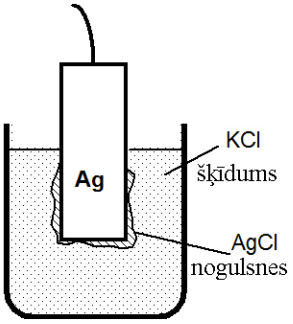
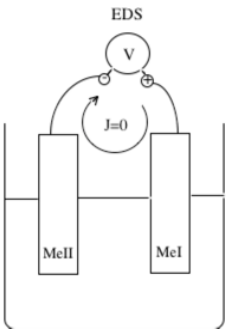
Aris Kaksis 2026. Riga Latvijas universitāte

II veida Prigožina atraktori metālu elektrodiem Ag, Hg, Pb, Al, Ca, Mg ar to nogulsnēm.

Sudrabasavienojumu šķīšanas, protolīzes un oksidēšanas Prigožina absolūtās enerģijas atraktori.





K^+Cl^- šķīduma ar nešķīstošās sāls AgCl pret joniem Cl^- un sudraba metāla Ag elektrodu. Elektriskā potenciāla mērījumi voltos ar elektrodu pāri ir **E**lektro **D**zinēja **S**pēks EDS volti. Starp indikatora elektrodu MeI un MeII salīdzināšanas elektrodu savienotiem noslēgtā elektriskā ķēdē aprēķina MeI indikatora elektroda potenciālu EI kā summu: EI=EDS+EII. Standarta salīdzināšanas elektrods EII kalpo par konstantu potenciālu ar hlorīda koncentrāciju.

Sudraba I-veida elektroda: $\mathbf{Ag}(s)+H_2O=\mathbf{Ag}^++e^-$ absolūtais $\mathbf{Ag}(s)+H_2O=\mathbf{Ag}^++e^-$; potenciāls satur standarta potenciālu $E°_{klasisko}$=0,7996 V [1], logaritmu -0,1029953 un summu ΔE°: $E_{Ag/Ag+}=E°_{klasisko}-0,0591/1*lg(1/[H_2O]^1)+\Delta E°$=0,7996-0,102995+0,10166-0,37239=**0,631865** V.

$$\Delta\mathbf{G}_{\mathbf{eq\_Ag}}=E°_{Ag}\bullet F\bullet n=\mathbf{0,631865}*96485*1=\mathbf{60,9655}\ ^{kJ}/_{mol},$$

$$\Delta G_{\mathbf{eq\_Ag}}=G_{Ag+}+G_{e-}-(G_{Ag}+\mathbf{G_{H2O}})=\mathbf{103,825}+\mathbf{0}-(\mathbf{42,8595}+0)=\mathbf{60,9655}\ ^{kJ}/_{mol};$$

$$G_{Ag}=G_{Ag+}+G_{e-}-(\Delta G_{\mathbf{eq\_Ag}}+\mathbf{G_{H2O}})=\mathbf{103,825}+\mathbf{0}-(\mathbf{60,9655}+0)=\mathbf{42,8595}\ ^{kJ}/_{mol};$$

$$G_{Ag+}=\Delta\mathbf{G}_{\mathbf{eq\_As}}-G_{e-}+(G_{Ag}+\mathbf{G_{H2O}})=\mathbf{60,9655}-\mathbf{0}+(\mathbf{42,855}+0)=\mathbf{103,825}\ ^{kJ}/_{mol}\ ;$$

$$G_{e-}=\Delta G_{\mathbf{eq\_Ag}}-G_{Ag+}+(G_{Ag}+\mathbf{G_{H2O}})=\mathbf{60,9655}-\mathbf{103,825}+(\mathbf{42,8595}+0)=\mathbf{0,0}\ ^{kJ}/_{mol};$$

