1. Ikasgaia

$$pV_m = RT$$

$$p_i = x_i p$$

$$\left(p + \frac{a}{V_m^2}\right)(V_m - b) = RT$$

$$\alpha = \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_p$$

$$\kappa = -\frac{1}{V}\left(\frac{\partial V}{\partial p}\right)_T ; \left(\frac{\partial p}{\partial T}\right)_V = \frac{\alpha}{\kappa}$$

2. Ikasgaia

$$pV^\gamma = kte$$

$$TV^{\gamma-1} = kte$$

$$T^\gamma p^{1-\gamma} = kte$$

$$Q_V = C_V = \left(\frac{\partial U}{\partial T}\right)_V$$

$$Q_p = C_p = \left(\frac{\partial H}{\partial T}\right)_p$$

$$C_p - C_V = \left[p + \left(\frac{\partial U}{\partial V}\right)_T\right]\left(\frac{\partial V}{\partial T}\right)_p$$

$$C_p - C_V = nR$$

$$H = U + pV$$

$$\mu_J = \left(\frac{\partial T}{\partial V}\right)_U \quad \mu_{JT} = \left(\frac{\partial T}{\partial p}\right)_H$$

$$\left(\frac{\partial U}{\partial V}\right)_T = \frac{C_p - C_V}{\alpha V} - p$$

$$\left(\frac{\partial U}{\partial V}\right)_T = -\mu_J C_V$$

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

$$\left(\frac{\partial U}{\partial T}\right)_p = C_p - p\left(\frac{\partial V}{\partial T}\right)_p$$

$$\left(\frac{\partial U}{\partial p}\right)_T = pV\kappa - \frac{\kappa}{\alpha}(C_p - C_V)$$

$$\left(\frac{\partial U}{\partial p}\right)_V = \frac{\kappa\, C_V}{\alpha}$$

$$\left(\frac{\partial U}{\partial p}\right)_T = -T\left(\frac{\partial V}{\partial T}\right)_p - p\left(\frac{\partial V}{\partial p}\right)_T$$

$$\left(\frac{\partial U}{\partial V}\right)_p = C_p\left(\frac{\partial T}{\partial V}\right)_p - p$$

$$\left(\frac{\partial H}{\partial V}\right)_T = \frac{C_p - C_v}{\alpha V} - \frac{1}{\kappa}$$

$$\left(\frac{\partial H}{\partial V}\right)_T = T\left(\frac{\partial p}{\partial T}\right)_V + V\left(\frac{\partial p}{\partial V}\right)_T$$

$$\left(\frac{\partial H}{\partial p}\right)_T = \frac{\kappa}{\alpha}(C_V - C_p) + V$$

$$\left(\frac{\partial H}{\partial p}\right)_T = -\mu_{JT} C_p$$

$$\left(\frac{\partial H}{\partial p}\right)_T = -T\left(\frac{\partial V}{\partial T}\right)_p + V$$

$$\left(\frac{\partial H}{\partial p}\right)_V = \frac{\kappa}{\alpha} C_V + V$$

$$\left(\frac{\partial H}{\partial V}\right)_p = \frac{C_p}{\alpha V}$$

$$\left(\frac{\partial H}{\partial T}\right)_V = C_V + \frac{\alpha V}{\kappa}$$

3. Ikasgaia

$$dS = \frac{1}{T}dU + \frac{p}{T}dV$$

$$dS = \frac{1}{T}dH - \frac{V}{T}dp$$

$$\left(\frac{\partial S}{\partial T}\right)_V = \frac{C_V}{T}$$

$$\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial p}{\partial T}\right)_V$$

$$\left(\frac{\partial S}{\partial T}\right)_P = \frac{C_P}{T}$$

$$\left(\frac{\partial S}{\partial p}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_p$$

$$\left(\frac{\partial S}{\partial p}\right)_V = \frac{C_v \kappa}{\alpha T}$$

$$\left(\frac{\partial S}{\partial V}\right)_p = \frac{C_p}{\alpha V T}$$

$$G = H - TS$$

$$A = U - TS$$

$$dU = TdS - pdV$$

$$dH = TdS + Vdp$$

$$dA = -SdT - pdV$$

$$dG = -SdT + Vdp$$

$$\left(\frac{\partial G}{\partial T}\right)_p = -S; \left(\frac{\partial G}{\partial p}\right)_T = V$$

$$\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial p}{\partial S}\right)_V ; \left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial p}{\partial T}\right)_V$$

$$\left(\frac{\partial T}{\partial p}\right)_S = \left(\frac{\partial V}{\partial S}\right)_p ; \left(\frac{\partial V}{\partial T}\right)_p = -\left(\frac{\partial S}{\partial p}\right)_T$$

$$\left[\frac{\partial (G/T)}{\partial T}\right]_p = -\frac{H}{T^2}; \left[\frac{\partial (A/T)}{\partial T}\right]_V = -\frac{U}{T^2}$$

$$\mu - \mu^* = RT \ln p$$

Deribatu partzialen arteko erla.

