Pirmā veida Prigožina absolūtās enerģijas atraktori elektrodi: metāli Fe, Cu, Zn, Cr iegremdēti jonu šķīdumā. Dzelzs savienojumu šķīšanas, protolīzes un reducēšanas-oksidēšanas Prigožina absolūtās enerģijas atraktori.

$Fe_{(s)}+H_2O=Fe^{2+}+\mathbf{2e^-}$;

$E_{Fe}=E°_{Fe/Fe2+}+0,0591/2*\log([Fe^{2+}]/[Fe]/([H_2O]))=\mathbf{-0,66623}+0,0591/2*\log(0,1/1/(55,3))=-0,74728$ V;

Atšķirība -0,74728 V ir 4. ciparā -0,74739 V.

$E_{Fe}=E°_{Fe/Fe2+}+0,0591/2*\log([Fe^{2+}]/[Fe]/([H_2O]-6[Fe^{2+}]))=\mathbf{-0,66623}+0,0591/2*\log(0,1/1/(56,38-0,6))=-0,74739$ V;

$[H_2O]=55,3$ M$=(996^g/_L)/(18^g/_{mol})$; $m_{H2O}=m_L-m_{FeSO4}=1030-15,191=1014,8$ g; $[H_2O]=1014,8\ ^g/18\ ^g/_{mol}=56,38$ M.

Formation Fe $+O_2\ ^{gas}+H_2{}^{gas}=Fe(OH)_2$;

$\Delta G°_{form}=G_{Fe(OH)2}-(G_{Fe(}+G_{O2}{}^{gas}+G_{H2}{}^{gas})=\mathbf{39,349}-(\mathbf{140,609}+\mathbf{303,1}+\mathbf{85,64})=-490\ ^{kJ}/_{mol}$; [37]

$G_{Fe(OH)2}=\Delta G°_{form}+(G_{Fe}+G_{O2}{}^{gas}+G_{H2}{}^{gas})=-490+(\mathbf{140,609}+\mathbf{303,1}+\mathbf{85,64})=\mathbf{39,349}\ ^{kJ}/_{mol}$;

Formation Fe $+1,5O_2\ ^{gas}+1,5H_2{}^{gas}=Fe(OH)_3$;

$\Delta G°_{form}=G_{Fe(OH)3}-(G_{Fe(}+1,5G_{O2}{}^{gas}+1,5G_{H2}{}^{gas})=\mathbf{27,119}-(\mathbf{140,609}+1,5*\mathbf{303,1}+1,5*\mathbf{85,64})=-696,6\ ^{kJ}/_{mol}$; [33]

$G_{Fe(OH)3}=\Delta G°_{form}+(G_{Fe}+G_{O2}{}^{gas}+G_{H2}{}^{gas})=-696,6+(\mathbf{140,609}+1,5*\mathbf{303,1}+1,5*\mathbf{85,64})=\mathbf{27,119}\ ^{kJ}/_{mol}$;

[1] Solubility $Fe(OH)_2+3H_2O=\mathbf{Fe^{2+}}+2\mathbf{OH^-}$; $K_{sp}=\mathbf{[Fe^{2+}]*[OH^-]^2}/[H_2O]^3=4,87*10^{\wedge(-17)}/55,3^{\wedge 3}=10^{\wedge(-21,54)}$;

Atraktors $\Delta\mathbf{G}_{sp}=-RT\ln(\mathbf{K}_{speq})=-8,3144*298,15*\ln(10^{\wedge(-21,54)})=\mathbf{122,95}\ ^{kJ}/_{mol}$

$\Delta G_{sp}=G_{Fe2+}+2G_{OH-}-(G_{Fe\ (OH)2}+3G_{H2O})=G_{Fe2+}+2*\mathbf{77,36}-(\mathbf{24,72}+3*\mathbf{0})=\mathbf{122,95}\ ^{kJ}/_{mol}$;

$G_{Fe2+}=\Delta G_{sp}-2G_{OH-}+(G_{Fe(OH)2}+3G_{H2O})=\mathbf{122,95}-2*\mathbf{77,36}+(\mathbf{24,72}+3*\mathbf{0})=\mathbf{12,04855}\ ^{kJ}/_{mol}$;

[1] Solubility $Fe(OH)_3+4H_2O=\mathbf{Fe^{3+}}+3\mathbf{OH^-}$; $K_{sp}=\mathbf{[Fe^{3+}]*[OH^-]^3}/[H_2O]^4=2,79*10^{\wedge(-39)}/55,3^{\wedge 4}=10^{\wedge(-44,369)}$;

Atraktors $\Delta\mathbf{G}_{sp}=-RT\ln(\mathbf{K}_{speq})=-8,3144*298,15*\ln(10^{\wedge(-44,369)})=\mathbf{259,855}\ ^{kJ}/_{mol}$;

$\Delta G_{sp}=G_{Fe3+}+3G_{OH-}-(G_{Fe(OH)3}+4G_{H2O})=\mathbf{40,2605}+3*\mathbf{77,36}-(\mathbf{12,4855}+4*\mathbf{0})=\mathbf{259,855}\ ^{kJ}/_{mol}$;

$G_{Fe(OH)3}=G_{Fe3+}+3G_{OH-}-(\Delta G_{sp}+4G_{H2O})=\mathbf{40,2605}+3*\mathbf{77,36}-(\mathbf{259,855}+4*\mathbf{0})=\mathbf{12,4855}\ ^{kJ}/_{mol}$;

$G_{Fe3+}=\Delta G_{sp}-3G_{OH-}+(G_{Fe(OH)3}+4G_{H2O})=\mathbf{259,855}-3*\mathbf{77,36}+(\mathbf{12,4855}+4*\mathbf{0})=\mathbf{40,2605}\ ^{kJ}/_{mol}$;

[1] Acid $\mathbf{HCO_3^-}+H_2O=\mathbf{H_3O^+}+CO_3^{2-}$; $K_{prot}=K_a/[H_2O]=\mathbf{[H_3O^+]*[CO_3^{2-}]}/[H_2O]/\mathbf{[HCO_3^-]}=10^{\wedge(-10,33)}/55,3=10^{\wedge(-12,073)}$;

Attractor $\Delta\mathbf{G}_{prot}=-RT\ln(\mathbf{K}_{prot})=-8,3144*298,15*\ln(10^{\wedge(-12,073)})=\mathbf{68,9123}\ ^{kJ}/_{mol}$;

$\Delta G_{prot}=G_{\mathbf{H3O}+}+G_{CO32-}-(G_{\mathbf{H}CO3-}+G_{H2O})=\mathbf{22,44}+\mathbf{102,55}-(\mathbf{56,08}+\mathbf{0})=\mathbf{68,9123}\ ^{kJ}/_{mol}$;

$G_{CO32}=\Delta G_{prot}-G_{\mathbf{H3O}+}+(G_{\mathbf{H}CO3-}+G_{H2O})=\mathbf{68,9123}-\mathbf{22,44}+(\mathbf{56,08}+\mathbf{0})=\mathbf{102,5523}\ ^{kJ}/_{mol}$;

[1[ Solubility $FeCO_3^{2-}+2H_2O=Fe^{2+}+CO_3^{2-}$; $K_{sp}=[Fe^{2+}]*[CO_3^{2-}]^3/[H_2O]^2=3,13*10^{\wedge(-11)}/55,3^{\wedge 2}=10^{\wedge(-13,99)}$;

Attractor $\Delta\mathbf{G}_{sp}=-RT\ln(\mathbf{K}_{speq})=-8,3144*298,15*\ln(10^{\wedge(-13,99)})=\mathbf{79,8545}\ ^{kJ}/_{mol}$;

$\Delta G_{sp}=G_{Fe3+}+G_{CO32-}-(G_{FeCO3}+2G_{H2O})=\mathbf{60,31655}+\mathbf{102,55}-(G_{FeCO3}+2*\mathbf{0})=\mathbf{79,8545}\ ^{kJ}/_{mol}$;

$G_{FeCO3}=G_{Fe3+}+G_{CO32-}-(\Delta G_{sp}+2G_{H2O})=\mathbf{60,31655}+\mathbf{102,55}-(\mathbf{79,8545}+2*\mathbf{0})=\mathbf{83,01205}\ ^{kJ}/_{mol}$;

Formation $\Delta G°_{form}=G_{FeCO3}-(G_{Fe(}+1,5G_{O2}{}^{gas}+G_{Cgraph})=\mathbf{19,819}-(\mathbf{140,609}+1,5*\mathbf{303,1}+\mathbf{91,26})=-666,7\ ^{kJ}/_{mol}$; [33]

$G_{FeCO3}=\Delta G°_{form}+(G_{Fe}+1,5G_{O2}{}^{gas}+G_{Cgraph})=-666,7+(\mathbf{140,609}+1,5*\mathbf{303,1}+\mathbf{91,26})=\mathbf{19,819}\ ^{kJ}/_{mol}$;

Formation Fe $+1,5O_2\ ^{gas}+C_{graph}=FeCO_3$; $1,5O_2\ ^{gas}+C_{graph}+2G_{e-}=CO_3^{2-}$; $1,5O_2\ ^{gas}+0,5H_2{}^{gas}+C_{graph}+G_{e-}=\mathbf{HCO_3^-}$;

$\Delta G°_{form}=G_{CO32-}-(1,5G_{O2}{}^{gas}+G_{Cgraph}+2G_{e-})=\mathbf{102,5523}-(1,5*\mathbf{303,1}+\mathbf{91,26}+2*\mathbf{42,2212})=-527,8\ ^{kJ}/_{mol}$; [1]

$G_{e-}=(G_{CO32-}-(1,5G_{O2}{}^{gas}+G_{Cgraph}+\Delta G°_{form}))/2=(\mathbf{102,5523}-(1,5*\mathbf{303,1}+\mathbf{91,26}-527,8))/2=\mathbf{42,2212}\ ^{kJ}/_{mol}$; [1]

$\Delta G°_{form}=G_{HCO3-}-(1,5G_{O2}+G_{Cgr}+0,5G_{H2}+G_{e-})=\mathbf{56,08}-(1,5*\mathbf{303,1}+\mathbf{91,26}+0,5*\mathbf{85,64}+\mathbf{54,15})=-586,8\ ^{kJ}/_{mol}$; [1]

$G_{e-}=G_{HCO3-}-(1,5G_{O2}+G_{Cgr}+0,5G_{H2}+\Delta G°_{form})=\mathbf{56,08}-(1,5*\mathbf{303,1}+\mathbf{91,26}+0,5*\mathbf{85,64}-586,8)=\mathbf{54,15}\ ^{kJ}/_{mol}$;

Formation [8] $Fe^{2+}+\mathbf{2e^-}=Fe^{2+}$; $G_{e-}=(G_{Fe}-(G_{Fe2+}+\Delta G°))/2=(\mathbf{140,609}-(\mathbf{12,04855}-\mathbf{82,14}))/2=\mathbf{105,35}\ ^{kJ}/_{mol}$;

Formation [1] $Fe^{2+}+\mathbf{2e^-}=Fe^{2+}$; $G_{e-}=(G_{Fe}-(G_{Fe2+}+\Delta G°))/2=(\mathbf{140,609}-(\mathbf{12,04855}-78,9))/2=\mathbf{103,73}\ ^{kJ}/_{mol}$;

Iron(II) Metāls dzelzs $Fe_{(s)}+H_2O=Fe^{2+}+\mathbf{2e^-}$ $[FeSO_4]=0,1$ M šķīdumā masa $FeSO_4=15,191$ g, blīvums 1,03 $^g/_{mL}$. $Fe+H_2O=Fe^{2+}+\mathbf{2e^-}$; Absolūtais potenciāls ir $E°_{classic}=-0,447$ V [1], ūdens logaritms 0,0515, un summa $\Delta E°$:

$E°_{Fe/Fe2+}=E°_{classic}-0,0591/2*\log(1/[H_2O]^1)+\Delta E°=-0,447-0,0591/2*\log(1/55,3)+0,10166-0,37239=\mathbf{-0,66623}$ V.

$\Delta\mathbf{G}_{eq}=E°_{Fe}\bullet F\bullet 2=\mathbf{-0,66623}*96485*2=\mathbf{-128,56}\ ^{kJ}/_{mol}$,

$\Delta\mathbf{G}_{eq}=G_{Fe2+}+2G_{e-}-(G_{Fe}+\mathbf{G_{H2O}})=\mathbf{12,049}+2*\mathbf{0,0}-(\mathbf{140,609}+\mathbf{0})=\mathbf{-128,56}\ ^{kJ}/_{mol}$;

$G_{e-}=(\Delta\mathbf{G}_{eq}-G_{Fe2+}+(G_{Fe}+\mathbf{G_{H2O}}))/2=(\mathbf{-128,56}-\mathbf{12,049}+(\mathbf{140,609}+\mathbf{0}))/2=\mathbf{0,0}\ ^{kJ}/_{mol}$;

$G_{Fe}=G_{Fe2+}+2G_{e-0}-(\Delta\mathbf{G}_{eq}+\mathbf{G_{H2O}})=\mathbf{12,049}+2*\mathbf{0}-(\mathbf{-128,56}+\mathbf{0})=\mathbf{140,6}\ ^{kJ}/_{mol}$;

$G_{Fe2+}=\Delta\mathbf{G}_{eq}-2G_{e-}+(G_{Fe}+\mathbf{G_{H2O}})=\mathbf{-128,56}-2*\mathbf{0,0}+(\mathbf{140,609}+\mathbf{0})=\mathbf{12,04855}\ ^{kJ}/_{mol}$;

Iron(II) $Fe_{(s)}+2H_2O=Fe(OH)^++H_3O^++\mathbf{2e^-}$ $[FeSO_4]=0,1$ M solution mas $FeSO_4=15,191$ g, density 1,03 $^g/_{mL}$. $Fe_{(s)}+2H_2O=Fe(OH)^++H_3O^++\mathbf{2e^-}$; $E°_{classic}=-0,447$ V [1], water logarithm 0,102995 and sum $\Delta E°$:

$E°_{Fe/Fe(OH)+}=E°_{classic}-0,0591/2*\log(1/[H_2O]^2)+\Delta E°=-0,447+0,102995+0,10166-0,37239=\mathbf{-0,614735}$ V.

$\Delta\mathbf{G}_{eq}=E°_{Fe}\bullet F\bullet 2=\mathbf{-0,614735}*96485*2=\mathbf{-118,625}\ ^{kJ}/_{mol}$,

$\Delta\mathbf{G}_{eq}=G_{Fe(OH)+}+G_{H3O+}+2G_{e-}-(G_{Fe}+\mathbf{2G_{H2O}})=\mathbf{38,02755}+\mathbf{22,44}+2*\mathbf{0}-(\mathbf{140,609}+2*\mathbf{0})=\mathbf{-118,625}\ ^{kJ}/_{mol}$;

$G_{e-}=(\Delta\mathbf{G}_{eq}-G_{Fe(OH)+}+(G_{Fe}+\mathbf{G_{H2O}}))/2=(\mathbf{-118,625}-\mathbf{38,02755}-\mathbf{22,44}+(\mathbf{140,609}+2*\mathbf{0}))/2=\mathbf{-19,2418}\ ^{kJ}/_{mol}$; Wrong!