Formation $\mathbf{Ag}+0,5Cl_2^{gas}=\mathbf{AgCl}$; $\Delta G°_{eqAgCl}=G_{AgCl}-(G_{Ag}+0,5*G_{Cl2}^{gas})=\mathbf{130,236}-(\mathbf{42,8595}+\mathbf{197,1765})$=-109,8 $^{kJ}/_{mol}$;

$$G_{Cl2}^{gas}=2*(G_{AgCl}-(G_{Ag}+\Delta G°_{eq\_AgCl}))=2*(\mathbf{130,236}-(\mathbf{42,8595}-109,8))=2*\mathbf{197,1765}=\mathbf{394,353}\ ^{kJ}/_{mol};$$

$$G_{AgCl}=\Delta G°_{eq\_AgCl}+(G_{Ag}+0,5*G_{Cl2}^{gas})=-109,8+(\mathbf{42,8595}+\mathbf{394,353}/2)=\mathbf{130,236}\ ^{kJ}/_{mol};$$

Formation $\mathbf{Ag}=\mathbf{Ag}^++e^-$; $\Delta\mathbf{G}_{\mathbf{eq\_Ag}}=G_{Ag+}+G_{e-}-(G_{Ag})=\mathbf{103,825}+\mathbf{16,1345}-(\mathbf{42,8595})$=77,1 $^{kJ}/_{mol}$; [1]

$$G_{e-}=\Delta\mathbf{G}_{\mathbf{eq\_Ag}}-G_{Ag+}+(G_{Ag})=77,1-\mathbf{103,825}+(\mathbf{42,8595})=\mathbf{16,1345}\ ^{kJ}/_{mol};$$

Šķīdības līdzsvara mol daļās $\mathbf{AgCl}(s)+2H_2O=Cl^-+\mathbf{Ag}^+$ absolūtā konstante :

$$K_{Absolute\mathbf{AgCl}}=K_{sp\mathbf{AgCl}}/[H_2O]^{\wedge 2}=[\mathbf{Ag}^+]*[Cl^-]/[\mathbf{AgCl}]/[H_2O]^{\wedge 2}=1,77*10^{\wedge(-10)}/55,3^{\wedge 2}=10^{\wedge(-13,2375)};$$

$\Delta\mathbf{G}_{sp\mathbf{AgCl}}=-\mathbf{R}\bullet\mathbf{T}\bullet\mathbf{ln}(\mathbf{K}_{sp\mathbf{AgCl}})$=-8,3144*298,15*ln($10^{\wedge(-13,2375)}$)=**75,559** $^{kJ}/_{mol}$; kompensē ūdens molekulu

$$\Delta\mathbf{G}_{sp\mathbf{AgCl}}=G_{Ag+}+G_{Cl-}-(G_{AgCl}+\mathbf{2G_{H2O}})=\mathbf{103,825}+\mathbf{101,97}-(\mathbf{130,236}+\mathbf{2*0})=\mathbf{75,559}\ ^{kJ}/_{mol}\ ;$$

$$G_{Cl-}=\Delta\mathbf{G}_{sp\mathbf{AgCl}}-G_{Ag+}+(G_{AgCl}+\mathbf{2G_{H2O}})=\mathbf{75,559}-\mathbf{103,825}+(\mathbf{130,236}+\mathbf{2*0})=\mathbf{101,97}\ ^{kJ}/_{mol}\ ;$$

$$G_{AgCl}=G_{Ag+}+G_{Cl-}-(\Delta\mathbf{G}_{sp\mathbf{AgCl}}+\mathbf{2G_{H2O}})=\mathbf{103,825}+\mathbf{101,97}-(\mathbf{75,559}+\mathbf{2*0})=\mathbf{130,236}\ ^{kJ}/_{mol}\ ;$$