$$\left(\frac{\partial x}{\partial y}\right)_z = \frac{1}{\left(\frac{\partial y}{\partial x}\right)_z}$$

$$\left(\frac{\partial y}{\partial x}\right)_z \left(\frac{\partial x}{\partial z}\right)_y \left(\frac{\partial z}{\partial y}\right)_x = -1$$

4. Ikasgaia

$$\bar{V}_{m,i} = \left(\frac{\partial V}{\partial n_i}\right)_{p,T,n_{j\neq i}}$$

$$\Delta_M X = n_1\left(\bar{X}_{m,1} - X^0_{m,1}\right) + n_2\left(\bar{X}_{m,2} - X^0_{m,2}\right)$$

$$V = n_1 V_{m,1} + n_2 V_{m,2}$$

$V_m = f\left(x_1\right)$ bada:

$$\bar{V}_2 = V_m - \frac{dV_m}{dx_1}x_1,\ \bar{V}_1 = V_m + \frac{dV_m}{dx_1}(1-x_1)$$

Orokorrean $\Delta_M X_m = f\left(x_1\right)$ bada:

$$\left(\bar{X}_{m,2} - X^0_{m,2}\right) = \Delta_M X_m - \frac{d\Delta_M X_m}{dx_1}x_1$$

$$\left(\bar{X}_{m,1} - X^0_{m,1}\right) = \Delta_M X_m + \frac{d\Delta_M X_m}{dx_1}(1-x_1)$$

$$\Delta_M G = \sum_i n_i\left(\mu_i - \mu_i^0\right)$$

$$\Delta_M G = RT\left[n_1 \ln x_1 + n_2 \ln x_2\right]$$

$$\Delta_M S = -R\left[n_1 \ln x_1 + n_2 \ln x_2\right]$$

5. Ikasgaia

$$\frac{dp}{dT} = \frac{\Delta H}{T\Delta V}$$

$$\frac{d\ln p}{dT} = \frac{\Delta H_m}{RT^2};\ \frac{d\ln p}{d\left(1/T\right)} = -\frac{\Delta H_m}{R}$$

6. Ikasgaia

$$p_i = p_1^0 x_i$$

$$\mu_i - \mu_i^0 = RT\ln x_i$$

$$\frac{1}{T} - \frac{1}{T_0} = -\frac{R\ln x_1}{\Delta_{fus.}H_m}$$

$$\frac{1}{T_E} - \frac{1}{\left(T_E\right)_0} = \frac{R\ln x_1}{\Delta_{lur.}H_m}$$

$$\pi = -\frac{RT}{V_{m,1}}\ln x_1$$

$$\Delta T_c = K_c m$$

$$\Delta T_b = K_b m$$

$$\pi = RTc$$

$$p_i = K_i x_i$$

$$a_i = \frac{p_i}{p_i^0}$$

$$\gamma_i = \frac{a_i}{x_i}$$

$$\frac{1}{T} - \frac{1}{T_0} = -\frac{R\ln a_1}{\Delta_{fus.}H_m}$$

$$\frac{1}{T_E} - \frac{1}{\left(T_E\right)_0} = \frac{R\ln a_1}{\Delta_{lur.}H_m}$$

$$\pi = -\frac{RT}{V_{m,1}}\ln a_1$$

$$\mu_i - \mu_i^0 = RT\ln a_i$$

$$\Delta_M G = RT\left[n_1 \ln a_1 + n_2 \ln a_2\right]$$

7. Ikasgaia

$$p = p_2^0 + \left(p_1^0 - p_2^0\right)x_1$$

$$p = \frac{p_1^0 p_2^0}{p_1^0 + \left(p_2^0 - p_1^0\right)y_1}$$

$$x_1 = \frac{y_1 p_2^0}{p_1^0 + \left(p_2^0 - p_1^0\right)y_1}$$

$$y_1 = \frac{x_1 p_1^0}{p_2^0 + \left(p_1^0 - p_2^0\right)x_1}$$

8. Ikasgaia

$$K_p = K_x p^{\Delta\nu}$$

$$\Delta G_m^0 = -RT\ ln\, K_p$$

$$\frac{d\ ln\, K_p}{dT} = \frac{\Delta H_m^0}{RT^2};\ \frac{d\ ln\, K_p}{d\left(1/T\right)} = -\frac{\Delta H_m^0}{R}$$