$G_{Fe}=G_{Fe(OH)+}+2G_{e-0}-(\Delta\mathbf{G}_{eq}+\mathbf{G_{H2O}})=\mathbf{38,02755}+\mathbf{22,44}+2*\mathbf{-19,2418}-(\mathbf{-118,625}+2*\mathbf{0})=\mathbf{140,609}\ ^{kJ}/_{mol}$;

$G_{Fe(OH)+}=\Delta\mathbf{G}_{eq}-2G_{e-}+(G_{Fe}+\mathbf{G_{H2O}})=\mathbf{-118,625}-\mathbf{22,44}-2*\mathbf{0}+(\mathbf{140,609}+2*\mathbf{0})=\mathbf{38,0276}\ ^{kJ}/_{mol}$;

Iron(III) $Fe_{(s)}+3H_2O=[Fe(OH)_2]^{+}+2H_3O^{+}+3e^{-}$; potential has $E°_{classic}$=-0,037 V [1], water log 0,102995 and ΔE°:
$E°_{Fe/FeOH2+}=E°_{classic}-0,0591/3*\log(1/[H_2O]^3)+ΔE°=-0,037-0,0591/3*\log(1/55,3^{\wedge}3)+0,10166-0,37239=$**-0,204735** V
$ΔG_{eq}=E°_{Fe/[Fe(OH2]+}•F•3=$**-0,204735**$*96485*3=$**-59,2616** kJ/mol,
$ΔG_{eq}=G_{[Fe(OH)2]+}+2G_{H3O+}+3G_{e-}-(G_{Fe(s)}+3G_{H2O})=$**47,8715**$+2*$**22,44**$+3*$**-4,1877**$-($**139,45**$+3*$**0**$)=$**-59,2616** kJ/mol;
$3G_{e-}=ΔG_{eq}-G_{[Fe(OH)2]+}-2G_{H3O+}+(G_{Fe(s)}+3G_{H2O})=$**-59,2616-47,8715**$-2*$**22,44**$+($**139,45**$+3*$**0**$)=3*$**-4,1877** kJ/mol;
$G_{Fe(s)}=G_{[Fe(OH)2]+}+2G_{H3O+}+3G_{e-}-(ΔG_{eq\_Fe}+G_{H2O})=$**47,8715**$+2*$**22,44**$+3*$**-4,1877**$-($**-59,2616**$+3*0)=$**139,45** kJ/mol;
$G_{[Fe(OH)2]+}=ΔG_{eq}-2G_{H3O+}-3G_{e-}+(G_{Fe(s)}+G_{H2O})=$**-59,2616**$-2*$**22,44**$-3*$**-4,1877**$+($**139,45**$+3*0)=$**47,8715** kJ/mol;

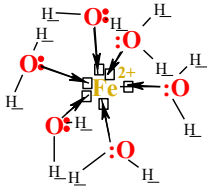
| *Viela* | $ΔH°_H$ kJ/mol | $ΔS°_H$ J/mol/K | $ΔG°_H$ , kJ/mol |
|---|---|---|---|
| Fe- | $E°_{Fe2+}$= | **-0,66623** | **140,609** |
| Fe | $E°_{Fe3+}$= | **-0,273398** | **139,45** |
| [8] $Fe^{2+}$ | **-87,45** | **-17,8** | **-82,14** |
| [1] $Fe^{2+}$ | -89,1 | -137,7 | -78,9 |
| $G_{e-}$-$Fe^{2+}$ | [1] Free e- | -78,9 | **103,73** |
| $Fe^{2+}$ | $E°_{Fe2+/Fe3+}$= | **0,50027** V | **12,04855** |
| $Fe^{2+}$ | $K_{sp}$= | $10^{-24,886}$ | **12,04855** |
| $Fe(OH)_2$ | $G_{Fe(OH)2}$= | **39,349** | -490 |
| [8] $Fe^{3+}$ | **-44,79** | **-110** | **-11,99** |
| $G_{e-}$-$Fe^{3+}$ | [8] Free e- | **-11,99** | **30,376** |
| [1] $Fe^{3+}$ | -48,5 | -315,9 | -4,7 |
| $G_{e-}$-$Fe^{3+}$ | [1] Free e- | -4,7 | **27,9455** |
| $Fe^{3+}$ | $E°_{Fe3/Fe2+}$ V | **-0,50027** | **56,2755** |
| $Fe^{3+}$ | $K_{sp}$= | $=10^{-44,369}$ | **40,2605** |
| $Fe(H_2O)^{3+}$ | $K_a$= | $=10^{-4,2027}$ | **60,31655** |
| $[Fe(OH)]^{+}$ | -324,7 | -29 | -277,4 |
| $[Fe(OH)]^{+}$ | $G_{e-}$-format | -277,4 | **18,39245** |
| $[Fe(OH)]^{+}$ | $K_a/[H_2O]$= | $10^{\wedge(-8,4827)}$ | **38,02755** |
| $Fe(OH)^{2+}$ | -290,8 | -142,0 | -229,4 |
| $Fe(OH)^{2+}$ | $G_{e-}$-format | -229,4 | **21,2773** |
| $Fe(OH)^{2+}$ | $K_a/[H_2O]$= | $10^{\wedge(-4,2027)}$ | **61,86545** |
| $Fe(OH)^{2+}$ | $ß_1=10^{\wedge 11,81}$ | $10^{\wedge(-4,2027)}$ | **60,3182** |
| $Fe(OH)_2^{+}$ | $ß_2=10^{\wedge 22,32}$ | $=10^{25,80545}$ | **67,74** |
| $Fe(OH)_2^{+}$ | $K_a/[H_2O]^2$= | $10^{\wedge(-5,6824)}$ | **47,8715** |
| $Fe(OH)_2^{+}$ | format $G_{e-}$ | -438,0 | **42,3185** |
| $Fe(OH)_3$ | -823 | 107 | -696,6 |
| $Fe(OH)_3$ | Formation | -696,6 | **27,119** |
| $Fe(OH)_3$ | $K_{sp}$= | $=10^{-44,369}$ | **12,4855** |
| $FeCO_3$ | -740,6 | 92,88 | -666,7 |
| $FeCO_3$ | Formation | -666,7 | **19,819** |
| $FeCO_3$ | $K_{prot}$= | $10^{-13,99}$ | **83,01205** |
| $CO_3^{2-}$ | -677,1 | -56,9 | -527,8 |
| $G_{e-}$-$CO_3^{2-}$ | Formation | -527,8 | **42,2212** |
| $CO_3^{2-}$ | $K_{prot}$= | $10^{-12,073}$ | **102,5523** |
| **$HCO_3^{-}$** | -692,0 | 91,2 | -586,8 |
| $G_{e-}$-**$HCO_3^{-}$** | Formation | -586,8 | **54,15** |
| **$H_3O^{+}$** | **$HCO_3^{-}$** | **22,44** | **56,08** |
| **$H_3O^{+}$** | $OH^{-}$ | **22,44** | **77,36** |

$G_{O2}^{gas}$=**303,1** kJ/mol; $G_{H2}^{gas}$=**85,64** kJ/mol; $G_{Cgraph}$=**91,26** kJ/mol;
$G_{Fe}=G_{Fe2+}+2G_{e-}-(ΔG_{eq}+G_{H2O})=$ **140,609** kJ/mol; $G_{e-}$=**0,0** kJ/mol;
$G_{Fe(s)}=G_{Fe3+}$**-**$(ΔG_{eq\_Fe}+G_{H2O})=$**104,875**$-(-$**79,1364**$)=$**139,45** kJ/mol;
$G_{e-}=(G_{Fe}-(G_{Fe2+}+ΔG°))/2=($**140,609**$-($**12,04855-82,14**$))/2=$**105,35** kJ/mol;
[1] $ΔG_{Fe2+}=ΔH_H–T*ΔS_H=$-89,1-298,15*-0,1377=-48,045 kJ/mol;
$G_{e-}=(G_{Fe}-(G_{Fe2+}+ΔG°))/2=($**140,609**$-($**12,04855**-78,9$))/2=$**103,73** kJ/mol;
$G_{Fe2+}=G_{Fe3+}$**-**$(ΔG_{eq})=$**60,31655**$-($**48,268**$+0)=$**12,04855** kJ/mol;
$G_{Fe2+}=ΔG_{sp}-2G_{OH-}+(G_{Fe(OH)2}+3G_{H2O})=$**12,048** kJ/mol;
[37] $G_{Fe(OH)2}=ΔG°_{form}+(G_{Fe}+G_{O2}^{gas}+G_{H2}^{gas})=$**39,349** kJ/mol;
[8] Biochem.Thermodyn. Massachusetts Technology Inst. pH=7,36
$G_{e-}=(G_{Fe}-(G_{Fe3+}+ΔG°))/3=($**139,45**$-($**60,3136**$+($**-11,99**$)))/3=$**30,376** kJ/mol;
[1] $ΔG_{Fe3+}=ΔH_H–T*ΔS_H=$-48,5-298,15*-0,3159=45,685585 kJ/mol;
$G_{e-}=(G_{Fe}-(G_{Fe2+}+ΔG°))/3=($**139,45**$-($**60,3136**$+(-4,7)))/3=$**27,9455** kJ/mol;
$G_{Fe3+}=ΔG_{eq}-G_{e-}+(G_{Fe2+})=$**48,268-4,0405+(12,048)=56,2755** kJ/mol;
$G_{Fe3+}=ΔG_{sp}-3G_{OH-}+(G_{Fe(OH)3}+4G_{H2O})=$**40,2605** kJ/mol;
$G_{[Fe(H2O)]3+}=G_{[Fe(OH)]2+}+G_{H3O+}-(ΔG_{prot}+G_{H2O})=$**60,31655** kJ/mol;
[1] $ΔG_{Fe3+}=ΔH_H–T*ΔS_H=$-324,7-298,15*0,029=-333,346 kJ/mol;
[1] $G_{e-}=ΔG°-G_{[Fe(OH)]+}+(G_{Fe}+G_{O2gas}/2+G_{H2}/2)=$**18,39245** kJ/mol;
[1] $G_{[Fe(OH)]+}=ΔG_{prot}-G_{H3O+}+(G_{[Fe(H2O)]2+}+G_{H2O})=$**38,02755** kJ/mol;
[1] $ΔG_{Fe3+}=ΔH_H–T*ΔS_H=$-229,4-298,15*0,142=-271,737 kJ/mol;
[1] $2G_{e-}=ΔG°-G_{[Fe(OH)]2+}+(G_{Fe}+G_{O2gas}/2+G_{H2}/2)=2*$**21,2773** kJ/mol;
[1] $G_{[Fe(OH)]2+}=ΔG_{prot}-G_{H3O+}+(G_{[Fe(H2O)]3+}+G_{H2O})=$**61,86545** kJ/mol;
[18] $G_{[Fe(OH)]2+}=ΔG_{stab\_eq}-G_{H2O}+(G_{[Fe(H2O)]3+}+G_{OH-})=$**60,3182** kJ/mol;
[18]$G_{[Fe(OH)]2+}=ΔG_{stab\_eq}$ $-2G_{H2O}+(G_{[Fe(H2O)]3+}+2G_{OH-})=$**67,74** kJ/mol;
[38] $G_{[Fe(OH)]2+}=ΔG_p-2G_{H3O+}+(G_{[Fe(H2O)2]3+}+2G_{H2O})=$**47,8715** kJ/mol;
[1] $G_{e-}=ΔG°-G_{[Fe(OH)]2+}+(G_{Fe}+G_{O2gas}+G_{H2})=$**42,3185** kJ/mol;
[33] $ΔG_{Fe3+}=ΔH_H–T*ΔS_H=$-823-298,15*0,107=-854,902 kJ/mol;
$G_{Fe(OH)3}=ΔG°_{form}+(G_{Fe}+G_{O2}^{gas}+G_{H2}^{gas})=$**27,119** kJ/mol;
$G_{Fe(OH)3}=G_{Fe3+}+3G_{OH-}-(ΔG_{sp}+4G_{H2O})=$**12,4855** kJ/mol;
[33]$ΔG_H=ΔH_H–T*ΔS_H=$-740,6-298,15*0,092,88=-768,29 kJ/mol;
$G_{FeCO3}=ΔG°_{form}+(G_{Fe}+1,5G_{O2}^{gas}+G_{Cgraph})=$**19,819** kJ/mol;
$G_{FeCO3}=G_{Fe3+}+G_{CO32-}-(ΔG_{sp}+2G_{H2O})=$**83,01205** kJ/mol;
$ΔG_H=ΔH_H–T*ΔS_H=$-677,1-298,15*-0,0569=-660,135 kJ/mol;
$G_{e-}=(G_{CO32-}-(1,5G_{O2}^{gas}+G_{Cgraph}+ΔG°_{form}))/2=$**42,2212** kJ/mol;
$G_{CO32}=ΔG_{prot}-G_{H3O+}+(G_{HCO3-}+G_{H2O})=$**102,5523** kJ/mol;
$ΔG_H=ΔH_H–T*ΔS_H=$-692-298,15*0,0912=-719,19128 kJ/mol;
$G_{e-}=G_{HCO3-}-(1,5G_{O2}+G_{Cgr}+0,5G_{H2}+ΔG°_{form})=$**54,15** kJ/mol;
$G_{H3O+HCO3}=G_{H3O+}+G_{HCO3-}=$22,44+**56,08**=78,52 kJ/mol;
$ΔG_{eq2}=$-99,8 kJ/mol$=2*G_{H2O}-(G_{H3O+}+G_{OH-})=2*$0-(22,44+77,36)

$Fe_{(s)}+2H_2O=[Fe(OH)]^{2+}+H_3O^{+}+3e^{-}$; classic potential $E°_{classic}$=-0,037 V [1], water logarithm 0,0686634 and ΔE°:
$E°_{Fe/FeOH2+}=E°_{classic}-0,0591/3*\log(1/[H_2O]^2)+ΔE°=-0,037-0,0591/3*\log(1/55,3^{\wedge}2)+0,10166-0,37239=$ **-0,23907** V
$ΔG_{eq}=E°_{Fe/FeOH2+}•F•3=$**-0,2390666**$*96485*3=$**-69,199** kJ/mol,
$ΔG_{eq}=G_{FeOH2+}+G_{H3O+}+3G_{e-}-(G_{Fe(s)}+2G_{H2O})=$**61,866**$+$**22,44**$+3*$**-4,685**$-($**139,45**$+2*$**0**$)=$**-69,199** kJ/mol;
$3G_{e-}=ΔG_{eq}-G_{FeOH2+}-G_{H3O+}+(G_{Fe(s)}+2G_{H2O})=$**-69,199-61,866-22,44**$+($**139,45**$+2*$**0**$)=3*$**-4,685** kJ/mol;
$G_{Fe(s)}=G_{FeOH2+}+G_{H3O+}+3G_{e-}-(ΔG_{eq\_Fe}+2G_{H2O})=$**61,866**$+$**22,44**$+3*$**-4,685**$-($**-69,199**$+2*$**0**$)=$**139,45** kJ/mol;
$G_{FeOH2+}=ΔG_{eq}-G_{H3O+}-3G_{e-}+(G_{Fe(s)}+2G_{H2O})=$**-69,199-22,44**$-3*$**-4,685**$+($**139,45**$+2*$**0**$)=$**61,866** kJ/mol;

Iron(II/III) $Fe^{2+}=Fe^{3+}+e^-$; $E°_{Fe2+/Fe3+}$=**0,50027** V; potential has $E°_{classic}$=0,771 V water 0 zero and ΔE°: [1]

$E°_{Fe2+/Fe3+}=E°_{classic}-0,0591/1*\log(1/[H_2O]^0)+\Delta E°=0,771-0,0591/1*\log(1/55,3^{\wedge 0})+0,10166-0,37239=$**0,50027** V



$Fe^{2+}=Fe^{3+}+e^-$; $\Delta G_{eq}=E°_{Fe3+/Fe2+}•F•1=$**0,50027**$*96485*1=$**48,268** $^{kJ}/_{mol}$;

$\Delta G_{eq}=G_{Fe3+}+G_{e-}-(G_{Fe2+})=$**56,2755+4,0405-(12,048)=48,268** $^{kJ}/_{mol}$;

$G_{e-}=G_{Fe3+}-\Delta G_{eq}+(G_{Fe2+})=$**56,2755-48,268+(12,048)=4,0405** $^{kJ}/_{mol}$;

$G_{Fe2+}=G_{Fe3+}+G_{e-}-(\Delta G_{eq})=$**56,2755+4,0405-(48,268)=12,048** $^{kJ}/_{mol}$;

$G_{Fe3+}=\Delta G_{eq}- -G_{e-}+(G_{Fe2+})=$**48,268-4,0405+(12,048)=56,2755** $^{kJ}/_{mol}$;

Formation [1] $Fe^{3+}+3e^-=Fe$; $\Delta G°=G_{Fe}-(G_{Fe3+}+3G_{e-})=$**139,45-(60,3136**$+3*G_{e-})=-4,7$ $^{kJ}/_{mol}$;

$G_{e-}=(G_{Fe}-(G_{Fe3+}+\Delta G°))/3=$**(139,45-(60,3136**$+(-4,7)))/3=$**27,9455** $^{kJ}/_{mol}$;

Formation [8] $Fe^{3+}+3e^-=Fe$; $\Delta G°=G_{Fe}-(G_{Fe3+}+3G_{e-})=$**139,45-(60,3136**$+3*$**30,376**$)=-$**11,99** $^{kJ}/_{mol}$;

$G_{e-}=(G_{Fe}-(G_{Fe3+}+\Delta G°))/3=$**(139,45-(60,3136**$+(-$**11,99**$)))/3=$**30,376** $^{kJ}/_{mol}$;

Formation [8] $Fe^{2+}+2e^-=Fe$; $\Delta G°=G_{Fe}-(G_{Fe2+}+2G_{e-})=$**140,609-(12,04855**$+2*G_{e-})=-$**82,14** $^{kJ}/_{mol}$;

$G_{e-}=(G_{Fe}-(G_{Fe2+}-\Delta G°))/2=$**(140,609-(12,04855**$+(-$**82,14**$)))/2=$**105,35** $^{kJ}/_{mol}$;

Formation [1] $Fe^{2+}+2e^-=Fe$; $\Delta G°=G_{Fe}-(G_{Fe2+}+2G_{e-})=$**140,609-(12,04855**$+2*G_{e-})=-78,9$ $^{kJ}/_{mol}$;

$G_{e-}=(G_{Fe}-(G_{Fe2+}-\Delta G°))/2=$**(140,609-(12,04855**$+(-78,9)))/2=$**103,73** $^{kJ}/_{mol}$;

Formation $Fe+O_2^{gas}/2+H_2/2=[Fe(OH)]^++e^-$;

$\Delta G°=G_{[Fe(OH)]+}+G_{e-}-(G_{Fe}+G_{O2gas}/2+G_{H2}/2)=$**38,02755+18,39245-(139,45+303,1**$/2+$**85,64**$/2)=-277,4$ $^{kJ}/_{mol}$;

$G_{e-}=\Delta G°-G_{[Fe(OH)]+}+(G_{Fe}+G_{O2gas}/2+G_{H2}/2)=-277,4-$**38,02755**$+($**139,45+303,1**$/2+$**85,64**$/2)=$**18,39245** $^{kJ}/_{mol}$;

Formation $Fe+O_2^{gas}/2+H_2/2=[Fe(OH)]^{2+}+2e^-$;

$\Delta G°=G_{[Fe(OH)]2+}+2G_{e-}-(G_{Fe}+G_{O2gas}/2+G_{H2}/2)=$**61,86545**$+2*$**21,277-(139,45+303,1**$/2+$**85,64**$/2)=-229,4$ $^{kJ}/_{mol}$;

$2G_{e-}=\Delta G°-G_{[Fe(OH)]+}+(G_{Fe}+G_{O2gas}/2+G_{H2}/2)=-229,4-$**61,86545**$+($**139,45+303,1**$/2+$**85,64**$/2)=2*$**21,277** $^{kJ}/_{mol}$;

Formation $Fe+O_2^{gas}+H_2=[Fe(OH)_2]^++e^-$;

$\Delta G°=G_{[Fe(OH)2]+}+2G_{e-}-(G_{Fe}+G_{O2gas}+G_{H2})=$**47,8715**$+G_{e-}-($**139,45+303,1+85,64**$)=-438$ $^{kJ}/_{mol}$;

$G_{e-}=\Delta G°-G_{[Fe(OH)2]+}+(G_{Fe}+G_{O2gas}+G_{H2})=-438-$**47,8715**$+($**139,45+303,1+85,64**$)=$**42,3185** $^{kJ}/_{mol}$;

[38] IUPAC $Fe^{2+}$ Acid $[Fe(H_2O)]^{2+}+H_2O=[Fe(OH)]^++H_3O^+$; Prigogine attractor $\Delta G_{eq}=-RT\ln(K_{eq})$,

Equilibrium constant $K_{prot\_eq}=[[Fe(OH)]^+]*[H_3O^+]^2/[[Fe(H_2O)]^{2+}]/[H_2O]=10^{\wedge(-6,74)}/55,3=10^{\wedge(-8,4827)}$;

Protolysis attractor $\Delta G_{prot\_eq}=-RT\ln(K_{prot\_eq})=-8,3144*298,15*\ln(10^{\wedge(-8,4827)})=$**48,419** $^{kJ}/_{mol}$;

Hess law expression $\Delta G_{prot}=G_{[Fe(OH)]+}+G_{H3O+}-(G_{[Fe(H2O)]2+}+G_{H2O})=$**38,02755+22,44-(12,04855+0)=48,419** $^{kJ}/_{mol}$;

$G_{[Fe(OH)]+}=\Delta G_{prot}-G_{H3O+}+(G_{[Fe(H2O)]2+}+G_{H2O})=$**48,419-22,44+(12,04855+0)=38,02755** $^{kJ}/_{mol}$;

[38] IUPAC $Fe^{3+}$ Acid $[Fe(H_2O)]^{3+}+H_2O=Fe(OH)^{2+}+H_3O^+$; Prigogine attractor $\Delta G_{prot\_eq}=-RT\ln(K_{prot\_eq})$.

