

Relazioni tra frazioni massiche e molari

$$\omega_i \triangleq \frac{m_i}{m}$$

$$\sum_{i=1}^{N_c} \omega_i = 1$$

$$x_i \triangleq \frac{n_i}{n}$$

$$\sum_{i=1}^{N_c} x_i = 1$$

$$\bar{M} = \sum_{k=1}^{N_c} x_k M_k = \frac{1}{\sum_{k=1}^{N_c} \frac{\omega_k}{M_k}}$$

$$m_i = n_i M_i$$

$$m = n \bar{M}$$

$$x_i M_i = \omega_i \bar{M}$$

Relazioni tra concentrazioni massiche e concentrazioni molari

$$\rho \triangleq \frac{m}{V} = \frac{n\bar{M}}{V} = c\bar{M}$$


$$\bar{M} = \frac{\rho}{c}$$

$$\rho_i \triangleq \frac{m_i}{V} = \frac{n_i M_i}{V} = c_i M_i$$



$$\rho \triangleq \frac{m}{V}$$


$$c \triangleq \frac{n}{V}$$


$$\bar{M} = \frac{\rho}{c}$$



$$\rho_i \triangleq \frac{m_i}{V}$$



$$\omega_i = \frac{\rho_i}{\rho}$$


$$\rho = \sum_{i=1}^{N_c} \rho_i$$


$$c_i \triangleq \frac{n_i}{V}$$

$$x_i = \frac{c_i}{c}$$


$$c = \sum_{i=1}^{N_c} c_i$$


$$\rho_i = c_i M_i$$

Equazione di stato e miscela di gas ideali

$$PV = nRT$$

$$P = cRT$$

$$P_i \triangleq x_i P$$

$$P = \sum_{i=1}^{N_c} P_i$$

$$n_i = \frac{P_i V}{RT}$$

$$V_i \triangleq x_i V$$

$$V = \sum_{i=1}^{N_c} V_i$$

$$n_i = \frac{P V_i}{RT}$$

$$c_i = \frac{P_i}{RT}$$

$$c = \sum_{i=1}^{N_c} c_i$$

$$\tilde{V} = \tilde{V}_i = \frac{RT}{P}$$



$$\sum_i v_i A_i = 0 \quad (v_i > 0 \text{ per i prodotti e } v_i < 0 \text{ per i reagenti})$$

Grado di avanzamento

$$n_i = n_i^0 + n_i^g = n_i^0 + v_i \zeta$$

$$\frac{n_1^g}{v_1} = \frac{n_2^g}{v_2} = \dots = \frac{n_i^g}{v_i} = \dots = \frac{n_C^g}{v_C} = \zeta$$

Reagente limitante (1...R reagenti, $v_i < 0$)

$$\zeta_{max} = \min \left\{ \frac{n_1^0}{-v_1}, \frac{n_2^0}{-v_2}, \dots, \frac{n_i^0}{-v_i}, \dots, \frac{n_R^0}{-v_R} \right\} = \min \left\{ \frac{n_i^0}{-v_i} \text{ tale che } v_i < 0 \right\}$$

Resa relativa

$$\eta = \frac{m_p^g}{(m_p^g)_{max}} = \frac{n_p^g}{(n_p^g)_{max}} = \frac{\zeta}{\zeta_{max}}$$

$$\sum_i \nu_i A_i = 0 \quad (\nu_i > 0 \text{ per i prodotti e } \nu_i < 0 \text{ per i reagenti})$$

$$n_{\nu_i} = \nu_i \times 1 \text{ mol}$$

$$\Delta H = \sum_i n_{\nu_i} \tilde{H}_i \quad (n_{\nu_i} > 0 \text{ per i prodotti e } n_{\nu_i} < 0 \text{ per i reagenti})$$

$$[n_{\nu_i}] = \text{mol} \quad [\tilde{H}_i] = \text{kJ mol}^{-1} \quad [\Delta H] = \text{kJ}$$

$$\Delta H = \Delta U + (\Delta n)_{\text{gas}} RT$$

$$\Delta_r H = \sum_i \nu_i \tilde{H}_i$$

$$[\tilde{H}_i] = \text{kJ mol}^{-1} \quad [\Delta_r H] = \text{kJ mol}^{-1}$$

$$\Delta_r H = \Delta_r U + (\Delta \nu)_{\text{gas}} RT$$

$$v_1 A_1 + v_2 A_2 + \dots + v_R A_R + \dots + v_C A_C = 0$$

$$\sum_i v_i A_i = 0 \quad (v_i > 0 \text{ per i prodotti e } v_i < 0 \text{ per i reagenti})$$

$$n_i^g = v_i \zeta$$

$$\Delta H = \sum_i n_i^g \tilde{H}_i = \zeta \sum_i v_i \tilde{H}_i$$

Calore sviluppato dalla reazione

$$q_{\text{ambiente}} = \zeta \left(- \sum_i v_i \tilde{H}_i \right)$$

$$\sum_i \nu_i A_i = 0 \quad (\nu_i > 0 \text{ per i prodotti e } \nu_i < 0 \text{ per i reagenti})$$

$$n_{\nu_i} = \nu_i \times 1 \text{ mol}$$

$$\Delta G = \sum_i n_{\nu_i} \tilde{G}_i = \sum_i n_{\nu_i} \mu_i \quad (\mu_i = \tilde{G}_i)$$

