb}{V_1 - nb}\right) - n^2a\left(\frac{1}{V_2} - \frac{1}{V_1}\right)$

$\varepsilon = \frac{T_h - T_c}{T_h}$

$\Delta S = nR\ln\frac{V_f}{V_i}$

$\Delta S = nR\ln\frac{P_i}{P_f}$

$\Delta S = nC_{p,m}\ln\frac{T_f}{T_i}$

$\Delta S = nC_{v,m}\ln\frac{T_f}{T_i}$

$\Delta S = -R(x_1\ln x_1 + x_2\ln x_2)$

$G = H - TS$

$\Delta G = \Delta H - T\Delta S$

$\Delta S = n_1R\ln\left(\frac{V_1 + V_2}{V_1}\right) + n_2R\ln\left(\frac{V_1 + V_2}{V_2}\right)$

$A = U - TS$

$\Delta A = \Delta U - T\Delta S$

$\left(\frac{\partial U}{\partial V}\right)_T = -P + T\left(\frac{\partial P}{\partial T}\right)_V$

$\left(\frac{\partial H}{\partial P}\right)_T = V - T\left(\frac{\partial V}{\partial T}\right)_P$

$RT\ln\frac{f}{P} = \int_0^P \left(V_m - \frac{RT}{P'}\right)dP'$

$$\Delta G = \Delta G^0 + RT\ln Q$$ $$K_P = \left(\frac{\cdots P_Y^y P_Z^z}{P_A^a P_B^b \cdots}\right)_{eq}$$ $$\Delta G^0 = -RT\ln K_P^{\circ}$$

$$K_C = \left(\frac{\cdots [\mathrm{Y}]^y [\mathrm{Z}]^z}{[\mathrm{A}]^a [\mathrm{B}]^b \cdots}\right)_{eq}$$ $$\Delta G = \Delta G^0 + RT\ln\left(\frac{\cdots [\mathrm{Y}]^y [\mathrm{Z}]^z}{[\mathrm{A}]^a [\mathrm{B}]^b \cdots}\right)^u$$

$$K_a = \left(\frac{\cdots a_{\mathrm{Y}}^y a_{\mathrm{Z}}^z}{a_{\mathrm{A}}^a a_{\mathrm{B}}^b \cdots}\right)_{eq}$$ $$K_P = K_C (RT)^{\sum \nu}$$ $$K_P = K_x P^{\sum \nu}$$

$$\mu_{\mathrm{A}} = \left(\frac{\partial G}{\partial n_{\mathrm{A}}}\right)_{T,P,n_{\mathrm{B}},n_{\mathrm{Y}}\cdots}$$ $$\frac{d\ln K_P^{\circ}}{d(1/T)} = -\frac{\Delta H^{\circ}}{R}$$ $$\ln K_P^{\circ} = -\frac{\Delta H^{\circ}}{R}\left(\frac{1}{T}\right) + \frac{\Delta S^{\circ}}{R}$$

$$\frac{d\ln K_C^{\circ}}{dT} = \frac{\Delta U^{\circ}}{RT^2}$$ $$\frac{d\ln K_C^{\circ}}{d(1/T)} = -\frac{\Delta U^{\circ}}{R}$$ $$x = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$$

$$f = c - p + 2$$ $$P_i = P_i^* x_i$$ $$[\mathrm{A}] = [\mathrm{A}]_0 - kt$$

$$[\mathrm{A}] = [\mathrm{A}]_0 e^{-kt}$$ $$\frac{1}{[\mathrm{A}]} - \frac{1}{[\mathrm{A}]_0} = kt$$ $$\frac{1}{[\mathrm{A}]_0 - [\mathrm{B}]_0}\ln\frac{[\mathrm{B}]_0[\mathrm{A}]}{[\mathrm{A}]_0[\mathrm{B}]} = kt$$

$$\frac{1}{[\mathrm{A}]_0 - [\mathrm{B}]_0}\ln\frac{[\mathrm{B}]_0([\mathrm{A}]_0 - [\mathrm{P}])}{[\mathrm{A}]_0([\mathrm{B}]_0 - [\mathrm{P}])} = kt$$ $$kt = \frac{1}{(n-1)}\left[\frac{1}{[\mathrm{A}]^{n-1}} - \frac{1}{[\mathrm{A}]_0^{n-1}}\right]$$

$$t_{1/2} = \frac{[\mathrm{A}]_0}{2k}$$ $$t_{1/2} = \frac{\ln 2}{k}$$ $$t_{1/2} = \frac{1}{[\mathrm{A}]_0 k}$$

$$t_{1/2} = \frac{2^{n-1} - 1}{k(n-1)[\mathrm{A}]_0^{n-1}}$$ $$k = \frac{k_B T}{h} e^{-\Delta^{\ddagger} G^o/RT}$$ $$k = \frac{k_B T}{h} e^{\Delta^{\ddagger} S^o/R} e^{-\Delta^{\ddagger} H^o/RT}$$

$$k = e\left(\frac{k_B T}{h}\right) e^{\Delta^{\ddagger} S^o/R} e^{-E_a/RT}$$ $$E_a = \Delta H^{\ddagger} + nRT$$ $$k = e^2\left(\frac{k_B T}{h}\right) e^{\Delta^{\ddagger} S^o/R} e^{-E_a/RT}$$

$$K_C = \frac{k_1}{k_{-1}}$$ $$K_C = K_1 K_2 K_3 \cdots = \frac{k_1 k_2 k_3 \cdots}{k_{-1} k_{-2} k_{-3} \cdots}$$ $$K_M = \frac{k_{-1} + k_2}{k_1}$$

L = 6.022×10^{23} mol^{-1}
R = 8.3145 J K^{-1} mol^{-1} = 0.082057 atm dm^3 K^{-1} mol^{-1} = 1.98719 cal K^{-1} mol^{-1}
k_B = 1.381×10^{-23} J K^{-1}
h = 6.626×10^{-34} J s