Equilibrium constant $K_{prot\_eq}=[Fe(OH)^{2+}]*[H_3O^+]^2/[Fe(H_2O)^{3+}]/[H_2O]=10^{\wedge(-2,46)}/55,3=10^{\wedge(-4,2027)}$;

Protolysis attractor $\Delta G_{sp}=-RT\ln(K_{speq})=-8,3144*298,15*\ln(10^{\wedge(-4,2027)})=$**23,9889** $^{kJ}/_{mol}$;

Hess law expression $\Delta G_{prot}=G_{[Fe(OH)]2+}+G_{H3O+}-(G_{[Fe(H2O)]3+}+G_{H2O})=$**61,86545+22,44-(60,31655+0)=23,9889** $^{kJ}/_{mol}$;

$G_{[Fe(OH)]2+}=\Delta G_{prot}-G_{H3O+}+(G_{[Fe(H2O)]3+}+G_{H2O})=$**23,9889-22,44+(60,31655+0)=61,86545** $^{kJ}/_{mol}$;

$G_{[Fe(H2O)]3+}=G_{[Fe(OH)]2+}+G_{H3O+}-(\Delta G_{prot}+G_{H2O})=$**61,86545+22,44-(23,9889+0)=60,31655** $^{kJ}/_{mol}$;

[38] IUPAC $Fe^{3+}$ Acid $Fe(H_2O)^{3+}+H_2O=Fe(OH)^{2+}+H_3O^+$;

$K_{prot\_eq}=[Fe(OH)^{2+}]*[H_3O^+]^2/[Fe(H_2O)^{3+}]/[H_2O]=10^{\wedge(-2,46)}/55,3=10^{\wedge(-4,2027)}$;

Protolysis attractor $\Delta G_{prot\_eq}=-RT\ln(K_{prot\_eq})=-8,3144*298,15*\ln(10^{\wedge(-4,2027)})=$**23,9889** $^{kJ}/_{mol}$;

$\Delta G_{prot\_eq}=G_{[Fe(OH)]2+}+G_{H3O+}-(G_{[Fe(H2O)]3+}+G_{H2O})=$**61,86545+22,44-(60,31655+0)=23,9889** $^{kJ}/_{mol}$;

$G_{[Fe(OH)]2+}=\Delta G_{prot}-G_{H3O+}+(G_{[Fe(H2O)]3+}+G_{H2O})=$**23,9889-22,44+(60,31655+0)=61,86545** $^{kJ}/_{mol}$;

$G_{[Fe(H2O)]3+}=G_{[Fe(OH)]2+}+G_{H3O+}-(\Delta G_{prot}+G_{H2O})=$**61,86545+22,44-(23,9889+0)=60,31655** $^{kJ}/_{mol}$;

[18] $Fe(H_2O)^{3+}+OH^-=Fe(OH)^{2+}+H_2O$;

$K_{stab\_eq}=ß_1*[H_2O]=[Fe(OH)^{2+}]*[H_2O]/[Fe^{3+}]/[OH^-]=10^{\wedge 11,81}*55,3=10^{\wedge 13,5527}$;

Stability attractor $\Delta G_{stab\_eq}=-RT\ln(K_{stab\_eq})=-8,3144*298,15*\ln(10^{\wedge 13,5527})=$**-77,35836** $^{kJ}/_{mol}$;

$\Delta G_{stab\_eq}=G_{[Fe(OH)]2+}+G_{H2O}-(G_{[Fe(H2O)]3+}+G_{OH-})=$**60,31819+0-(60,31655+77,36)=-77,35836** $^{kJ}/_{mol}$;

$G_{[Fe(OH)]2+}=\Delta G_{stab\_eq}-G_{H2O}+(G_{[Fe(H2O)]3+}+G_{OH-})=$**-77,35836-0+(60,31655+77,36)=60,31819** $^{kJ}/_{mol}$;

[18] $[Fe(H_2O)_2]^{3+}+2OH^-=Fe(OH)_2{}^++2H_2O$;

$K_{stab\_eq}=ß_2*[H_2O]^2=[Fe(OH)_2{}^+]*[H_2O]^2/[Fe^{3+}]/[OH^-]^2=10^{\wedge 22,32}*55,3^{\wedge}2=10^{\wedge 25,80545}$;

Stability attractor $\Delta G_{stab\_eq}=-RT\ln(K_{stab\_eq})=-8,3144*298,15*\ln(10^{\wedge 25,80545})=$**-147,2966** $^{kJ}/_{mol}$;

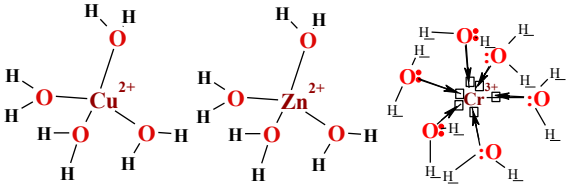
$\Delta G_{stab\_eq}=G_{[Fe(OH)]2+}+2G_{H2O}-(G_{[Fe(H2O)]3+}+2G_{OH-})=$**67,73995**$+2*$**0-(60,31655**$+2*$**77,36**$)=-$**147,2966** $^{kJ}/_{mol}$;

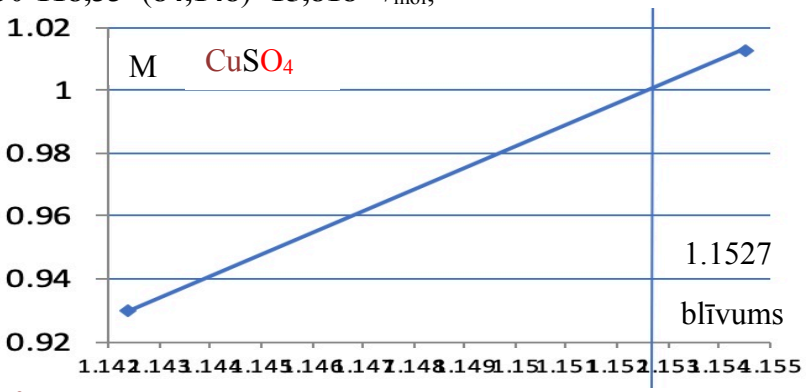
$G_{[Fe(OH)]2+}=\Delta G_{stab\_eq}-2G_{H2O}+(G_{[Fe(H2O)]3+}+2G_{OH-})=-$**147,2966**$-2*$**0**$+($**60,31655**$+2*$**77,36**$)=$**67,73995** $^{kJ}/_{mol}$;

Vara savienojumu šķīšanas, protolīzes un reducēšanas-oksidēšanas Prigožina absolūtās enerģijas atraktori.

Formation [1] $Cu^{2+}+2e^-=Cu$; $\Delta G°=G_{Cu2+}+2G_{e-}-(G_{Cu})=\mathbf{108,618}+2*G_{e-}-(\mathbf{84,148})=65,5$ $^{kJ}/_{mol}$;
Formation [1] $Cu^{2+}+2e^-=Cu$; $G_{e-}=(\Delta G°-G_{Cu2+}+(G_{Cu}))/2=(65,5-\mathbf{108,618}+(\mathbf{84,148}))/2=\mathbf{20,515}$ $^{kJ}/_{mol}$;
Formation [1] $Cu=Cu^{+}+e^-$; $\Delta G°=G_{Cu+}+G_{e-}-(G_{Cu})=\mathbf{118,33}+G_{e-}-(\mathbf{84,148})=50$ $^{kJ}/_{mol}$;
Formation [1] $Cu=Cu^{+}+e^-$; $G_{e-}=\Delta G°-G_{Cu+}+(G_{Cu})=50-\mathbf{118,33}+(\mathbf{84,148})=\mathbf{15,818}$ $^{kJ}/_{mol}$;

$[Cu^{2+}]$=1 M mola masa $M_{CuSO4}$=159,602 $^{g}/_{mol}$ masa, blīvums 1,1527 $^{g}/_{mL}$; [1]
Absolūtais potenciāls satur klasisku $E°_{Classic}$=0,345 V [1], ūdens logaritmu 0,051497, summu $\Delta E°$=+0,10166-0,37239:






$Cu(Hg)+H_2O=Cu^{2+}+2e^-$; $E°_{Classic}$=0,345 V[1].
$E°_{Cu/Cu2+}=E°_{Classic}-0,0591/2*\log(1/[H_2O])+\Delta E°_{Cu}=0,345-0,0591/2*\log(1/55,3)+0,10166-0,371339=\mathbf{0,1268185}$ V.
$\Delta\mathbf{G}_{eq\_Cu}=E°_{Cu}\bullet F\bullet 2=\mathbf{0,1268185}*96485*2=\mathbf{24,472}$ $^{kJ}/_{mol}$,
$\Delta\mathbf{G}_{eq\_Cu}=G_{Cu2+}+2G_{e-}-(G_{Cu}+G_{H2O})=\mathbf{108,618}+2*\mathbf{0}-(\mathbf{84,148}+\mathbf{0})=\mathbf{24,47}$ $^{kJ}/_{mol}$;
$G_{Cu}=G_{Cu2+}+2G_{e-}-(\Delta\mathbf{G}_{eq\_Cu}+\mathbf{G_{H2O}})=\mathbf{108,618}+2*\mathbf{0}-(\mathbf{24,47}+\mathbf{0})=\mathbf{84,148}$ $^{kJ}/_{mol}$;
$2G_{e-}=\Delta\mathbf{G}_{eq\_Cu}-G_{Cu2+}+(G_{Cu}+G_{H2O})=\mathbf{24,47}-\mathbf{108,618}+(\mathbf{84,148}+\mathbf{0})=2*\mathbf{0}$ $^{kJ}/_{mol}$;
$E_{Cu}=E°_{Cu}+0,0591/2*\log([Cu^{2+}]/[Cu]/([H_2O]))=\mathbf{0,12682}+0,0591/2*\log(1/1/(55,3))=0,075322$ V;
$E_{Cu}=E°_{Cu}+0,0591/2*\log([Cu^{2+}]/[Cu]/([H_2O]-4[Cu^{2+}]))=\mathbf{0,12682}+0,0591/2*\log(1/1/(57,24-4))=0,07581$ V;
$m_{H2O}=(m_L-m_{CuSO4})/18=1190-159,602=1030,4/18=57,24-4=53,24$ mol; Atšķirība 0,075322 V ir trešajā 3. ciparā.

| *Viela* | $\Delta H°_H$ $^{kJ}/_{mol}$ | $\Delta S°_H$ $^{J}/_{mol/K}$ | $\Delta G°_H$ , $^{kJ}/_{mol}$ |
|---|---|---|---|
| Cu | $E°_{Cu}$= | 0,**12682** V | **84,148** |
| $Cu_2O$ | -168,6 | 93,1 | -146,0 |
| $Cu_2O$ | formation | -146,0 | **173,846** |
| CuO | -157,3 | 42,6 | -129,7 |
| CuO | formation | -129,7 | **105,998** |
| $Cu^+$ | 71,7 | 40,6 | 50,0 |
| $Cu^+$ | $E°_{Cu}$= | **0,35432**V | **118,33** |
| $G_{e-}$ $Cu^+$ | formation | 50 | **15,818** |
| $Cu^{2+}$ | 64,8 | -99,6 | 65,5 |
| $Cu^{2+}$ | $K_{sp}$= | $10^{-24,886}$ | **108,618** |
| $G_{e-}$ $Cu^{2+}$ | formation | 65,5 | **20,515** |
| $Cu(OH)_2$ | -449,8 | 108 | -337 |
| $Cu(OH)_2$ | Formation | -337 | **121,29** |
| $Cu(OH)_2$ | $K_{sp}$= | $10^{-24,886}$ | **121,29** |
| $CO_3^{2-}$ | -677,1 | -56,9 | -527,8 |
| $CuCO_3$ | Formation | -527,8 | **102,258** |
| $CO_3^{2-}$ | $K_{sp}$= | $10^{-13,339}$ | **70,07286** |
| $C_2O_4^{2-}$ | -825,1 | 45,6 | -673,9 |
| $C_2O_4^{2-}$ | formation | -673,9 | **114,62** |
| $C_2O_4^{2-}$ | $K_{sp}$= | $10^{-12,839}$ | **40,1746** |
| $CuC_2O_4$ | formation | -797,16 | **75,508** |
| $S^{2-}$ | 33,1 | -14,6 | 85,8 |
| $S^{2-}$ | $E°_{S↓/S2-}$= | **-0,79853**V | **157,63** |
| $S^{2-}$ | $K_{sp}$= | $10^{-39,7073}$ | **152,1216** |
| CuS | -53,1 | 66,5 | -53,6 |
| CuS | formation | -53,6 | **34,0916** |

[1]$\Delta H°_{Cu(OH)2}$=-449,8 $^{kJ}/_{mol}$; $G_{Srhombic}$=**3,5436** $^{kJ}/_{mol}$;
$G_{Cu}=G_{Cu2+}-(\Delta\mathbf{G}_{eq\_Cu}+\mathbf{G_{H2O}})=\mathbf{108,618}-(\mathbf{24,47}+0)=\mathbf{84,148}$ $^{kJ}/_{mol}$;
[1] $\Delta G_{CuO}=\Delta H_H-T*\Delta S_H=-168,6-298,15*0,0931=-196,358$ $^{kJ}/_{mol}$;
[1] $G_{CuO}=\Delta G°_{CuO}+(2G_{Cu}+G_{O2}/2)=-146,0=\mathbf{173,846}$ $^{kJ}/_{mol}$;
[1] $\Delta G_{CuO}=\Delta H_H-T*\Delta S_H=-157,3-298,15*0,0426=-170$ $^{kJ}/_{mol}$;
[1] $G_{CuO}=\Delta G°_{CuO}+(G_{Cu}+G_{O2}/2)=-129,7=\mathbf{105,998}$ $^{kJ}/_{mol}$;
[1] $\Delta G_{Cu2+}=\Delta H_H-T*\Delta S_H=71,7-298,15*0,0406=59,595$ $^{kJ}/_{mol}$;
$G_{Cu+}=\Delta\mathbf{G}_{eq\_Cu}+(G_{Cu}+G_{H2O})=\mathbf{34,1866}+\mathbf{84,148}=\mathbf{118,33}$ $^{kJ}/_{mol}$;
[1] Formation $Cu=Cu^{+}+e^-$; $G_{e-}=\Delta G°-G_{Cu+}+(G_{Cu})=\mathbf{15,818}$ $^{kJ}/_{mol}$;
[1] $\Delta G_{Cu2+}=\Delta H_H-T*\Delta S_H=64,8-298,15*-0,098=94,0187$ $^{kJ}/_{mol}$;
$G_{Cu2+}=\Delta G_{sp}-2G_{OH-}+(G_{Cu(OH)2}+3G_{H2O})=\mathbf{108,618}$ $^{kJ}/_{mol}$;
$G_{e-}=(\Delta G°-G_{Cu2+}+(G_{Cu}))/2=(65,5-\mathbf{108,618}+(\mathbf{84,148}))/2=\mathbf{20,515}$ $^{kJ}/_{mol}$;
[33]$\Delta G_{Cu(OH)2}=\Delta H_H-T*\Delta S_H=-450,2-298,15*-0,108=-418$ $^{kJ}/_{mol}$;
$G_{Cu(OH)2}=\Delta G°_{form}+(G_{Cu}+G_{O2}^{gas}+G_{H2}^{gas})=\mathbf{121,29}$ $^{kJ}/_{mol}$;
$G_{Cu(OH)2}=G_{Cu2+}+2G_{OH-}-(\Delta G_{sp}+3G_{H2O})=\mathbf{121,29}$ $^{kJ}/_{mol}$;
$\Delta G_H=\Delta H_H-T*\Delta S_H=-677,1-298,15*-0,0569=-660,135$ $^{kJ}/_{mol}$;
$G_{CuCO3}=\Delta G°_{form}+(G_{Cu}+1,5G_{O2}^{gas}+G_{Cgraph})=\mathbf{102,258}$ $^{kJ}/_{mol}$;
$G_{CO32-}=\Delta G_{sp}-G_{Cu2+}+(G_{CuCO3}+2G_{H2O})=\mathbf{70,07286}$ $^{kJ}/_{mol}$;
[1] $\Delta G_H=\Delta H_H-T*\Delta S_H=-825,1-298,15*0,0456=-862,637$ $^{kJ}/_{mol}$;
$G_{C2O4(2-)}=\Delta G°_{C2O4(2-)Form}+(2G_{Cgr}+2G_{O2}^{gas}+2G_{e-})=\mathbf{114,62}$ $^{kJ}/_{mol}$;
$G_{C2O42-}=\Delta G_{sp}-G_{Cu2+}+(G_{CuC2O4}+2G_{H2O})=\mathbf{40,1746}$ $^{kJ}/_{mol}$;
$G_{CuC2O4cr}=\Delta G°_{CuC2O4crForm}+(Cu+2O_2^{gas}+2C_{graph})=\mathbf{75,508}$ $^{kJ}/_{mol}$;
[1] $\Delta G_H=\Delta H_H-T*\Delta S_H=33,1-298,15*-0,0146=-862,637$ $^{kJ}/_{mol}$;
$G_{S2-aq}=G_{Srombic}+G_{H2O}-(\Delta G_{eqS2-aq})=\mathbf{157,63}$ $^{kJ}/_{mol}$;
$G_{S2-}=\Delta G_{sp}-G_{Cu2+}+(G_{CuS}+2G_{H2O})=\mathbf{152,1216}$ $^{kJ}/_{mol}$;
[1] $\Delta G_H=\Delta H_H-T*\Delta S_H=-53,164,8-298,15*0,0665=-72,99$ $^{kJ}/_{mol}$;
$G_{CuS}=\Delta G°_{form}+(G_{Cu}+G_{Sromb})=\mathbf{34,0916}$ $^{kJ}/_{mol}$;