Viela	$\Delta H°_H$ $^{kJ}/_{mol}$	$\Delta S°_H$ $^{J}/_{mol/K}$	$\Delta G°_H$ $^{kJ}/_{mol}$
Ag	$E°_{Ag/Ag+}$=	**-0,6319** V	**42,8595**
Ag	$E°_{Ag/AgCl}$=	**-0,151395**	**42,87335**
Ag+	105,6	72,7	77,1
Ag+ G_{e-}	Formation	77,1	**16,1345**
Ag+	$E°_{Ag}$=	**0,631865**	**103,825**
AgCl(s)	-127,0	96,25	-109,8
AgCl(s)	formation	-109,8	**130,236**
AgCl(s)	$\mathbf{K}_{sp\mathbf{AgCl}}$=	$10^{\wedge(-13,2375)}$	**130,236**
Cl_2^{gas}	-109,8;$AgCl_s$	formation	**394,353**
$Cl^-_{(aq)}$	$\mathbf{K}_{sp\mathbf{AgCl}}$=	$10^{\wedge(-13,2375)}$	**101,97**
$Cl^-_{(aq)}$	-167,2	56,6	-131,2
$Cl^-_{(aq)}$ G_{e-}	formation	-131,2	**35,9935**
$\mathbf{Cl}^-_{aqNaCl}$	$E°_{2Cl-Cl2}$=	**1,03756** V	**66,1832**
$Ag(NH_3)_2^+$	$E°_{Ag(NH3)2+}$	**-0,06995**	**224,9895**
$\mathbf{Ag_2O}$(s)	-31,1	121,3	-11,2
$\mathbf{Ag_2O}$(s)	formation	-11,2	**226,069**
2Ag	$E°_{Ag/Ag2O}$=	**0,02277**V	2*33,4773

jons G_{Ag+}=**103,8** $^{kJ}/_{mol}$ virs G_{Ag}=**42,855** $^{kJ}/_{mol}$ elementa **60,945**;]

$$G_{Ag}=G_{Ag+}-(\Delta G_{\mathbf{eq\_Ag}}+\mathbf{G_{H2O}})=\mathbf{103,825}-(\mathbf{60,9655}+0)=\mathbf{42,8595}\ ^{kJ}/_{mol};$$

$$G_{Ag}=G_{AgCl}+\mathbf{G_{H2O}}-(\Delta G_{\mathbf{eq\_Ag}}+\mathbf{G_{Cl-}})=\mathbf{42,85335}\ ^{kJ}/_{mol};$$

$$\Delta G_{AgCl}=\Delta H_H-T*\Delta S_H=105,6-298,15*0,0727=83,9245\ ^{kJ}/_{mol};\ [1]$$

$$G_{e-}=\Delta\mathbf{G}_{\mathbf{eq\_Ag}}-G_{Ag+}+(G_{Ag})=83,9245-\mathbf{103,825}+(\mathbf{42,8595})=\mathbf{16,1345}\ ^{kJ}/_{mol};$$

$$G_{Ag+}=\Delta\mathbf{G}_{\mathbf{eq\_As}}+(G_{Ag}+\mathbf{G_{H2O}})=\mathbf{60,95}+(\mathbf{42,855}+0)=\mathbf{103,825}\ ^{kJ}/_{mol}\ ;$$

$$\Delta G_{AgCl}=\Delta H_H-T*\Delta S_H=-127,0-298,15*0,09625=-155,71\ ^{kJ}/_{mol};\ [1]$$

$$G_{AgCl}=\Delta G°_{eq\_AgCl}+(G_{Ag}+0,5*G_{Cl2}^{gas})=\mathbf{130,236}\ ^{kJ}/_{mol};$$

$$G_{AgCl}=G_{Ag+}+G_{Cl-}-(\Delta\mathbf{G}_{sp\mathbf{AgCl}}+\mathbf{2G_{H2O}})=\mathbf{130,236}\ ^{kJ}/_{mol};$$

$$G_{Cl2}^{gas}=2*(G_{AgCl}-(G_{Ag}+\Delta G°_{eq\_AgCl}))=2*\mathbf{197,1765}=\mathbf{394,353}\ ^{kJ}/_{mol};$$

$$G_{Cl-}=\Delta\mathbf{G}_{sp\mathbf{AgCl}}-G_{Ag+}+(G_{AgCl}+\mathbf{2G_{H2O}})=\mathbf{101,97}\ ^{kJ}/_{mol};$$

$$\Delta G_{Cl-}=\Delta H_H-T*\Delta S_H=-167,08-298,15*0,0566=-183,955\ ^{kJ}/_{mol};[1]$$