9. Ikasgaia

$$a_\pm^\nu = a_2$$

$$a_\pm = \gamma_\pm m_\pm$$

$$m_\pm^\nu = m_+^{\nu_+} m_-^{\nu_-} = m^\nu\left[\nu_+^{\nu_+}\nu_-^{\nu_-}\right]$$

$$I = \frac{1}{2}\sum_i m_i z_i^2$$

$$\log\gamma_\pm = -0.5092 z_+ z_- I^{1/2}$$

$$\Delta G = -nF\varepsilon$$

$$\Delta G^0 = -nF\varepsilon^0$$

$$\varepsilon = \varepsilon^0 - \frac{RT}{nF}\ln\frac{a_C^\gamma a_D^\delta}{a_A^\alpha a_B^\beta}$$

$$nF\varepsilon^0 = RT\ln K_a$$

10. Ikasgaia

$$\gamma = \frac{rh\left(\rho_2 - \rho_1\right)g}{2\cos\theta};\ \gamma = \frac{rh\rho g}{2\cos\theta}$$

Langmuir: $\theta = \frac{bp}{1+bp}$

$$v = \frac{v_m bp}{1+bp} \Rightarrow \frac{1}{v} = \frac{1}{v_m bp} + \frac{1}{v_m}$$

Freundlich: $\log v = \log k + a\log \mathrm{p}$

Temkin: $v = k_1\cdot\ln k_2 + k_1\cdot\ln p$

BET

$$\frac{p}{v\left(p^* - p\right)} = \frac{1}{v_{\text{monoka.}}c} + \frac{c-1}{v_{\text{monoka.}}c}\frac{p}{p^*}$$

11. Ikasgaia

Efusioa

$$p = p_0\, exp\left[-\frac{A\cdot t}{V}\left(\frac{RT}{2\pi M}\right)^{1/2}\right]$$

$$p = \left(\frac{2\pi RT}{M}\right)^{1/2}\frac{\Delta m}{A\cdot\Delta t}$$

Fick: $\frac{dn}{dt} = -DA\frac{dc}{dx}$

Einstein-Smoluchowski

$$x_{rms} = \left(2Dt\right)^{1/2};\ D = \frac{\lambda^2}{2\tau}$$

$$r_{rms} = \left(6Dt\right)^{1/2}$$

Fourier: $\frac{dQ}{dt} = -kA\frac{dT}{dx}$

Newton: $\frac{d\vec{p}}{dt} = -\eta A\frac{dv_y}{dx}$;

$Re = \frac{\rho v d}{\eta}$; Emar.: $\frac{V}{t} = v\cdot A$

Poiseuille: $\frac{V}{t} = \frac{\pi r^4}{8\eta}\frac{\left(p_1 - p_2\right)}{\left(y_2 - y_1\right)}$;

Ostwald bisk., Stokes:

$$\frac{\eta_a}{\eta_b} = \frac{\rho_a t_a}{\rho_b t_b};\ v = 2\left(\rho_{likido} - \rho_{solido}\right)\frac{gr^2}{9\eta}$$

Nernst-Einstein; Stokes-E.:

$$D_{iB}^{\infty} = kT/f;\ D_{iB}^{\infty} = \frac{kT}{6\pi\eta_B r_i}$$

Sedimentazioa:

$$\bar{s} = \frac{v}{\omega^2 x} = \frac{m\left(1-\bar{V}\rho\right)}{f}$$

$$\ln\left(\frac{x_{b,t}}{x_{b,t=0}}\right) = \omega^2\bar{s}t;\ M = \frac{RT\bar{s}}{D_{iB}^{\infty}\left(1-\bar{V}\rho\right)}$$

$$I = \frac{dQ}{dt} = -\kappa A\frac{d\phi}{dx};\ \Lambda_m = \kappa/c$$

Kohlrausch: $\Lambda_m = \Lambda_m^0 - K\sqrt{\frac{c}{c_0}}$

Ostwald dil. legea:

$$\frac{1}{\Lambda_m} = \frac{1}{\Lambda_m^0} + \frac{c\Lambda_m}{K_a\left(\Lambda_m^0\right)^2}$$

12. Ikasgaia

$$M = X_p PM_{\text{unitate errep.}}$$

$$\bar{M}_n = \frac{1}{N}\sum_i N_i M_i$$

$$\bar{M}_w = \frac{1}{m}\sum_i m_i M_i \Rightarrow \bar{M}_w = \frac{\sum_i N_i M_i^2}{\sum_i N_i M_i}$$

$$\left[\eta\right] = \lim_{c\to 0}\left(\frac{\eta - \eta_0}{c\eta_0}\right) = \lim_{c\to 0}\left(\frac{\eta/\eta_0 - 1}{c}\right)$$