Formation [1] $2Cu+O=Cu_2O$; $\Delta G°_{Cu2O}=G_{Cu2O}-(2G_{Cu}+G_{O2}/2)=G_{CuO}-(2*\mathbf{84,148}+\mathbf{303,1}/2)=-146,0$ $^{kJ}/_{mol}$;
$G_{CuO}=\Delta G°_{CuO}+(2G_{Cu}+G_{O2}/2)=-146,0+(2*\mathbf{84,148}+\mathbf{303,1}/2)=\mathbf{173,846}$ $^{kJ}/_{mol}$;

Formation [1] $Cu+O=CuO$; $\Delta G°_{CuO}=G_{CuO}-(G_{Cu}+G_{O2}/2)=G_{CuO}-(\mathbf{84,148}+\mathbf{303,1}/2)=-129,7$ $^{kJ}/_{mol}$;

$G_{CuO}=\Delta G°_{CuO}+(G_{Cu}+G_{O2}/2)=-129,7+(\mathbf{84,148}+\mathbf{303,1}/2)=\mathbf{105,998}$ $^{kJ}/_{mol}$;

$Cu+H_2O=Cu^{+}+\mathbf{2e^{-}}$; $E°_{Classic}=0,521$ V[1].

$E°_{Cu/Cu+}=E°_{Classic}-0,0591*\log(1/[H_2O])+\Delta E°_{Cu}=0,521-0,0591*\log(1/55,3)+0,10166-0,371339=\mathbf{0,35432}$ V.

$\Delta\mathbf{G}_{\mathbf{eq\_Cu}}=E°_{Cu}\bullet F\bullet 1=\mathbf{0,35432}*96485*1=\mathbf{34,1866}$ $^{kJ}/_{mol}$,

$\Delta\mathbf{G}_{\mathbf{eq\_Cu}}=G_{Cu+}+G_{e-}-(G_{Cu}+G_{H2O})=\mathbf{118,33}+\mathbf{0,00460}-(\mathbf{84,148}+\mathbf{0})=\mathbf{34,1866}$ $^{kJ}/_{mol}$;

$G_{Cu+}=\Delta\mathbf{G}_{\mathbf{eq}Cu}-G_{e-}+(G_{Cu}+G_{H2O})=\mathbf{34,1866}-\mathbf{0,00460}+(\mathbf{84,148}+\mathbf{0})=\mathbf{118,33}$ $^{kJ}/_{mol}$;

$G_{e-}=\Delta\mathbf{G}_{\mathbf{eq}Cu}-G_{Cu+}+(G_{Cu}+G_{H2O})=\mathbf{34,1866}-\mathbf{118,33}+(\mathbf{84,148}+\mathbf{0})=\mathbf{0,00460}$ $^{kJ}/_{mol}$;

$G_{Cu}=G_{Cu+}+G_{e-}-(\Delta\mathbf{G}_{\mathbf{eq\_Cu}}+G_{H2O})=\mathbf{118,33}+\mathbf{0,00460}-(\mathbf{34,1866}+\mathbf{0})=\mathbf{84,148}$ $^{kJ}/_{mol}$;

Formation $Cu+O_{2\ g}+H_{2g}=Cu(OH)_2$; $\Delta G°=G_{Cu(OH)2}-(G_{Cu}+G_{O2g}+G_{H2g})=\mathbf{121,29}-(\mathbf{69,5467}+\mathbf{303,1}+\mathbf{85,64})=-337$ $^{kJ}/_{mol}$;

$G_{Cu(OH)2}=\Delta G°_{form}+(G_{Cu}+G_{O2}^{gas}+G_{H2}^{gas})=-337+(\mathbf{69,5467}+\mathbf{303,1}+\mathbf{85,64})=\mathbf{121,29}$ $^{kJ}/_{mol}$;

[33] Solubility $Cu(OH)_2+3H_2O=Cu^{2+}+2OH^{-}$; $K_{sp}=[Cu^{2+}]*[OH^{-}]^2/[H_2O]^3=2,2*10^{\wedge(-20)}/55,3^{\wedge 3}=10^{\wedge(-24,886)}$;

Attractor $\Delta\mathbf{G}_{sp}=-RT\ln(\mathbf{K}_{speq})=-8,3144*298,15*\ln(10^{\wedge(-24,886)})=\mathbf{142,048}$ $^{kJ}/_{mol}$

$\Delta G_{sp}=G_{Cu2+}+2G_{OH-}-(G_{Cu(OH)2}+3G_{H2O})=G_{Cu2+}+2*\mathbf{77,36}-(\mathbf{121,29}+3*\mathbf{0})=\mathbf{142,048}$ $^{kJ}/_{mol}$;

$G_{Cu2+}=\Delta G_{sp}-2G_{OH-}+(G_{Cu(OH)2}+3G_{H2O})=\mathbf{142,048}-2*\mathbf{77,36}+(\mathbf{121,29}+3*\mathbf{0})=\mathbf{108,618}$ $^{kJ}/_{mol}$;

$G_{Cu(OH)2}=G_{Cu2+}+2G_{OH-}-(\Delta G_{sp}+3G_{H2O})=\mathbf{108,618}+2*\mathbf{77,36}-(\mathbf{142,048}+3*\mathbf{0})=\mathbf{121,29}$ $^{kJ}/_{mol}$;

Formation $Cu+1,5O_2^{gas}+C_{graph}=CuCO_3$; $Cu+S_{romb}=CuS$; Formation $Cu+2O_2^{gas}+2C_{graph}=CuC_2O_4$;

$\Delta G°_{form}=G_{CuCO3}-(G_{Cu}+1,5G_{O2}^{gas}+G_{Cgraph})=\mathbf{102,258}-(\mathbf{84,148}+1,5*\mathbf{303,1}+\mathbf{91,26})=-527,8$ $^{kJ}/_{mol}$; [1]

$G_{CuCO3}=\Delta G°_{form}+(G_{Cu}+1,5G_{O2}^{gas}+G_{Cgraph})=-527,8+(\mathbf{84,148}+1,5*\mathbf{303,1}+\mathbf{91,26})=\mathbf{102,258}$ $^{kJ}/_{mol}$;

$\Delta G°_{form}=G_{CuS}-(G_{Cu}+G_{Sromb})=\mathbf{34,0916}-(\mathbf{84,148}+\mathbf{3,5436})=-53,6$ $^{kJ}/_{mol}$;

$G_{CuS}=\Delta G°_{form}+(G_{Cu}+G_{Sromb})=-53,6+(\mathbf{84,148}+\mathbf{3,5436})=\mathbf{34,0916}$ $^{kJ}/_{mol}$;

$\Delta G°_{CuC2O4crForm}=G_{CuC2O4cr}-(Cu+2O_2^{gas}+\mathbf{2}C_{graph})=\mathbf{75,508}-(\mathbf{84,148}+2*\mathbf{303}+2*\mathbf{91,26})=-797,16$ $^{kJ}/_{mol}$.

$G_{CuC2O4cr}=\Delta G°_{CuC2O4crForm}+(Cu+2O_2^{gas}+\mathbf{2}C_{graph})=-797,16+(\mathbf{84,148}+2*\mathbf{303}+2*\mathbf{91,26})=\mathbf{75,508}$ $^{kJ}/_{mol}$.

[33] Solubility $CuCO_3+2H_2O=Cu^{2+}+CO_3^{2-}$; $K_{sp}=[Cu^{2+}]*[CO_3^{2-}]/[H_2O]^2=1,4*10^{\wedge(-10)}/55,3^{\wedge 2}=10^{\wedge(-13,339)}$;

Attractor $\Delta\mathbf{G}_{sp}=-RT\ln(\mathbf{K}_{speq})=-8,3144*298,15*\ln(10^{\wedge(-13,339)})=\mathbf{76,13856}$ $^{kJ}/_{mol}$

$\Delta G_{sp}=G_{Cu2+}+G_{CO32-}-(G_{CuCO3}+2G_{H2O})=\mathbf{108,618}+\mathbf{70,07286}-(\mathbf{102,5523}+2*\mathbf{0})=\mathbf{76,13856}$ $^{kJ}/_{mol}$;

$G_{CO32-}=\Delta G_{sp}-G_{Cu2+}+(G_{CuCO3}+2G_{H2O})=\mathbf{76,13856}-\mathbf{108,618}+(\mathbf{102,5523}+2*\mathbf{0})=\mathbf{70,07286}$ $^{kJ}/_{mol}$;

[1] Solubility $CuC_2O_4+2H_2O=Cu^{2+}+C_2O_4^{2-}$; $K_{sp}=[Cu^{2+}]*[C_2O_4^{2-}]/[H_2O]^2=4,43*10^{\wedge(-10)}/55,3^{\wedge 2}=10^{\wedge(-12,839)}$;

Attractor $\Delta\mathbf{G}_{sp}=-RT\ln(\mathbf{K}_{speq})=-8,3144*298,15*\ln(10^{\wedge(-12,839)})=\mathbf{73,2846}$ $^{kJ}/_{mol}$

$\Delta G_{sp}=G_{Cu2+}+G_{C2O42-}-(G_{CuC2O4}+2G_{H2O})=\mathbf{108,618}+\mathbf{40,1746}-(\mathbf{102,5523}+2*\mathbf{0})=\mathbf{73,2846}$ $^{kJ}/_{mol}$;

$G_{C2O42-}=\Delta G_{sp}-G_{Cu2+}+(G_{CuC2O4}+2G_{H2O})=\mathbf{73,2846}-\mathbf{108,618}+(\mathbf{75,508}+2*\mathbf{0})=\mathbf{40,1746}$ $^{kJ}/_{mol}$;

[33] Solubility $CuS+2H_2O=Cu^{2+}+S^{2-}$; $K_{sp}=[Cu^{2+}]*[S^{2-}]/[H_2O]^2=6*10^{\wedge(-37)}/55,3^{\wedge 2}=10^{\wedge(-24,886)}$;

Attractor $\Delta\mathbf{G}_{sp}=-RT\ln(\mathbf{K}_{speq})=-8,3144*298,15*\ln(10^{\wedge(-39,707299)})=\mathbf{226,648}$ $^{kJ}/_{mol}$

$\Delta G_{sp}=G_{Cu2+}+G_{S2-}-(G_{CuS}+2G_{H2O})=\mathbf{108,618}+\mathbf{152,1216}-(\mathbf{34,0916}+2*\mathbf{0})=\mathbf{226,648}$ $^{kJ}/_{mol}$;

$G_{S2-}=\Delta G_{sp}-G_{Cu2+}+(G_{CuS}+2G_{H2O})=\mathbf{226,648}-\mathbf{108,618}+(\mathbf{34,0916}+2*\mathbf{0})=\mathbf{152,1216}$ $^{kJ}/_{mol}$;

Zn-Cinka savienojumu šķīšanas, protolīzes un reducēšanas-oksidēšanas Prigožina absolūtās enerģijas atraktori.

Formation [1] $2C_{gr}+3O_2^{gas}+Zn+2\mathbf{H}_2^{gas}=ZnC_2O_4\bullet 2H_2O$ -solubility $ZnC_2O_{4(s)}+2H_2O=Zn^{2+}+C_2O_4^{2-}$ $K_{sp}=0{,}0026^{\wedge 2}$;
$\Delta G°=G_{ZnC2O4\bullet 2H2O}-(G_{Zn}+3G_{O2g}+2G_{graph}+2G_{H2})=\mathbf{321{,}7642}-(\mathbf{404{,}657}+3*\mathbf{303{,}1}+2*\mathbf{91{,}26}+2*\mathbf{85{,}64})=-1345{,}99$ $^{kJ}/_{mol}$;
$G_{ZnC2O4\bullet 2H2O}=\Delta G°+(G_{Zn}+3G_{O2g}+2G_{graph}+2G_{H2})=-1345{,}9928+(\mathbf{404{,}66}+3*\mathbf{303{,}1}+2*\mathbf{91{,}26}+2*\mathbf{85{,}64})=\mathbf{321{,}76}$ $^{kJ}/_{mol}$;
[1] Solubility $ZnC_2O_4+2H_2O=Zn^{2+}+C_2O_4^{2-}$; $M_{ZnC2O4}=0{,}00026/153{,}4=10^{\wedge(-5{,}77085)}$ M;
$K_{eqsp}=[Zn^{2+}]*[C_2O_4^{2-}]/[H_2O]^2=10^{\wedge(-5{,}77085*2)}/55{,}3^{\wedge 2}=10^{\wedge(-15{,}027)}$;
Attractor $\Delta\mathbf{G}_{sp}=-RTln(\mathbf{K}_{sp})=-8{,}3144*298{,}15*\ln(10^{\wedge(-15{,}027)})=\mathbf{85{,}7736}$ $^{kJ}/_{mol}$;
$\Delta G_{sp}=G_{Zn2+}+G_{C2O42-}-(G_{ZnC2O4}+2G_{H2O})=\mathbf{404{,}657}+\mathbf{207{,}188}-(\mathbf{526{,}0714}+2*\mathbf{0})=\mathbf{85{,}7736}$ $^{kJ}/_{mol}$;
$G_{ZnC2O4}=G_{Zn2+}+G_{CO32-}-(\Delta G_{sp}+2G_{H2O})=\mathbf{404{,}657}+\mathbf{207{,}188}-(\mathbf{85{,}7736}+2*\mathbf{0})=\mathbf{526{,}0714}$ $^{kJ}/_{mol}$;
$G_{C2O42-}=\Delta G_{sp}-G_{Zn2+}+(G_{ZnC2O4}+2G_{H2O})=\mathbf{85{,}7736}-\mathbf{404{,}657}+(\mathbf{526{,}0714}+2*\mathbf{0})=\mathbf{207{,}188}$ $^{kJ}/_{mol}$;

| *Viela* | $\Delta H°_{H5}$ $^{kJ}/_{mol}$ | $\Delta S°_H$ $^{J}/_{mol/K}$ | $\Delta G°_H$ , $^{kJ}/_{mol}$ |
|---|---|---|---|
| Zn | $E°_{Zn}=$ | **-0,980** V | **404,657** |
| Zn | Formation | -147,1 | **404,657** |
| $Zn^{2+}$ | -153,9 | -112,1 | -147,1 |
| $Zn^{2+}$ | formation | -147,1 | **215,55** |
| $G_{e-}$ $Zn^{2+}$ | Free e- | -147,1 | **14,415** |
| $Zn(OH)^+$ | format $G_{e-}$ | -330,1 | **13,642** |
| $Zn(OH)^+$ | $K_{aeqZn(2+}$ | $=10^{-10{,}8927}$ | **255,285** |
| $Zn(OH)^+$ | $K_{stab\_eq}$ | $=10^{6{,}782725}$ | **254,194** |
| $Zn(H_2O)^{2+}$ | format-$2G_{e-}$ | **14,415** | **215,55** |
| $G_{e-}Zn^{2+}$ | $E°_{Zn}=$ | **-0,980** V | **0,0** |
| $Zn^{2+}$ | $E°_{Zn}=$ | **-0,980** V | **215,55** |
| $Zn^{2+}$ | $K_{spZn(OH)2}=$ | $10^{\wedge -25{,}149}$ | **228,727** |
| $Zn(OH)_2$ | -641,9 | 81,2 | -553,5 |
| $Zn(OH)_2$ | formation | -553,5 | **239,897** |
| $Zn(OH)_2$ | $K_{spZn(OH)2}=$ | $10^{\wedge -25{,}149}$ | **239,897** |
| $ZnCO_3$ | -812,8 | 82,4 | -731,3 |
| $ZnCO_3$ | formation | -731,3 | **219,267** |
| $CO_3^{2-}$ | -677,1 | -56,9 | -527,8 |
| $CO_3^{2-}$ | formation | -527,8 | **46,94** |
| ZnS | -206,0 | 57,7 | -201,3 |
| ZnS | formation | -201,3 | **206,90** |
| $S^{2-}$ | 33,1 | -14,6 | 85,8 |
| $S^{2-}$ | formation | if**14,415** | **118,1736** |
| $G_{e-}$ $S^{2-}$ | Free e- | 85,8 if | **34,1432** |
| $S^{2-}$ | $E°_{S\downarrow/S2-}=$ | **-0,79853**V | **157,63** |
| $ZnC_2O_4\bullet 2H_2O$ | -1564,816 | 195,3928 | -1345,9928 |
| $ZnC_2O_4\bullet 2H_2O$ | formation | -1345,99 | **321,76** |
| $ZnC_2O_4$ | $K_{sp}=$ | $10^{-8{,}6555}$ | **526,0714** |
| $C_2O_4^{2-}$ | formation | -pH=7,36 | **-677,14** |
| $C_2O_4^{2-}$ | -825,1 | 45,6 | -673,9 |
| $C_2O_4^{2-}$ | formation | -673,9 | **114,62** |
| $C_2O_4^{2-}$ | formation | **-677,14** | **111,38** |
| $C_2O_4^{2-}$ | $_{ZnC2O4}K_{sp}=$ | $10^{-15{,}027}$ | **207,188** |
| $C_2O_4^{2-}$ | $_{acid\_2}$ **33,563** | $pK_{a2}$=5,88 | **207,173** |
| $C_2O_4^{2-}$ | $E°_{C2O4}=$ | **-0,7607** V | **183,55** |