$$G_{e-}=G_{Cl-}-(G_{Cl}+\Delta\mathbf{G}_{eqCl})=\mathbf{101,97}-(\mathbf{197,1765}-131,2)=\mathbf{35,9935}\ ^{kJ}/_{mol};$$

$$\mathbf{2G_{Cl-}}=G_{Hg2Cl2}+\mathbf{2G_{H2O}}-(\Delta\mathbf{G}_{\mathbf{eq\_}Hg2Cl2}+2G_{Hg})=2*\mathbf{66,1832}\ ^{kJ}/_{mol};$$

$$G_{Ag(NH3)2+}=\Delta\mathbf{G}_{Ag/Ag(NH3)2+}-\mathbf{G_{H2O}}+(G_{Ag}+2G_{NH3aq})=\mathbf{224,985}\ ^{kJ}/_{mol};$$

$$\Delta G_{Ag2O}=\Delta H_H-T*\Delta S_H=-31,1-298,15*0,1213=-67,2656\ ^{kJ}/_{mol};\ [1]$$

$$\mathbf{G_{Ag2O}}=\Delta\mathbf{G°_{Ag2O}}+(2G_{\mathbf{Ag}}+0,5\mathbf{G}_{O2}^{gas})=\mathbf{226,069}\ ^{kJ}/_{mol};$$

$$2G_{Ag}=G_{\mathbf{Ag2O}}+\mathbf{G_{H2O}}-(\Delta G_{Ag/\mathbf{Ag2O}}+2G_{OH})=2*\mathbf{33,4773}\ ^{kJ}/_{mol};$$

$[Cl^-]$=0,1 M=$[K^+Cl^-]$ šķīduma $\mathbf{Ag}_{(s)}+H_2O=\mathbf{Ag}^++e^-$; $\mathbf{Ag}_{(s)}+H_2O+Cl^-=\mathbf{AgCl}_{(s)}+2H_2O+e^-$; summārajā reakcijā. $\mathbf{Ag}_s+Cl^-=\mathbf{AgCl}_s+H_2O+e^-$; Absolūtā standarta potenciāla aprēķins satur $E°_{klasisko}$=0,22233 V [1], ūdens -0,103 un ΔE°: $E_{Ag/AgCl}=E°_{Classic}-0,0591/1*lg([H_2O]^1)+\Delta E°$=0,22233-0,103+0,10166-0,37239=**-0,151395** V;

$$\Delta\mathbf{G}_{\mathbf{eq\_Ag}}=E°_{Ag}\bullet F\bullet n=\mathbf{-0,151395}*96485*1=\mathbf{-14,60735}\ ^{kJ}/_{mol};$$

$$\Delta\mathbf{G}_{\mathbf{eq\_Ag}}=G_{AgCl}+\mathbf{G_{H2O}}+G_{e-}-(G_{Ag}+G_{Cl-})=\mathbf{130,236}+0-(\mathbf{42,87335}+\mathbf{101,97})=\mathbf{-14,60735}\ ^{kJ}/_{mol}\ ;$$

$$G_{Ag}=G_{AgCl}+\mathbf{G_{H2O}}+G_{e-}-(\Delta\mathbf{G}_{\mathbf{eq\_Ag}}+\mathbf{G_{Cl-}})=\mathbf{130,236}+0-(-\mathbf{14,60735}+\mathbf{101,97})=\mathbf{42,87335}\ ^{kJ}/_{mol};$$

$$G_{e-0}=\Delta\mathbf{G}_{\mathbf{eq\_Ag}}-G_{AgCl}-\mathbf{G_{H2O}}+(G_{Ag}+G_{Cl-})=\mathbf{-14,60735}-\mathbf{130,236}-0+(\mathbf{42,87335}+\mathbf{101,97})=\mathbf{0}\ ^{kJ}/_{mol}\ ;$$