$$[n_{\nu_i}] = \text{mol} \quad [\tilde{G}_i] = [\mu_i] = \text{kJ mol}^{-1} \quad [\Delta G] = \text{kJ}$$

$$\Delta G_r = \Delta G_r^{\circ} + RT \ln \prod_i a_i^{\nu_i} \quad Q = \prod_i a_i^{\nu_i}$$

$$[\Delta_r G] = \text{kJ mol}^{-1}$$

$$\text{Equilibrio: } \Delta G_r = 0 \quad \Delta G_r^{\circ} = -RT \ln K^{\circ} \quad Q = K^{\circ}$$

$$K^0 = \left(\prod_i a_i^{\nu_i} \right)_{\text{equilibrio}} \quad (\text{adimensionata})$$

$$a_i = \frac{P_i}{p_0} \quad i \text{ gas ideale}$$

$$a_i = \frac{c_i}{c_0} \quad i \text{ soluto in soluzione diluita}$$

$$a_i \cong 1 \quad i \text{ solvente di una soluzione diluita}$$

$$a_i = 1 \quad i \text{ solido puro}$$

$$K_Z = \prod_i z_i^{\nu_i} \quad K_c = \prod_i c_i^{\nu_i} \quad K_n = \prod_i n_i^{\nu_i} \quad K_P = \prod_i P_i^{\nu_i} \quad \text{all'equilibrio}$$

Miscela di gas ideali

$$PV = nRT \quad P_i V = n_i RT \quad c_i = \frac{n_i}{V} = \frac{P_i}{RT} \quad P_i = c_i RT$$

$$K^0 = \frac{K_P}{p_0^{\Delta \nu_g}} = K_c \left(\frac{RT}{p_0} \right)^{\Delta \nu_g} = K_n \left(\frac{RT}{V p_0} \right)^{\Delta \nu_g}$$

Combinazioni lineari di reazioni

$$(1), (2), \dots, (r) \quad \sum_i \nu_i^1 A_i^1 = 0, \sum_i \nu_i^2 A_i^2 = 0, \dots, \sum_i \nu_i^r A_i^r = 0$$

$$\sum_i \nu_i^0 A_i^0 = m_1 \times \left(\sum_i \nu_i^1 A_i^1 \right) + m_2 \times \left(\sum_i \nu_i^2 A_i^2 \right) + \dots + m_r \times \sum_i \nu_i^r A_i^r = 0$$

$$(0) = m_1 \times (1) + m_2 \times (2), \dots, m_r \times (r)$$

Costanti di equilibrio

$$K_0^0 = (K_1^0)^{m_1} \times (K_2^0)^{m_2} \times \dots \times (K_r^0)^{m_r}$$

Entalpie di reazione - Legge di Hess

$$\sum_i \nu_i^0 \tilde{H}_i^0 = m_1 \times \left(\sum_i \nu_i^1 \tilde{H}_i^1 \right) + m_2 \times \left(\sum_i \nu_i^2 \tilde{H}_i^2 \right) + \dots + m_r \times \sum_i \nu_i^r \tilde{H}_i^r$$

$$\Delta H_0 = m_1 \times \Delta H_1 + m_2 \times \Delta H_2 + \dots + m_r \times \Delta H_r$$

$$\sum_i \nu_i A_i = 0 \quad (\nu_i > 0 \text{ per i prodotti e } \nu_i < 0 \text{ per i reagenti})$$

$$\Delta_r G = \Delta_r G^\circ + RT \ln Q \quad Q = \prod_i a_i^{\nu_i}$$

$$\ln K^\circ = -\frac{\Delta G_r^\circ}{RT}$$

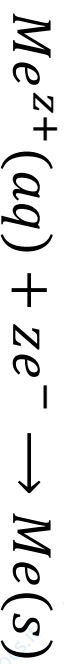
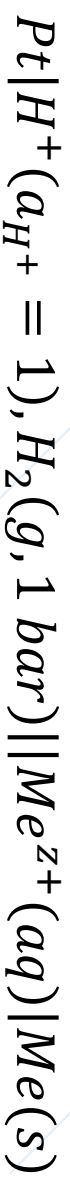
$$\Delta_r G = -n_r F E_{\text{cell}} \quad \Delta_r G^\circ = -n_r F E_{\text{cell}}^\circ$$

Legge di Nernst

$$E_{\text{cell}} = E_{\text{cell}}^\circ - \frac{RT}{n_r F} \ln Q = E_D^\circ - E_S^\circ - \frac{RT}{n_r F} \ln \left(\prod_i a_i^{\nu_i} \right)$$

$$\ln K^\circ = \frac{n_r F E_{\text{cell}}^\circ}{RT}$$

Potenziale di riduzione standard di un catione



$$E_{Me^{z+}|Me} = E_{Me^{z+}|Me}^0 - \frac{RT}{zF} \ln \left(\frac{1}{a_{Me^{z+}}} \right) = E_{Me^{z+}|Me}^0 + \frac{RT}{zF} \ln a_{Me^{z+}}$$

Legge di Faraday

$$Q_e = It = n_e F$$

Q_e : quantità di carica, C ($A \cdot s$)

I : intensità di corrente, A

t : intervallo di tempo, s

n_e : quantità di elettroni in moli, mol

$F = e N_A = 96485 \text{ C mol}^{-1}$, costante di Faraday