$G_{O2}^{gas}=\mathbf{303{,}1}$ $^{kJ}/_{mol}$; $G_{H2}^{gas}=\mathbf{85{,}64}$ $^{kJ}/_{mol}$; $G_{Cgraph}=\mathbf{91{,}26}$ $^{kJ}/_{mol}$;
$G_{Zn}=G_{Zn2+}-(\Delta\mathbf{G}_{eq\_Zn}+\mathbf{G_{H2O}})=\mathbf{215{,}55}-(-\mathbf{189{,}107}+0)=\mathbf{404{,}657}$ $^{kJ}/_{mol}$;
$G_{Zn}=G_{Zn(OH)2}-(\Delta G°+G_{O2g}+G_{H2g})=\mathbf{404{,}657}$ $^{kJ}/_{mol}$;
[1] $\Delta G_{Zn2+}=\Delta H_H-T*\Delta S_H=-153{,}39-298{,}15*-0{,}112=-119{,}967$ $^{kJ}/_{mol}$;
$G_{Zn2+}=G_{Zn}-(\Delta G°+2G_{e-})=\mathbf{391{,}48}-(-147{,}1+2*\mathbf{161{,}515})=\mathbf{215{,}55}$ $^{kJ}/_{mol}$;
$G_{e-}=\Delta G°-G_{Zn2+}+(G_{Zn})=(-147{,}1-\mathbf{215{,}55}+(\mathbf{391{,}48}))/2=\mathbf{14{,}415}$ $^{kJ}/_{mol}$;
$G_{e-}=\Delta G°-G_{[Zn(OH)]+}+(G_{Zn}+G_{O2gas}/2+G_{H2}/2)=-330{,}1=\mathbf{13{,}642}$ $^{kJ}/_{mol}$;
$G_{[Zn(OH)]+}=\Delta G_{prot}-G_{H3O+}+(G_{[Zn(H2O)]2+}+G_{H2O})=\mathbf{255{,}285}$ $^{kJ}/_{mol}$;
$G_{[Zn(OH)]+}=\Delta G_{stab\_eq}-G_{H2O}-(G_{[Zn(H2O)]2+}+G_{OH-})=\mathbf{254{,}194}$ $^{kJ}/_{mol}$;
$G_{Zn2+}=\Delta G°-2G_{e-}+(G_{Zn})=-147{,}1-2*\mathbf{14{,}415}+(\mathbf{391{,}48})=\mathbf{215{,}55}$ $^{kJ}/_{mol}$;
$2G_{e-}=\Delta\mathbf{G}_{eqZn}-G_{Zn2+}+(G_{Zn}+G_{H2O})=\mathbf{0{,}0}$ $^{kJ}/_{mol}$;
$G_{Zn2+}=\Delta\mathbf{G}_{eq\_Zn}+(G_{Zn}+\mathbf{G_{H2O}})=-\mathbf{189{,}107}+(\mathbf{404{,}657}+0)=\mathbf{215{,}55}$ $^{kJ}/_{mol}$;
$G_{Zn2+}=\Delta G_{sp}-2G_{OH-}+(G_{Zn(OH)2}+3G_{H2O})=\mathbf{215{,}55}$ $^{kJ}/_{mol}$;
[1] $\Delta G_{Zn2+}=\Delta H_H-T*\Delta S_H=-641{,}9-298{,}15*0{,}0812=-666{,}11$ $^{kJ}/_{mol}$;
$G_{Zn(OH)2}=\Delta G°_{form}+(G_{Zn}+G_{O2}^{gas}+G_{H2}^{gas})=\mathbf{239{,}897}$ $^{kJ}/_{mol}$;
$G_{Zn(OH)2}=G_{Zn2+}+2G_{OH-}-(\Delta G_{sp}+3G_{H2O})=\mathbf{239{,}897}$ $^{kJ}/_{mol}$;
[1] $\Delta G_{Zn2+}=\Delta H_H-T*\Delta S_H=-812{,}8-298{,}15*0{,}824=-1058{,}48$ $^{kJ}/_{mol}$;
$G_{ZnCO3}=\Delta G°_{form}+(G_{Zn}+1{,}5G_{O2}^{gas}+G_{H2}^{gas})=\mathbf{219{,}267}$ $^{kJ}/_{mol}$;
**[1]**$\Delta G_H=\Delta H_H-T*\Delta S_H=-677{,}1-298{,}15*-0{,}0569=-660{,}135$ $^{kJ}/_{mol}$;
$G_{CO32-}=\Delta G°+(1{,}5G_{O2g}+G_{graph}+2G_{e-})=\mathbf{46{,}94}$ $^{kJ}/_{mol}$;
[1] $\Delta G_{Zn2+}=\Delta H_H-T*\Delta S_H=-206-298{,}15*0{,}577=-382{,}36$ $^{kJ}/_{mol}$;
$G_{ZnS}=\Delta G°+(G_{Zn}+G_{Srhombic})=-201{,}3+(\mathbf{404{,}657}+\mathbf{3{,}5436})=\mathbf{206{,}9}$ $^{kJ}/_{mol}$;
[1] $\Delta G_{Zn2+}=\Delta H_H-T*\Delta S_H=-33{,}1-298{,}15*-0{,}0146=-382{,}36$ $^{kJ}/_{mol}$;
$G_{S2-}=\Delta G°+(G_{Srhombic}+2G_{e-})=85{,}8+(\mathbf{3{,}5436}+2*\mathbf{14{,}415})=\mathbf{118{,}1736}$ $^{kJ}/_{mol}$;
$2G_{e-}=G_{S2-}-(G_{Srhombic}+\Delta G°)=\mathbf{157{,}63}-(\mathbf{3{,}5436}+85{,}8)=2*\mathbf{34{,}1432}$ $^{kJ}/_{mol}$;
$G_{S2-aq}=G_{Srombic}+\mathbf{G_{H2O}}-(\Delta G_{eqS2-aq})=\mathbf{157{,}63}$ $^{kJ}/_{mol}$;
[38] $\Delta G_H=\Delta H_H-T*\Delta S_H=-1564{,}8-298{,}15*0{,}19539=-1623$ $^{kJ}/_{mol}$;
$G_{ZnC2O4\bullet 2H2O}=\Delta G°+(G_{Zn}+3G_{O2g}+2G_{graph}+2G_{H2})=\mathbf{321{,}76}$ $^{kJ}/_{mol}$;
$G_{ZnC2O4}=G_{Zn2+}+G_{CO32-}-(\Delta G_{sp}+2G_{H2O})=\mathbf{526{,}0714}$ $^{kJ}/_{mol}$;
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[1] $\Delta G_H=\Delta H_H-T*\Delta S_H=-825{,}1-298{,}15*0{,}0456=-862{,}637$ $^{kJ}/_{mol}$;
$G_{C2O4(2-)}=\Delta G°_{C2O4(2-)Form}+(2G_{Cgr}+2\mathbf{G_{O2}}^{gas}+2\mathbf{G_{e-}})=\mathbf{114{,}62}$ $^{kJ}/_{mol}$;
$G_{C2O4(2-)}=\Delta G°_{C2O4(2-)Form}+(2G_{Cgr}+2\mathbf{G_{O2}}^{gas}+\mathbf{G_{e-}})=\mathbf{111{,}38}$ $^{kJ}/_{mol}$;
$G_{C2O42-}=\Delta G_{sp}-G_{Zn2+}+(G_{ZnC2O4}+2G_{H2O})=\mathbf{207{,}188}$ $^{kJ}/_{mol}$;
$G_{\mathbf{C2O4}}=\Delta G_{eq2\mathbf{HC2O4}}-\mathbf{G_{H3O}}+(\mathbf{G_{HC2O4}}+\mathbf{G_{H2O}})=\mathbf{207{,}173}$ $^{kJ}/_{mol}$;
$G_{C2O4}=2G_{CO2aq}-(\Delta\mathbf{G}_{eqC2O4})=2*\mathbf{18{,}38}-(-\mathbf{146{,}79})=\mathbf{183{,}55}$ $^{kJ}/_{mol}$;

Metāls cinks $Zn+H_2O=Zn^{2+}+\mathbf{2e}^-$, $[Zn^{2+}]=C_{ZnSO4}=2$ M šķīdumā masa 2 moliem $m_{ZnSO4}=2*161{,}44=322{,}88$ g, blīvums 1,31 $^{g}/_{mL}$. Absolūtais standarta potenciāls satur potenciālu $E°_{Classic}=-0{,}7618$ V [1], ūdens logaritmu $-0{,}0591/2*\log(1/([H_2O]))=0{,}0515$, summu $\Delta E°=+0{,}10166-0{,}37239$ absolūtā standarta potenciāla izteiksmē:
$E°_{Zn/Zn2+}=E°_{cclassic}-0{,}0591/2*\log(1/([H_2O]))+\Delta E°=-0{,}7618-0{,}0591/2*\log(1/55{,}3)+0{,}10166-0{,}371339=\mathbf{-0{,}97998}$ V.
$E_{Zn}=E°_{Zn/Zn2+}+0{,}0591/2*\log([Zn^{2+}]/[Zn]/([H_2O]))=\mathbf{-0{,}97998}+0{,}0591/2*\log(2/1/(55{,}3))=-1{,}02258$ V
Atšķirība -1,02258V ir ceturtajā ciparā =-1,02045 V 2M; Šķīdība 57,7 $^{g}/_{100g\_H2O}$; w%=57,7/157,7*100=36,6%;
$m_{H2O}=m_L-m_{ZnSO4}=1310-161{,}44*2=987{,}12$ g; $m_{ZnSO4}=2*161{,}44=$g; $[H_2O]=987{,}12$ $^{g}/18$ $^{g}/_{mol}=54{,}84$ M.

$E_{Zn}=E°_{Zn/Zn2+}+0{,}0591/2*\log([Zn^{2+}]/[Zn]/([H_2O]))=\mathbf{-0{,}97998}+0{,}0591/2*\log(2/1/(54{,}84-4*2))=-1{,}02045$ V;

$\Delta\mathbf{G_{eq}}_{Zn}=E°_{Zn}\bullet F\bullet 2=\mathbf{-0{,}980}*96485*2=\mathbf{-189{,}107}=2*\mathbf{-94{,}553}$ kJ/mol;

$\Delta\mathbf{G_{eq}}_{Zn}=G_{Zn2+}+2G_{e-}-(G_{Zn}+G_{H2O})=\mathbf{215{,}55}+2*\mathbf{0}-(\mathbf{404{,}657}+0)=\mathbf{-189{,}107}$ kJ/mol;

$2G_{e-}=\Delta\mathbf{G_{eq}}_{Zn}-G_{Zn2+}+(G_{Zn}+G_{H2O})=\mathbf{-189{,}107-215{,}55}+(\mathbf{404{,}657}+0)=\mathbf{0{,}0}$ kJ/mol;

$G_{Zn}=G_{Zn2+}+2G_{e-}-(\Delta\mathbf{G_{eq\_Zn}}+\mathbf{G_{H2O}})=\mathbf{215{,}55}+2*\mathbf{0}-(\mathbf{-189{,}107}+0)=\mathbf{404{,}657}$ kJ/mol;

$G_{Zn2+}=\Delta\mathbf{G_{eq\_Zn}}-2G_{e-}+(G_{Zn}+\mathbf{G_{H2O}})=\mathbf{-189{,}107}-2*\mathbf{0}+(\mathbf{404{,}657}+0)=\mathbf{215{,}55}$ kJ/mol;

Formation $Zn=Zn^{2+}+\mathbf{2e^-}$; $\Delta G°=G_{Zn2+}+2G_{e-}-(G_{Zn})=\mathbf{215{,}55}+2*\mathbf{161{,}515}-(\mathbf{391{,}48})=-147{,}1$ kJ/mol;

$G_{e-}=\Delta G°-G_{Zn2+}+(G_{Zn})=(-147{,}1-\mathbf{215{,}55}+(\mathbf{391{,}48}))/2=\mathbf{14{,}415}$ kJ/mol;

$G_{Zn2+}=\Delta G°-2G_{e-}+(G_{Zn})=-147{,}1-2*\mathbf{14{,}415}+(\mathbf{391{,}48})=\mathbf{215{,}55}$ kJ/mol;

Formation $Zn+S_{rhombic}=ZnS$; $G_{Srhombic}=\mathbf{3{,}5436}$ kJ/mol;

$\Delta G°=G_{ZnS}-(G_{Zn}+G_{Srhombic})=\mathbf{206{,}9006}-(\mathbf{404{,}657}+\mathbf{3{,}5436})=-201{,}3$ kJ/mol;

$G_{ZnS}=\Delta G°+(G_{Zn}+G_{Srhombic})=-201{,}3+(\mathbf{404{,}657}+\mathbf{3{,}5436})=\mathbf{206{,}9006}$ kJ/mol;

Formation $S_{rhombic}+\mathbf{2e^-}=S^{2-}$; $G_{Srhombic}=\mathbf{3{,}5436}$ kJ/mol;

$\Delta G°=G_{S2-}-(G_{Srhombic}+2G_{e-})=\mathbf{157{,}63}-(\mathbf{3{,}5436}+2*\mathbf{14{,}415})=85{,}8$ kJ/mol;

$2G_{e-}=G_{S2-}-(G_{Srhombic}+\Delta G°)=\mathbf{157{,}63}-(\mathbf{3{,}5436}+85{,}8)=2*\mathbf{34{,}1432}$ kJ/mol;

$G_{S2-}=\Delta G°+(G_{Srhombic}+2G_{e-})=85{,}8+(\mathbf{3{,}5436}+2*\mathbf{34{,}1432})=\mathbf{157{,}63}$ kJ/mol;

$G_{S2-}=\Delta G°+(G_{Srhombic}+2G_{e-})=85{,}8+(\mathbf{3{,}5436}+2*\mathbf{14{,}415})=\mathbf{118{,}1736}$ kJ/mol;

$G_{Zn}=\Delta G°+(G_{Zn2+}+2G_{e-})=-147{,}1+(\mathbf{538{,}58}+2*0)=\mathbf{391{,}48}$ kJ/mol;

Formation $Zn+O_{2g}+H_{2g}=Zn(OH)_2$;

$\Delta G°=G_{Zn(OH)2}-(G_{Zn}+G_{O2g}+G_{H2g})=\mathbf{239{,}897}-(\mathbf{404{,}657}+\mathbf{303{,}1}+\mathbf{85{,}64})=-553{,}5$ kJ/mol;

$G_{Zn}=G_{Zn(OH)2}-(\Delta G°+G_{O2g}+G_{H2g})=\mathbf{239{,}897}-(-553{,}5+\mathbf{303{,}1}+\mathbf{85{,}64})=\mathbf{404{,}657}$ kJ/mol;

$G_{Zn(OH)2}=\Delta G°_{form}+(G_{Zn}+G_{O2}^{gas}+G_{H2}^{gas})=-553{,}5+(\mathbf{404{,}657}+\mathbf{303{,}1}+\mathbf{85{,}64})=\mathbf{239{,}897}$ kJ/mol;

[1] Solubility $Zn(OH)_2+3H_2O=Zn^{2+}+2OH^-$; $K_{sp}=[Zn^{2+}]*[OH^-]^2/[H_2O]^3=3*10^{\wedge(-17)}/55{,}3^{\wedge 3}=10^{\wedge(-25{,}149)}$;