$$\left[\eta\right] = KM_r^a$$

13. Ikasgaia

$$r = -\frac{1}{\alpha}\frac{d[\mathrm{A}]}{dt};\ r_{\text{desagertze}} = -\frac{d[\mathrm{A}]}{dt}$$

$$[\mathrm{A}]\text{-}[\mathrm{A}]_0 = -k_0 t;\ t_{1/2} = \frac{[\mathrm{A}]_0}{2k_0}$$

$$\ln\frac{[\mathrm{A}]}{[\mathrm{A}]_0} = -k_A t;\ t_{1/2} = \frac{\ln 2}{k_A}$$

$$\frac{1}{[\mathrm{A}]} - \frac{1}{[\mathrm{A}]_0} = k_A t;\ t_{1/2} = \frac{1}{k_A[\mathrm{A}]_0}$$

$$k_2 t = \frac{1}{\nu_A[\mathrm{B}]_0 - \nu_B[\mathrm{A}]_0}\ln\frac{[\mathrm{B}]}{[\mathrm{B}]_0}\frac{[\mathrm{A}]_0}{[\mathrm{A}]}$$

14. Ikasgaia

$$\ln\frac{[\mathrm{A}] - [\mathrm{A}]_{oreka}}{[\mathrm{A}]_0 - [\mathrm{A}]_{oreka}} = -\left(k_z + k_a\right)t$$

$$\frac{k_z}{k_a} = \frac{[\mathrm{C}]_{oreka}}{[\mathrm{A}]_{oreka}} = K_{oreka}$$

$$[\mathrm{A}] = [\mathrm{A}]_0 e^{-\left(k_1+k_2\right)t}\quad \frac{[\mathrm{C}]}{[\mathrm{D}]} = \frac{k_1}{k_2}$$

$$[\mathrm{C}] = \frac{k_1[\mathrm{A}]_0}{\left(k_1 + k_2\right)}\left(1 - e^{-\left(k_1+k_2\right)t}\right)$$

$$[\mathrm{D}] = \frac{k_2[\mathrm{A}]_0}{\left(k_1 + k_2\right)}\left(1 - e^{-\left(k_1+k_2\right)t}\right)$$

$$\ln t_{1/2} = \ln\frac{2^{n-1} - 1}{\left(n-1\right)k_A} - \left(n-1\right)\ln[\mathrm{A}]_0$$

$$\ln t_\alpha = \ln\frac{\alpha^{1-n} - 1}{\left(n-1\right)k_A} - \left(n-1\right)\ln\,[\mathrm{A}]_0$$

$$r = k\frac{a^\alpha b^\beta}{a^{\alpha+\beta}}[\mathrm{A}]^{\alpha+\beta} = k'[\mathrm{A}]^n$$

$$\ln r_0 = \ln k + \alpha\ln\,[\mathrm{A}]_0 + \beta\,\ln\,[\mathrm{B}]_0$$

$$r = k[\mathrm{A}]^\alpha[\mathrm{B}]_0^\beta = k'[\mathrm{A}]^\alpha;\ k' = k[\mathrm{B}]_0^\beta$$

$$\ln k = \ln A - \frac{E_a}{RT}$$

16. Ikasgaia

$$r = \frac{k_1 k_2[\mathrm{A}][\mathrm{M}]}{k_{-1}[\mathrm{M}] + k_2}$$

$$k' = \frac{1}{k_{uni}} = \frac{k_{-1}}{k_1 k_2} + \frac{1}{k_1[\mathrm{M}]}$$

$$r_p = k_p\left(\frac{f\cdot k_d}{k_t}\right)^{1/2}[\mathrm{M}][\mathrm{I}]^{1/2}$$

$$\bar{x}_n = \frac{k_p}{\nu_P\left(f\cdot k_i\cdot k_t\right)^{1/2}}\frac{[\mathrm{M}]}{[\mathrm{I}]^{1/2}}$$

$$\ln\left([\mathrm{A}]\text{-}[\mathrm{A}]_{oreka}\right) = ln\left([\mathrm{A}]_0\text{-}[\mathrm{A}]_{oreka}\right) - \frac{t}{\tau}$$

$$\tau^{-1} = k_z\left([\mathrm{A}]_{oreka} + [\mathrm{B}]_{oreka}\right) + k_a$$

17. Ikasgaia

$$r_S = k\frac{b_B p_B}{1 + b_B p_B + b_C p_C + b_D p_D}$$

$$r_0 = \frac{k_2[\mathrm{E}]_0[\mathrm{S}]_0}{K_M + [\mathrm{S}]_0}\ \text{non}\ K_M = \frac{k_{-1} + k_2}{k_1}$$

$$\frac{1}{r_0} = \frac{K_M}{k_2[\mathrm{E}]_0}\frac{1}{[\mathrm{S}]_0} + \frac{1}{k_2[\mathrm{E}]_0}$$