Attractor $\Delta\mathbf{G}_{sp}=-RT\ln(\mathbf{K}_{speq})=-8{,}3144*298{,}15*\ln(10^{\wedge(-25{,}149)})=\mathbf{143{,}55}$ kJ/mol

$\Delta G_{sp}=G_{Zn2+}+2G_{OH-}-(G_{Zn(OH)2}+3G_{H2O})=\mathbf{228{,}727}+2*\mathbf{77{,}36}-(\mathbf{239{,}897}+3*\mathbf{0})=\mathbf{143{,}55}$ kJ/mol;

$G_{Zn(OH)2}=G_{Zn2+}+2G_{OH-}-(\Delta G_{sp}+3G_{H2O})=\mathbf{228{,}727}+2*\mathbf{77{,}36}-(\mathbf{143{,}55}+3*\mathbf{0})=\mathbf{239{,}897}$ kJ/mol;

$G_{Zn2+}=\Delta G_{sp}-2G_{OH-}+(G_{Zn(OH)2}+3G_{H2O})=\mathbf{143{,}55}-2*\mathbf{77{,}36}+(\mathbf{239{,}897}+3*\mathbf{0})=\mathbf{228{,}727}$ kJ/mol;

Formation $Zn+1{,}5O_{2g}+C_{graph}=ZnCO_3$;

$\Delta G°=G_{ZnCO3}-(G_{Zn}+1{,}5G_{O2g}+G_{graph})=\mathbf{219{,}267}-(\mathbf{404{,}657}+1{,}5*\mathbf{303{,}1}+\mathbf{91{,}26})=-731{,}3$ kJ/mol;

$G_{ZnCO3}=\Delta G°_{form}+(G_{Zn}+1{,}5G_{O2}^{gas}+G_{H2}^{gas})=-731{,}3+(\mathbf{404{,}657}+1{,}5*\mathbf{303{,}1}+\mathbf{91{,}26})=\mathbf{219{,}267}$ kJ/mol;

[1] Solubility $ZnCO_3+2H_2O=Zn^{2+}+CO_3^{2-}$; $K_{sp}=[Zn^{2+}]*[CO_3^{2-}]/[H_2O]^2=1{,}46*10^{\wedge(-10)}/55{,}3^{\wedge 2}=10^{\wedge(-13{,}321)}$;

Attractor $\Delta\mathbf{G}_{sp}=-RT\ln(\mathbf{K}_{sp})=-8{,}3144*298{,}15*\ln(10^{\wedge(-13{,}321)})=\mathbf{76{,}0358}$ kJ/mol;

$\Delta G_{sp}=G_{Zn2+}+G_{CO32-}-(G_{ZnCO3}+2G_{H2O})=\mathbf{404{,}657}+\mathbf{102{,}5523}-(\mathbf{431{,}1735}+2*\mathbf{0})=\mathbf{76{,}0358}$ kJ/mol;

$G_{ZnCO3}=G_{Zn2+}+G_{CO32-}-(\Delta G_{sp}+2G_{H2O})=\mathbf{404{,}657}+\mathbf{102{,}5523}-(\mathbf{76{,}0358}+2*\mathbf{0})=\mathbf{431{,}1735}$ kJ/mol;

Formation $1{,}5O_{2g}+C_{graph}+\mathbf{2e^-}=CO_3^{2-}$;

$\Delta G°=G_{CO32-}-(1{,}5G_{O2g}+G_{graph}+2G_{e-})=\mathbf{46{,}94}-(1{,}5*\mathbf{303{,}1}+\mathbf{91{,}26}+2*\mathbf{14{,}415})=-527{,}8$ kJ/mol;

$G_{CO32-}=\Delta G°+(1{,}5G_{O2g}+G_{graph}+2G_{e-})=-527{,}8+(1{,}5*\mathbf{303{,}1}+\mathbf{91{,}26}+2*\mathbf{14{,}415})=\mathbf{46{,}94}$ kJ/mol;

Formation $Zn+O_2^{gas}/2+H_2/2=[Zn(OH)]^+$+**e-**; [1]

$\Delta G°=G_{[Zn(OH)]+}+G_{e-}-(G_{Zn}+G_{O2gas}/2+G_{H2}/2)=\mathbf{255{,}285}+\mathbf{13{,}642}-(\mathbf{404{,}657}+\mathbf{303{,}1}/2+\mathbf{85{,}64}/2)=-330{,}1$ kJ/mol;

$G_{e-}=\Delta G°-G_{[Zn(OH)]+}+(G_{Zn}+G_{O2gas}/2+G_{H2}/2)=-330{,}1-\mathbf{255{,}285}+(\mathbf{404{,}657}+\mathbf{303{,}1}/2+\mathbf{85{,}64}/2)=\mathbf{13{,}642}$ kJ/mol;

Acid $[Zn(H_2O)]^{2+}$ protolysis Prigogine atractor $\Delta\mathbf{G}_{eq}=-RT\ln(\mathbf{K}_{eq})$ equilibrium [38] IUPAC.

$[Zn(H_2O)]^{2+}+H_2O=[Zn(OH)]^+$+$H_3O^+$; [38] IUPAC.

$K_{eqZn(H2O)2+}=[[Zn(OH)]^+]*[H_3O^+]^2/[[Zn(H_2O)]^{2+}]/[H_2O]=K_a/[H_2O]=10^{\wedge(-9{,}15)}/55{,}3=10^{\wedge(-10{,}8927)}$;

[38] Attractor $\Delta\mathbf{G}_{sp}=-RT\ln(K_{eqZn(H2O)2+})=-8{,}3144*298{,}15*\ln(10^{\wedge(-10{,}8927)})=\mathbf{62{,}175167}$ kJ/mol;

Hess expression $\Delta G_{prot}=G_{[Zn(OH)]+}+G_{H3O+}-(G_{[Zn(H2O)]2+}+G_{H2O})=\mathbf{255{,}285}+\mathbf{22{,}44}-(\mathbf{215{,}55}+\mathbf{0})=\mathbf{62{,}175167}$ kJ/mol;

$G_{[Zn(OH)]+}=\Delta G_{prot}-G_{H3O+}+(G_{[Zn(H2O)]2+}+G_{H2O})=\mathbf{62{,}175167}-\mathbf{22{,}44}+(\mathbf{215{,}55}+\mathbf{0})=\mathbf{255{,}285}$ kJ/mol;

[18] $Zn(H_2O)^{2+}+OH^-=Zn(OH)^+$+$H_2O$;

Stability constant $\mathbf{K}_{stab\_eq}=ß_1*[H_2O]=[Zn(OH)^+]/[Zn^{2+}]/[OH^-]*[H_2O]=10^{\wedge 5{,}04}*55{,}3=10^{\wedge 6{,}782725}$;

[18] Attractor stability $\Delta\mathbf{G}_{stab\_eq}=-RT\ln(\mathbf{K}_{stab\_eq})=-8{,}3144*298{,}15*\ln(10^{\wedge 6{,}782725})=\mathbf{-38{,}715567}$ kJ/mol;

$\Delta G_{stab\_eq}=G_{[Zn(OH)]+}+G_{H2O}-(G_{[Zn(H2O)]2+}+G_{OH-})=\mathbf{254{,}194}+\mathbf{0}-(\mathbf{215{,}55}+\mathbf{77{,}36})=\mathbf{-38{,}715567}$ kJ/mol;

$G_{[Zn(OH)]+}=\Delta G_{stab\_eq}-G_{H2O}-(G_{[Zn(H2O)]2+}+G_{OH-})=\mathbf{-38{,}715567}-\mathbf{0}+(\mathbf{215{,}55}+\mathbf{77{,}36})=\mathbf{254{,}194}$ kJ/mol;

Hroma savienojumu šķīšanas, protolīzes un reducēšanas-oksidēšanas Prigožina absolūtās enerģijas atraktori.

Metāls hroms $[Cr^{3+}]$=1 M blīvums 1,172 $^{g}/_{mL}$, $Cr_2(SO_4)_3$=392,16 $^{g}/_{mol}$ mola masa,
masa ūdenim $m_{H2O}=m_L-m_{Cr2(SO4)3}$=1172-392,16=779,84 g un $[H_2O]$=779,84 $^{g}/18\ ^{g}/_{mol}$=43,32 M moli litrā.
$Cr+H_2O=Cr^{3+}+3e^-$. Absolūtā summā ir $E°_{Classic}$=-0,744 V [1], ūdens logaritms
-0,0591/3*log(1/([$H_2O$]))=0,03433 un $\Delta E°$:
$E°_{Cr/Cr3+}=E°_{Classic}$-0,0591/3*log(1/[$H_2O$])+$\Delta E°_{Cr}$=-0,744+0,03433+0,10166-0,371339=**-0,979347** V.
$\Delta G_{eq\_Cr}=E°_{Cr}•F•3$=**-0,979347***96485*3=**-283,5** $^{kJ}/_{mol}$,
$\Delta G_{eq\_Cr\_Cr3+}=G_{Cr3+}+3G_{e-}-(G_{Cr}+G_{H2O})$=**18,3**+3***0**-(**301,8**+0)=**-283,5** $^{kJ}/_{mol}$ ;
$G_{Cr3+}=\Delta G_{eq\_CR}+(G_{Cr}+G_{H2O})$=**-283,5**-3***0**+(**301,8**+0)=**18,3** $^{kJ}/_{mol}$;
$3G_{e-}=\Delta G_{eq\_CR}-G_{Cr3+}+(G_{Cr}+G_{H2O})$=(**-283,5**)-**18,3**+(**301,8**+0)=3***0** $^{kJ}/_{mol}$ ;
$E_{Cr}=E°_{Cr}$+0,0591/3*log([$Cr^{3+}$]/[Cr]/([$H_2O$]))=**-0,9793**+0,0591/3*log(1/1/55,3)=-1,0136 V; Atšķirība -1,0136 V
$[Cr^{3+}]$=1 M; ir trešajā ciparā -1,00208 V $[Cr^{3+}]$=2,32 M. Šķīdība 64 $^{g}/_{100g}$; w%=64/164*100=39,2 %;
39,2/100=X/1172/; 39,2/100*1172=459,4 $^{g}/_{L}$; $C_{Cr2(SO4)3}$=459,4/392,16*2=2,343 M;
$m_{H2O}=m_L-m_{Cr2(SO4)3}$=??1172??-459,4=712,6 g; $m_{Cr2(SO4)3}$=459,4 g; [$H_2O$]=714,93 $^{g}/18\ ^{g}/_{mol}$=39,59 M;
$E_{Cr}=E°_{Cr}$+0.0591/3*log([$Cr^{3+}$]/([Cr]-([$H_2O$]-6*[$Cr^{3+}$]))=
=**-0.9793**+0.0591/3*log(2.343/1/(39.59-6*1))=-1.002 V;

| *Viela* | $\Delta H°_H$ $^{kJ}/_{mol}$ | $\Delta S°_H$ $^{J}/_{mol/K}$ | $\Delta G°_H$ , $^{kJ}/_{mol}$ |
|---|---|---|---|
| $G_e$ Cr | [1] $Cr_2O_7^{2-}$ | **28,76975** | **332,515** |
| Cr | 308,90 | 23,8 | **301,8** |
| Cr assume | zero $G_{Cr2O3}$=0 $^{kJ}/_{mol}$ | | **301,8** |
| $Cr^{2+}$ | -143,5 | **-1,13118** | **83,516** |
| $Cr^{2+}$ $G_{e-}$ | -143,5 | formation | **37,392** |
| $Cr^{3+}$ | $E°_{Cr/Cr3+}$= | **-0,9793** V | **18,3** |
| $Cr(OH)_{2(s)}$ | [33] $K_{sp}$ | $=10^{-20,927}$ | **118,785** |
| $Cr(OH)_{3s}$ | [33] $K_{sp}$ | $=10^{-30,2)}$ | **38,206** |
| $Cr(OH)_3$ | $E°_{Cr(OH)3/Cr}$ | **-1,7497** V | **27,43** |
| $Cr(OH)_{3aq}$ | [18] $K_{stab}$ | $9,352*10^{30}$ | **73,599** |
| [33]$HCrO_2$ | $K_{prot}$= | 10^(-4,92318) | **191,014** |
| [1] $CrO_2^-$ | $E°_{CrO2-/Cr}$= | **-1,53834V** | **196,675** |
| $Cr(OH)_4^-$ | [33] $K_{eq\_for}$ | $=10^{36,874}$ | **117,264** |
| [1] $CrO_2$ | $E°_{CrO2}$= | **2,03428** V | **124,818** |
| [1]$H_2CrO_4$ | $pK_a$=0,74 | =0,00329 | **291,509** |
| $HCrO_4^-$ | [1]$E°_{Cr6+3+}$= | **1,45797** V | **283,24** |
| $G_{e-}HCrO_4^-$ | formation | -736,35 | **68,76975** |
| $CrO_4^{2-}$ | -881,2 | 50,2 | -727,8 |
| $2G_{e-}CrO_4^{2-}$ | formation | -727,8 | **68,76975** |
| [1] $CrO_4^{2-}$ | $pK_{a2}$=6,49 | $K_e=10^{-8,232}$ | **317,7395** |
| [1] $CrO_4^{2-}$ | $E°_{Cr(OH)3/Cr3+}$= | **-0,53701**V | **269,57** |
| $Cr_2O_7^{2-}$ | -1490,3 | 261,9 | -1301,1 |
| $Cr_2O_7^{2-}$ | $2G_{e-}$-formati | -1301,1 | **68,76975** |
| $Cr_2O_7^{2-}$ | formation | -1301,1 | **544,83** |
| [1] $Cr_2O_7^{2-}$ | $K_D$*[$H_2O$] | =6204,76 | **562,32** |
| $HCr_2O_7^-$ | $K_a$/[$H_2O$]= | 0,0002866 | **564,538** |
| $CrCl_{2(s)}$ | -395,4 | 115,3 | -356,0 |
| $CrCl_{2(s)}$ | -395,4 | 115,3 | -356,0 |
| $CrCl_{3(s)}$ | -556,5 | 123,0 | -486,1 |
| $CrCl_{3(s)}$ | -556,5 | 123,0 | -486,1 |
| $Cr_2O_3$ | -1139,7 | 81,2 | -1058,1 |
| Cr assum | formation | -1058,1 | **301,8** |
| $Cr_2O_3$ | $G_{Cr2O3}$ | =0 $^{kJ}/_{mol}$ | **0** |
| $H_2O$ | -285,85 | 69,9565 | -237,191 |
| $OH^-$ | $K_{eq1}$=3,26• | 10^(-18) | **77,36** |
| $OH^-$ | -230 | -10,8 | -157,2 |

$G_{O2}^{gas}$=**303,1** $^{kJ}/_{mol}$; $G_{H2}^{gas}$=**85,64** $^{kJ}/_{mol}$; $G_{Cgraph}$=**91,26** $^{kJ}/_{mol}$;
[1] $2G_{Cr}=G_{Cr2O72-}-(3,5G_{O2g}+\Delta G°_{C2rO72-}+2G_{e-})$=2***332,515** $^{kJ}/_{mol}$;
[1] $\Delta H_H=\Delta G_{Cl-}+T*\Delta S_H$=**301,8**+298,15*0,0238=308,90 $^{кэ}/_{μоλ}$;
$G_{Cr}=(G_{Cr2O3}-\Delta G°_{Cr2O3}-1,5G_{O2g})/2$=**301,8** $^{kJ}/_{mol}$;
$G_{Cr2+}=\Delta G_{eq\_CR}-2G_{e-}+(G_{Cr}+G_{H2O})$=**83,516** $^{kJ}/_{mol}$;
$2G_{e-}=\Delta G°-G_{Cr2+}+(G_{Cr})$=-143,5=2***37,392**=-143,5= **29,892** $^{kJ}/_{mol}$;
$G_{Cr3+}=\Delta G_{eq\_CR}+(G_{Cr}+G_{H2O})$=**-283,5**+(**301,8**+0)=**18,3** $^{kJ}/_{mol}$;
$G_{Cr(OH)2(s)}=G_{Cr2+}+2G_{OH}-(\Delta G_{eq}+3G_{H2O})$=**118,785** $^{kJ}/_{mol}$;
[33] $G_{Cr(OH)3(s)}=G_{Cr3+}+3G_{OH}-(\ \Delta G_{eq}+4G_{H2O})$=**38,206** $^{kJ}/_{mol}$;
[1] $G_{Cr(OH)3}=\Delta G°_{eq}-3G_{e-}+(Cr+3G_{OH})$=**27,43** $^{kJ}/_{mol}$;;
$G_{Cr(OH)3aq}=\Delta G_{eq}-4G_{H2O}+(G_{Cr3+}+3G_{OH-})$=**73,599** $^{kJ}/_{mol}$;
$G_{HCrO2}=G_{CrO2-}+G_{H3O}-(\Delta G_{eq}+G_{H2O})$=**191,014** $^{kJ}/_{mol}$;
$G_{Cr(O2-Cr}=\Delta G°_{eq}-3G_{e-}+2G_{H2O}+(G_{Cr}+4G_{OH})$=**196,675** $^{kJ}/_{mol}$;
$G_{Cr(OH)4-}=\Delta G_{eq}-4G_{H2O}+(G_{Cr3+(H2O)4}+4G_{OH-})$=**117,264** $^{kJ}/_{mol}$;
$G_{CrO2}=\Delta G_{eq}-4G_{H3O}-G_{e-}-(G_{Cr3+}+8G_{H2O})$=**124,818** $^{kJ}/_{mol}$;
$G_{H2CrO4}=G_{HCrO4-}+G_{H3O}-(\Delta G_{eq}+G_{H2O})$=**291,509** $^{kJ}/_{mol}$ ;
$G_{HCrO4}=\Delta G_{eq\_Cr3+/6+}$ -7$G_{H3O}$-$3G_{e-}$+($G_{Cr3+}$+11$G_{H2O}$)=**283,24** $^{kJ}/_{mol}$;
$\Delta G°_{HCrO4-}=G_{HCrO4-}-(0,5G_{H2}+2G_{O2g}+G_{Cr}+G_{e-})$=-736,34975 $^{kJ}/_{mol}$;
[1] $\Delta G_H=\Delta H_H-T*\Delta S_H$=-881,2-298,15*0,0502=-896,167 $^{кэ}/_{μоλ}$;
[1] $2G_{e-}=G_{CrO42-}-(G_{Cr}+\Delta G°+2G_{O2g})$=2***68,76975** $^{kJ}/_{mol}$;
$G_{CrO42-}=\Delta G_{eq}-G_{H3O}+(G_{HCrO4}+G_{H2O})$=**317,7395** $^{kJ}/_{mol}$;
$G_{CrO42-}=Z\Delta G_{eqCrO42-OH}$--4$G_{H2O}$-**0**-($G_{Cr(OH)3}$+5$G_{OH}$)=**269,57** $^{kJ}/_{mol}$;
[1] $\Delta G_H=\Delta H_H-T*\Delta S_H$=-1490,3-298,15*0,2619=-1568,385 $^{кэ}/_{μоλ}$;
[1]; $2G_{e-}=G_{Cr2O72-}-(3,5G_{O2g}+2G_{Cr}+\Delta G°_{Cr2O72-})$=2***68,76975** $^{kJ}/_{mol}$;
$G_{Cr2O7}=\Delta G_D-G_{H2O}+(2G_{HCrO4})$=**-21,64875**-0+(2***283,24**)=**544,83** $^{kJ}/_{mol}$ ;
$G_{Cr2O72}=\Delta G_{eq\_CR}$-14$G_{H3O}$-$6G_{e-}$+(2$G_{Cr3+}$+21$G_{H2O}$)=**562,32** $^{kJ}/_{mol}$;
$G_{HCr2O7-}=G_{Cr2O7}+G_{H3O}-(\Delta G_{eq}+G_{H2O})$=**564,538** $^{kJ}/_{mol}$;
[1]
[1]
[1]
[1]
[1] Formation $\Delta G°_{Cr2O3}=G_{Cr2O3}-(1,5G_{O2g}+2G_{Cr})$=-1058,1 $^{kJ}/_{mol}$;
$G_{Cr}=(G_{Cr2O3}-\Delta G°_{Cr2O3}-(1,5G_{O2g}))/2$=**301,8** $^{kJ}/_{mol}$;
$G_{Cr2O3}=\Delta G°_{Cr2O3}+1,5G_{O2g}+2G_{Cr}$=**0** $^{kJ}/_{mol}$;
Protolīze $\Delta G_{eq}=G_{H3O+}+G_{OH-}$=**-22,44**+**77,36**=99,8 $^{kJ}/_{mol}$;
$G_{OH-}=\Delta G_{eq}-G_{H3O+}$=99,8-**-22,44**=**77,36** $^{kJ}/_{mol}$;
CRC [1] $\Delta G°_{OH-}=\Delta H-T*\Delta S$=-230-298.15*-0.0109=-226.75 $^{kJ}/_{mol}$;

$Cr+H_2O=Cr^{2+}+2e^-$, The absolute standard has $E°_{classic}$=-0,913 V [1], water -0,0591/3*log(1/(55,3)=0,03433, sum $\Delta E°$: $E°_{Cr/Cr2+}=E°_{Classic}$-0,0591/2*log(1/[$H_2O$])+$\Delta E°_{Cr}$=-0,913+0,0515+0,10166-0,371339=**-1,1311815** V.

$\Delta G_{eq\_Cr}=E°_{Cr}•F•2$=**-1,1311815***96485*2=**-218,284** kJ/mol,

$\Delta G_{eq\_CR}=G_{Cr2+}+2G_{e-}-(G_{Cr}+G_{H2O})$=**83,516**+2***0**-(**301,8**+0)=**-218,284** kJ/mol ;

$G_{Cr2+}=\Delta G_{eq\_CR}-2G_{e-}+(G_{Cr}+G_{H2O})$=**-218,284**-2***0**+(**301,8**+0)=**83,516** kJ/mol ;

$2G_{e-}=\Delta G_{eq\_CR}-G_{Cr2+}+(G_{Cr}+G_{H2O})$=**-218,284-83,516**+(**301,8**+0)=2***0** kJ/mol ;

[1] Formation $Cr=Cr^{2+}+2e^-$, $\Delta G°=G_{Cr2+}+2G_{e-}-(G_{Cr})$=**83,516**+2* $G_{e-}$ -(**301,8**)=-143,5 kJ/mol ;

$2G_{e-}=\Delta G°-G_{Cr2+}+(G_{Cr})$=-143,5-**83,516**+(**301,8**)=2***37,392** kJ/mol ;

$G_{Cr2+}=\Delta G°-2G_{e-}+(G_{Cr})$=-143,5-2***37,392**+(**301,8**)=**83,516** kJ/mol ;

$Cr^{2+}=Cr^{3+}+e^-$. Absolūtā summā ir $E°_{Classic}$=-0,407 V [1], nulle ūdens logaritms -0,0591/3*log(1)=0,0 un $\Delta E°$:

$E°_{Cr/Cr3+}=E°_{Classic}$-0,0591/1*log(1)+$\Delta E°_{Cr}$=-0,407+0,0+0,10166-0,371339=**-0,67668** V.

$\Delta G_{eq\_Cr2+Cr3+}=E°_{Cr2+Cr3+}•F•1$= **=-0,676679***96485*1=**-65,2894** kJ/mol,

$G_{e-}=\Delta G_{eq\_Cr2+Cr3+}-G_{Cr3+}+(G_{Cr2+})$=**-65,2894-18,3**+(**83,516**+0)=**-0,0734** kJ/mol ;

$Cr^{3+}+11H_2O=HCrO_4^-+7H_3O^++3e^-$. Absolūtā summā ir $E°_{Classic}$=1,350 V [1],

-0,0591/3*log(1/([$H_2O$]^^11))= 0,37765 ūdens logaritms un $\Delta E°$:

$E°_{Cr3+/HCrO4}=E°_{Classic}$-0,0591/3*log(1/([$H_2O$]^^11))+$\Delta E°_{Cr}$=

=1,350-0,0591/3*log(1/(55,3^^11))+0,10166-0,371339=**1,45797** V.

$\Delta G_{eq\_Cr3+/HCrO4}=E°_{Cr2+Cr3+}•F•3$=**1,45797** *96485*3=**422,0167** kJ/mol,

$\Delta G_{eq\_Cr3+/HCrO4}=G_{HCrO4}+7G_{H3O}+3G_{e-}-(G_{Cr3+}+11G_{H2O})$=**283,24**+7***22**,44+3***0**-(**18,3**+11***0**)=**422,02** kJ/mol,

$G_{HCrO4}=\Delta G_{eq\_Cr3+/HCrO4}-7G_{H3O}-3G_{e-}+(G_{Cr3+}+11G_{H2O})$=**422,02**-7***22**,44-3***0**+(**18,3**+11***0**)=**283,24** kJ/mol,

$3G_{e-}=\Delta G_{eq\_Cr3+/HCrO4}-G_{HCrO4}-7G_{H3O}++(G_{Cr3+}+11G_{H2O})$=**422,02-283,24**-7***22**,44-3***0**+(**18,3**+11***0**)=3***0** kJ/mol,

$Cr+3OH^-=\underline{Cr(OH)_3}+3e^-$; pH>9 ; Absolute standard has $E°_{classic}$=-1,48 V [1], water 0,137327, sum $\Delta E°$:

$E°_{\underline{Cr(OH)3}/Cr}=E°_{Classic}$-0,0591/3*log(1)+$\Delta E°$=-1,48+0,0+0,10166-0,371339=**-1,74968** V.

$\Delta G_{eq}=E°_{Cr3/\underline{OH}}•F•3$=**-1,74968***96485*3=**-506,45** kJ/mol,

$\Delta G°_{\underline{eq}}=G_{Cr(\underline{OH}3}+3G_{e-}+(Cr+3G_{OH})$=**27,43**+3***0**-(**301,8**+3***77,36**)=**-506,45** kJ/mol;

$G_{Cr(\underline{OH}3}=\Delta G°_{\underline{eq}}-3G_{e-}+(Cr+3G_{OH})$=**-506,45**-3***0**+(**301,8**+3***77,36**)=**27,43** kJ/mol;

$Cr+4OH^-=CrO_2^-+2H_2O+3e^-$; pH>9 ; Absolute standard has $E°_{classic}$=-1,2 V [1], water -0,06866, sum $\Delta E°$:

$E°_{\underline{CrO2-}/Cr}=E°_{Classic}$-0,0591/3*log([$H_2O$]^2)+$\Delta E°$=-1,2-0,0591/3*log(55,3^^2)+0,10166-0,371339=**-1,53834** V.

$\Delta G_{eq}=E°_{Cr/\underline{O2-Cr}}•F•3$=**-1,53834***96485*3= **-445,28** kJ/mol,

$\Delta G°_{\underline{eq}}=G_{Cr\underline{O2-Cr}}+3G_{e-}+2G_{H2O}-(G_{Cr}+4G_{OH})$=**165,96**+3***0**+2***0**-(**301,8**+4***77,36**)=**-445,28** kJ/mol;

$G_{Cr\underline{O2-Cr}}=\Delta G°_{\underline{eq}}-3G_{e-}+2G_{H2O}+(G_{Cr}+4G_{OH})$=**-445,28**-3***0**-2***0**+(**301,8**+4***77,36**)=**165,96** kJ/mol;

$\Delta G°_{\underline{eq}}=G_{Cr\underline{O2-Cr}}+3G_{e-}+2G_{H2O}-(G_{Cr}+4G_{OH})$=**196,675**+3***0**+2***0**-(**332,515**+4***77,36**)=**-445,28** kJ/mol;

$G_{Cr\underline{O2-Cr}}=\Delta G°_{\underline{eq}}-3G_{e-}+2G_{H2O}+(G_{Cr}+4G_{OH})$=**-445,28**-3***0**-2***0**+(**332,515**+4***77,36**)=**196,675** kJ/mol;

$G_{Cr}=G_{Cr\underline{O2-Cr}}+3G_{e-}+2G_{H2O}-(\Delta G°_{\underline{eq}}+4G_{OH})$=**196,675**+3***0**+2***0**-(**-445,28**+4***77,36**)=**332,515** kJ/mol;

$\underline{Cr(OH)_3}+5OH^-=CrO_4^{2-}+4H_2O+3e^-$; pH>9 ; Absolute standard has $E°_{classic}$=-0,13 V [1], water -0,137326, sum $\Delta E°$:

$E°_{\underline{Cr(OH)3}/Cr3+}=E°_{Classic}$-0,0591/3*log([$H_2O$]^4)+$\Delta E°$=-0,13-0,0591/3*log(55,3^^4)+0,10166-0,371339=**-0,53701** V.

$\Delta G_{eq}=E°_{Cr3/\underline{OH}}•F•3$=**-0,5370057***96485*3=**-155,44** kJ/mol,

$\Delta G_{eq}CrO42-\underline{OH}=G_{CrO42-}+4G_{H2O}+3G_{e-}-(G_{Cr(\underline{OH}3}+5G_{OH})=G_{CrO42-}$+4***0**+3***0**-(**38,206**+5***77,36**)=**-155,44** kJ/mol,

$G_{CrO42-}=\Delta G_{eq}CrO42-\underline{OH}$--4$G_{H2O}$-3$G_{e-}$-($G_{Cr(\underline{OH}3}$+5$G_{OH}$)=**-155,44**-4***0**-3***0**+(**38,206**+5***77,36**)=**269,566** kJ/mol,

$\Delta G_{eq}CrO42-\underline{OH}=G_{CrO42-}+4G_{H2O}+3G_{e-}-(G_{Cr(\underline{OH}3}+5G_{OH})=G_{CrO42-}$+4***0**+3***0**-(**27,43**+5***77,36**)=**-155,44** kJ/mol,

$\Delta G_{eq}CrO42-\underline{OH}=G_{CrO42-}+4G_{H2O}+3G_{e-}-(G_{Cr(\underline{OH}3}+5G_{OH})$=**-155,44**-4***0**-3***0**+(**27,43**+5***77,36**)=**258,79** kJ/mol,

$Cr^{3+}+8H_2O=CrO_2+4H_3O^++e^-$; Absolute standard has $E°_{classic}$=1,48 V [1], water 0,82396, sum $\Delta E°$:

$E°_{CrO2}=E°_{Classic}$-0,0591/1*log(1/[$H_2O$]^8)+$\Delta E°$=1,48-0,0591/1*log(1/55,3^^8)+0,10166-0,371339=**2,034281** V.

$\Delta G_{eq}=E°_{CrO2}•F•3$=**2,034281***96485*1=**196,278** kJ/mol,

$\Delta G_{eq}=G_{CrO2}+4G_{H3O}+G_{e-}-(G_{Cr3+}+8G_{H2O})$=**124,818**+4***22,44**+**0**-(**18,3**+8*0)=**196,278** kJ/mol ;

$G_{CrO2}=\Delta G_{eq}-4G_{H3O}-G_{e-}-(G_{Cr3+}+8G_{H2O})$=**196,278**-4***22,44**-**0**+(**18,3**+8*0)=**124,818** kJ/mol ;

$2Cr^{3+}+21H_2O=Cr_2O_7^{2-}+14H_3O^{+}+6e^{-}$; Absolute standard has $E°_{classic}$=1,36 V [1], water 0,3604827, sum ΔE°:
$E°_{Cr2O72-/Cr3+}=E°_{Classic}$-0,0591/6*log(1/$[H_2O]^{21}$)+ΔE°=1,36+0,3604827+0,10166-0,371339=**1,450804** V.

$$\Delta G_{eq}=E°_{Cr2O72-/Cr3+}\bullet F\bullet 6=\mathbf{1,450804}*96485*6=\mathbf{839,88}\ ^{kJ}/_{mol},$$

$$\Delta G_{eq\_CR}=G_{Cr2O72}+14G_{H3O}+6G_{e^-}-(2G_{Cr3+}+21G_{H2O})=\mathbf{562,32}+14*\mathbf{22,44}+6*\mathbf{0}-(2*\mathbf{18,3}+21*0)=\mathbf{839,88}\ ^{kJ}/_{mol};$$

$$G_{Cr2O72}=\Delta G_{eq\_CR}-14G_{H3O}-6G_{e^-}+(2G_{Cr3+}+21G_{H2O})=\mathbf{839,88}-14*\mathbf{22,44}+6*\mathbf{0}+(2*\mathbf{18,3}+21*0)=\mathbf{562,32}\ ^{kJ}/_{mol};$$

/wiki/Chromium(III)_chloride Solubility $[[CrCl_2(H_2O)_4]Cl\bullet 2H_2O]_{(s)}+2[H_2O]=[CrCl_2(H_2O)_4]^{+}+[Cl^{-}\bullet 2H_2O]^{-}$;
$M(CrCl_3\bullet(H_2O)_6)$=158,36+6*18,02=158,36+108,12=266,48 $^{g}/_{mol}$ mas 347,65+237,35=585 $^{g}/_{1000\ mL\ H2O}$.
108,12/266,48=X/585; 108,12/266,48*585=X=237,35mL; $[H_2O]$=(1000+237,35)/18,02=68,665 mol 1237,35 mL
347,65/1237,35=X/1000; 347,65/1237,35*1000=280,96g/1000 g. w%=280,96/(280,96+1000)*100=22,696%;
$[CrCl_2(H_2O)_4]Cl\bullet 2H_2O$=280,96/158,36=1,774 M=$[Cr^{3+}]=[Cl^{-}\bullet 2H_2O]$ m=280,96+1000=1280,96 g=? volume
$[H_2O]$=(1000/18,02)=55,494 M ; $[H_2O]$=55,494-4*1,774-2*1,774=44,85 M in 1000

$[[CrCl_2(H_2O)_4]Cl\bullet 2H_2O]_{(s)}+2[H_2O]=[CrCl_2(H_2O)_4]^{+}+[Cl^{-}\bullet 2H_2O]^{-}$; mol fraction constant unit less :

$K_{sp\_eq}=[[CrCl_2(H_2O)_4]^{+}]*[[Cl^{-}\bullet 2H_2O]^{-}]/[[[CrCl_2(H_2O)_4]Cl\bullet 2H_2O]_{(s)}]/[H_2O]^2$=1,774^2/1/44,85^2=0,0015645;
Sum for mol fraction $[[CrCl_2(H_2O)_4]^{+}]+[Cl^{-}\bullet 2H_2O]+[H_2O]$=1,774+1,774+44,85=48,398 M;

$$\Delta G_{eq}=\mathbf{-R\bullet T}\bullet\ln(K_{eq})=-8,3144*298,15*\ln(0,0015645)=\mathbf{16,0144}\ ^{kJ}/_{mol}.$$

$$\Delta G_{eq}=G_{[CrCl2(H2O)4]+}+G_{[Cl-\bullet 2H2O]-}-(G_{[[CrCl2(H2O)4]Cl\bullet 2H2O](s)}+2G_{H2O})=\mathbf{16,0144}\ ^{kJ}/_{mol};$$

$$\Delta G_{eq}=G_{[CrCl2(H2O)4]+}+G_{[Cl-\bullet 2H2O]-}-(G_{[[CrCl2(H2O)4]Cl\bullet 2H2O](s)}+2G_{H2O})=\mathbf{16,0144}\ ^{kJ}/_{mol};$$

Formation $\Delta G°_{CrCl3}=G_{CrCl3}-(G_{Cr}+1,5G_{Cl2})=G_{CrCl3}-(\mathbf{301,8}+1,5*G_{Cl2})$=-486,1 $^{kJ}/_{mol}$;

$$\Delta G°_{CrCl3}=G_{CrCl3}-(G_{Cr}+1,5G_{Cl2})=G_{CrCl3}-(\mathbf{301,8}+1,5*G_{Cl2})=-486,1\ ^{kJ}/_{mol};$$

$[[CrCl_2(H_2O)_4]Cl\bullet 2]_{(s)}$=1, $[Cr^{3+}]$=1,774 M, $[Cl^{-}\bullet 2H_2O]$=1,774 M, $[H_2O]$=44,85 M

[33] Solubility $[Cr^{3+}(H_2O)_3(OH)_3]_{(s)}+4H_2O=[Cr^{3+}(H_2O)_6]+3OH$; $K_{sp}=10^{\wedge(-30,2)}$;

$$K_{eq}=K_{sp}/[H_2O]^4=6,3*10^{\wedge(-31)}/55,3^{\wedge}4=10^{\wedge(-37,17155)};$$

$$\Delta G_{eq}=\mathbf{-R\bullet T}\bullet\ln(K_{eq})=-8,3144*298,15*\ln(10^{\wedge(-37,17155)})=\mathbf{212,174}\ ^{kJ}/_{mol}.$$

$$\Delta G_{eq}=G_{Cr3+}+3\mathbf{G}_{OH-}-(G_{Cr(OH)3(s)}+\mathbf{4G_{H2O}})=G_{Cr3+}+3*\mathbf{77,36}-(G_{Cr(OH)3(s)}+*4*0)=\mathbf{212,174}\ ^{kJ}/_{mol};$$

$$G_{Cr(OH)3(s)}=G_{Cr3+}+3\mathbf{G}_{OH-}-(\Delta\mathbf{G_{eq}}+\mathbf{4G_{H2O}})=\mathbf{18,3}+3*\mathbf{77,36}-(\mathbf{212,174}+4*0)=\mathbf{38,206}\ ^{kJ}/_{mol};$$

[18] Stability $Cr^{3+}+3OH=Cr(OH)_3+4H_2O$;
$K_{stab}=ß3*[H_2O]^4=[Cr(OH)_3]/([Cr^{3+}]/[OH^{-}]^3)*[H_2O]^4=10^{\wedge}24*55,3^{\wedge}4=9,3519*10^{\wedge}30$ $10^{\wedge}24$ [I]=0; $10^{\wedge}22$ [I]=1 M;

$$\Delta G_{eq}=\mathbf{-R\bullet T}\bullet\ln(K_{stab})=-8,3144*298,15*\ln(9,3519*10^{\wedge}30)=\mathbf{-176,7807}\ ^{kJ}/_{mol}.$$

$$\Delta G_{eq}=G_{Cr(OH)3aq}+4\mathbf{G_{H2O}}-(G_{Cr3+}+3\mathbf{G}_{OH-})=\mathbf{73,599}+4*0-(\mathbf{18,3}+3*\mathbf{77,36})=\mathbf{-176,7807}\ ^{kJ}/_{mol};$$

$$G_{Cr(OH)3aq}=\Delta\mathbf{G_{eq}}-4\mathbf{G_{H2O}}+(G_{Cr3+}+3\mathbf{G}_{OH-})=\mathbf{-176,7807}-4*0+(\mathbf{18,3}+3*\mathbf{77,36})=\mathbf{73,599}\ ^{kJ}/_{mol};$$

[33] Complex formation $[Cr^{3+}]+EDTA=[Cr(EDTA)]+H_2O$; $K_{eq}=K_f*[H_2O]=1*10^{\wedge}23*55,3=5,53*10^{\wedge}24$;

$$\Delta G_{eq}=\mathbf{-R\bullet T}\bullet\ln(K_{eq})=-8,3144*298,15*\ln(5,53*10^{\wedge}24)=\mathbf{-141,23}\ ^{kJ}/_{mol}.$$

[18] Complex formation $[Cr^{3+}]+EDTA=[Cr(EDTA)]+H_2O$; $K_{eq}=K_f*[H_2O]=10^{\wedge}23,4*55,3=1,389*10^{\wedge}25$;

$$\Delta G_{eq}=\mathbf{-R\bullet T}\bullet\ln(K_{eq})=-8,3144*298,15*\ln(1,389*10^{\wedge}25)=\mathbf{-143,5137}\ ^{kJ}/_{mol},$$

[33] Complex formation $[Cr^{3+}(H_2O)_4]+4OH=[Cr(OH)_4]+4H_2O$;

$$K_{eq\_for}=K_{for}*[H_2O]^{\wedge}4=8*10^{\wedge}29*55,3^{\wedge}4=10^{\wedge}36,874;$$

$$\Delta G_{eq}=\mathbf{-R\bullet T}\bullet\ln(K_{eq\_for})=-8,3144*298,15*\ln(10^{\wedge}36,874)=\mathbf{-210,476}\ ^{kJ}/_{mol}.$$

$$\Delta G_{eq}=G_{Cr(OH)4-}+4\mathbf{G_{H2O}}-(G_{Cr3+(H2O)4}+4\mathbf{G}_{OH-})=\mathbf{117,264}+4*0-(\mathbf{18,3}+4*\mathbf{77,36})=\mathbf{-210,476}\ ^{kJ}/_{mol};$$

$$G_{Cr(OH)4-}=\Delta\mathbf{G_{eq}}-4\mathbf{G_{H2O}}+(G_{Cr3+(H2O)4}+4\mathbf{G}_{OH-})=\mathbf{-210,476}-4*0+(\mathbf{18,3}+4*\mathbf{77,36})=\mathbf{117,264}\ ^{kJ}/_{mol};$$

[33] Solubility $Cr(OH)_{2(s)}+3H_2O=Cr^{2+}+2OH^{-}$; $K_{sp}=[Cr^{2+}]*[OH^{-}]^2/[Cr(OH)_{3(s)}]=2*10^{-16}$; $^{-20,927}$

$$K_{eq}=K_{sp}/[H_2O]^3=[Cr^{2+}]*[OH^{-}]^2/[Cr(OH)_{2(s)}]/[H_2O]^3=2*10^{\wedge(-16)}/55,3^{\wedge}3=1,18264555*10^{\wedge(-21)}=10^{\wedge(-20,927)};$$

$$\Delta G_{eq}=\mathbf{-R\bullet T}\bullet\ln(\mathbf{K}_{eq})=-8,3144*298,15*\ln(10^{\wedge(-20,927)})=\mathbf{119,451}\ ^{kJ}/_{mol}.$$

$$\Delta G_{eq}=G_{Cr2+}+2\mathbf{G}_{OH-}-(G_{Cr(OH)2(s)}+3\mathbf{G_{H2O}})=\mathbf{83,516}+2*\mathbf{77,36}-(\mathbf{118,785}+3*0)=\mathbf{119,451}\ ^{kJ}/_{mol};$$

$$G_{Cr(OH)2(s)}=G_{Cr2+}+2\mathbf{G}_{OH-}-(\Delta\mathbf{G_{eq}}+3\mathbf{G_{H2O}})=\mathbf{83,516}+2*\mathbf{77,36}-(\mathbf{119,451}+3*0)=\mathbf{118,785}\ ^{kJ}/_{mol};$$

[1] Formation $2Cr+1,5O_2=Cr_2O_3$; $\Delta\mathbf{G°}_{Cr2O3}=G_{Cr2\mathbf{O3}}-(1,5G_{\mathbf{O2}g}+2G_{Cr})=0-(1,5*\mathbf{303}+2G_{Cr})$=-1058,1 $^{kJ}/_{mol}$;

$$G_{Cr}=(G_{Cr2\mathbf{O3}}-\Delta\mathbf{G°}_{Cr2O3}-(1,5G_{\mathbf{O2}g}))/2=(0+1058,1+(1,5*\mathbf{303}))/2=\mathbf{301,8}\ ^{kJ}/_{mol};$$

$$G_{Cr2\mathbf{O3}}=\Delta\mathbf{G°}_{Cr2O3}+1,5G_{\mathbf{O2}g}+2G_{Cr})=1058,1-1,5*\mathbf{303}-2*\mathbf{301,8})=0\ ^{kJ}/_{mol};$$

[1] Formation $Cr+2O_2+2\mathbf{e}^{-}=CrO_4^{2-}$;

$$\Delta\mathbf{G°}=G_{CrO42-}-(G_{Cr}+2G_{e^-}+2G_{\mathbf{O2}g})=\mathbf{317,7395}-(\mathbf{301,8}+2*\mathbf{68,76975}+2*\mathbf{303,1})=-727,8\ ^{kJ}/_{mol};$$

$$2G_{e^-}=G_{CrO42-}-(G_{Cr}+\Delta\mathbf{G°}+2G_{\mathbf{O2}g})=\mathbf{317,7395}-(\mathbf{301,8}-727,8+2*\mathbf{303,1})=2*\mathbf{68,76975}=\mathbf{137,5395}\ ^{kJ}/_{mol};$$

[1] Formation $0,5H_2+2O_2+Cr+\mathbf{e}^{-}=HCrO_4^{-}$;

$\Delta\mathbf{G°}_{HCrO4-}=G_{HCrO4-}-(0,5G_{H2}+2G_{\mathbf{O2}g}+G_{Cr}+G_{e^-})=\mathbf{283,24}-(0,5*\mathbf{85,64}+2*\mathbf{303,1}+\mathbf{301,8}+\mathbf{68,76975})$=-736,34975 $^{kJ}/_{mol}$;

$G_{e^-}=G_{HCrO4-}-(0,5G_{H2}+2G_{\mathbf{O2}g}+G_{Cr}+\Delta\mathbf{G°}_{HCrO4-})=\mathbf{283,24}-(0,5*\mathbf{85,64}+2*\mathbf{303,1}+\mathbf{301,8}-736,34975)=\mathbf{68,76975}\ ^{kJ}/_{mol}$;

[1] Formation $H_2+2O_2+Cr=H_2CrO_4$;

$\Delta G^o_{H2CrO4}=G_{H2CrO4}-(G_{H2}+2G_{O2g}+G_{Cr})=\mathbf{291,509}-(\mathbf{85,64}+2*\mathbf{303,1}+G_{Cr})=-727,8$ kJ/mol;

$\Delta G^o_{H2CrO4}=G_{H2CrO4}-(G_{H2}+2G_{O2g}+G_{Cr})=\mathbf{291,509}-(\mathbf{85,64}+2*\mathbf{303,1}+G_{Cr})=-727,8$ kJ/mol;

[1] Formation $3,5O_2+2Cr+2e^-=Cr_2O_7^{2-}$;

$\Delta G^o_{Cr2O72-}=G_{Cr2O72-}-(3,5G_{O2g}+2G_{Cr}+2G_{e-})=\mathbf{562,32}-(3,5*\mathbf{303,1}+2*\mathbf{332,515}+2*\mathbf{68,76975})=-1301,1$ kJ/mol;

$2G_{Cr}=G_{Cr2O72-}-(3,5G_{O2g}+\Delta G^o_{C2rO72-}+2G_{e-})=\mathbf{562,32}-(3,5*\mathbf{303,1}-1301,1+2*\mathbf{68,76975}=2*\mathbf{332,515}=\mathbf{665,0305}$ kJ/mol;

$2G_{e-}=G_{Cr2O72-}-(3,5G_{O2g}+2G_{Cr}+\Delta G^o_{Cr2O72-})=\mathbf{562,32}-(3,5*\mathbf{303,1}+2*\mathbf{332,515}-1301,1)=2*\mathbf{68,76975}$ kJ/mol;

[1] Protolysis $pK_a=0,74$; $H_2CrO_4+H_2O=HCrO_4^-+H_3O^+$; $K_{eq}=K_a/[H_2O]=10^{(-0,74)/55,3}=0,003290598$ ;

$\Delta G_{eq}=-R\bullet T\bullet\ln(K_a/[H_2O])=-8,3144*298,15*\ln(0,18197/55,3)=\mathbf{14,171}$ kJ/mol ;

$\Delta G_{eq}=G_{HCrO4-}+G_{\mathbf{H3O}}-(G_{H2CrO4}+G_{\mathbf{H2O}})=\mathbf{283,24}+\mathbf{22,44}-(\mathbf{291,509}+\mathbf{0})=\mathbf{14,171}$ kJ/mol ;

$G_{H2CrO4}=G_{HCrO4-}+G_{\mathbf{H3O}}-(\Delta G_{eq}+G_{\mathbf{H2O}})=\mathbf{283,24}+\mathbf{22,44}-(\mathbf{14,171}+\mathbf{0})=\mathbf{291,509}$ kJ/mol ;

[1] Protolysis $pK_{a2}=6,49$; $HCrO_4^-+H_2O=CrO_4^{2-}+H_3O^+$; $K_{eq}=K_{a2}/[H_2O]=10^{(-6,49)/55,3}=10^{(-8,2327)}$ ;

$\Delta G_{eq}=-R\bullet T\bullet\ln(K_{a2}/[H_2O])=-8,3144*298,15*\ln(5,8516*10^{(-9)}/55,3)=\mathbf{56,9395}$ kJ/mol;

$\Delta G_{eq}=G_{CrO42-}+G_{\mathbf{H3O}}-(G_{HCrO4}+G_{\mathbf{H2O}})=317,7395+\mathbf{22,44}-(\mathbf{283,24}+\mathbf{0})=\mathbf{56,9395}$ kJ/mol;

$G_{CrO42-}=\Delta G_{eq}-G_{\mathbf{H3O}}+(G_{HCrO4}+G_{\mathbf{H2O}})=\mathbf{56,9395}-\mathbf{22,44}+(\mathbf{283,24}+\mathbf{0})=\mathbf{317,7395}$ kJ/mol;

[33] Protolysis $Cr(OH)_3=HCrO_2+H_2O=CrO_2^-+H_3O^+$;

$K_a=6,6*10^{(-4)}$; $K_{prot}=K_a/[H_2O]=6,6*10^{(-4)}/55,3=1,19349*10^{(-5)}=10^{(-4,92318)}$;

$\Delta G_{eq}=-R\bullet T\bullet\ln(K_a/[H_2O])=-8,3144*298,15*\ln(1,19349*10^{(-5)})=\mathbf{28,10135}$ kJ/mol;

$\Delta G_{eq}=G_{CrO2-}+G_{\mathbf{H3O}}-(G_{HCrO2}+G_{\mathbf{H2O}})=\mathbf{196,675}+\mathbf{22,44}-(\mathbf{191,014}+\mathbf{0})=\mathbf{28,10135}$ kJ/mol;

$G_{HCrO2}=G_{CrO2-}+G_{\mathbf{H3O}}-(\Delta G_{eq}+G_{\mathbf{H2O}})=\mathbf{196,675}+\mathbf{22,44}-(\mathbf{28,10135}+\mathbf{0})=\mathbf{191,014}$ kJ/mol;

[39] https://en.wikipedia.org/wiki/Chromic_acid

Dissociation ; $2HCrO_4^-=Cr_2O_7^{2-}+H_2O$; $\log K_D=2,05$;

$K_{eq}=K_D*[H_2O]=[Cr_2O_7^{2-}]/[HCrO_4^-]^2*[H_2O]=10^{2,05}*55,3=10^{3,792725}=6204,76$;

$0,74<$ pH $<6$; $\Delta G_D=-R\bullet T\bullet\ln(K_D*[H_2O])=-8,3144*298,15*\ln(6204,76)=\mathbf{-21,64875}$ kJ/mol ;

$\Delta G_D=G_{Cr2O7}+G_{\mathbf{H2O}}-(2G_{HCrO4})=\mathbf{544,83}+\mathbf{0}-(2*\mathbf{283,24})=\mathbf{-21,65}-0+(2*\mathbf{283,24})=\mathbf{-21,64875}$ kJ/mol ;

$G_{Cr2O7}=\Delta G_D-G_{\mathbf{H2O}}+(2G_{HCrO4})=\mathbf{-21,64875}-0+(2*\mathbf{283,24})=\mathbf{544,83}$ kJ/mol ;

[39] https://en.wikipedia.org/wiki/Chromic_acid

Protolysis ; $pK_a=1,8$; $HCr_2O_7^-+H_2O=Cr_2O_7^{2-}+H_3O^+$;

$K_{eq}=K_a/[H_2O]=10^{(-1,8)}/55,3=0,0002865991$;

$\Delta G_{eq}=-R\bullet T\bullet\ln(K_{eq})=-8,3144*298,15*\ln(0,0002865991)=\mathbf{20,22175}$ kJ/mol;

$\Delta G_{eq}=G_{Cr2O7}+G_{\mathbf{H3O}}-(G_{HCr2O7-}+G_{\mathbf{H2O}})=\mathbf{562,32}+\mathbf{22,44}-(G_{HCr2O7-}+\mathbf{0})=\mathbf{20,22175}$ kJ/mol;

$G_{HCr2O7-}=G_{Cr2O7}+G_{\mathbf{H3O}}-(\Delta G_{eq}+G_{\mathbf{H2O}})=\mathbf{562,32}+\mathbf{22,44}-(\mathbf{20,22175}+\mathbf{0})=\mathbf{564,538}$ kJ/mol;

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