Šķīdība NH_3^{gas} un **Ag** kompensē katru ūdens molekulu Nernsta pus reakcijas produktos $NH_3^{gas}+H_2O=NH_{3aq}$;$Ag+H_2O=Ag^++e^-$; $Ag+H_2O+2NH_{3aq}=Ag(NH_3)_2^++2H_2O+e^-$; Absolūtais standarta potenciāls ar standartu $E°_{klasisko}$=0,373 V [17], ūdens $-0,0591/1*\log([H_2O]^1)$=-0,103 logaritmu un summu $\Delta E°$: $E°_{Ag/Ag(NH3)2+}=E°_{Classic}-0,0591/1*\log([H_2O]^1)+\Delta E°$=0,373-0,103+0,10166-0,37239=**-0,000725055** V;

$\Delta G_{Ag/Ag(NH3)2+}=E°_{Ag/Ag(NH3)2+}•F•n$=**0,000725055***96485*1=**-0,069956** $^{kJ}/_{mol}$;

$\Delta G_{Ag/Ag(NH3)2+}=G_{Ag(NH3)2+}+G_{H2O}+G_{e-}-(G_{Ag}+2G_{NH3aq})$=**224,9895**+0-(**42,8595+2*91,1**)=**0,069956** $^{kJ}/_{mol}$;

$G_{Ag(NH3)2+}=\Delta G_{Ag/Ag(NH3)2+}-G_{H2O}-G_{e-}+(G_{Ag}+2G_{NH3aq})$=**-0,069956**-0+(**42,8595+2*91,1**)=**224,9895** $^{kJ}/_{mol}$;

$G_{e-}=\Delta G_{Ag/Ag(NH3)2+}-G_{Ag(NH3)2+}-G_{H2O}+(G_{Ag}+2G_{NH3aq})$=**-0,069956-224,9895**-0+(**42,8595+2*91,1**)=**0** $^{kJ}/_{mol}$;

Formation $Cl_2^{gas}/2+e-=Cl-$;

$\Delta G_{eqCl}=G_{Cl-}-(G_{Cl}+G_{e-})$=**101,97-(197,1765+35,9935)**=-131,2 $^{kJ}/_{mol}$;

$G_{e-}=G_{Cl-}-(G_{Cl}+\Delta G_{eqCl})$=**101,97-(197,1765**-131,2)=**35,9935** $^{kJ}/_{mol}$;

Formation $2Ag+0,5O_2^{gas}=Ag_2O$;

$\Delta G°_{Ag2O}=G_{Ag2O}-(2G_{Ag}+0,5G_{O2}^{gas})$=**226,069-**(2***42,8595**+0,5***303,1**)=-11,2 $^{kJ}/_{mol}$;

$G_{Ag2O}=\Delta G°_{Ag2O}+(2G_{Ag}+0,5G_{O2}^{gas})$=-11,2+(2***42,8595**+0,5***303,1**)=**226,069** $^{kJ}/_{mol}$;

$2Ag+2OH^-=Ag_2O(s)+H_2O+2e^-$;

Absolūtā standarta potenciāla aprēķins satur $E°_{klasisko}$=0,342 V [1], ūdens logaritmu un $\Delta E°$:

$E°_{2Ag/Ag2O}=E°_{Classic}-0,0591/2*\lg([H_2O]^1)+\Delta E°$=0,345-0,0515+0,10166-0,37239=**0,0227725** V

$\Delta G_{Ag/Ag2O}=E°_{Ag/Ag2O}•F•n$=**0,0227725***96485*2=**4,3944** $^{kJ}/_{mol}$;

$\Delta G_{Ag/Ag2O}=G_{Ag2O}+G_{H2O}+2G_{e-}-(2G_{Ag}+2G_{OH})$=**226,069**+0+2***0-**(2***33,4773+2*77,36**)=**4,3944** $^{kJ}/_{mol}$;

$2G_{Ag}=G_{Ag2O}+G_{H2O}+2G_{e-}-(\Delta G_{Ag/Ag2O}+2G_{OH})$=**226,069**+0+2***0-**(**4,3944+2*77,36**)=**66,9546**=2***33,477** $^{kJ}/_{mol}$;

$2G_{e-}=\Delta G_{Ag/Ag2O}-G_{Ag2O}-G_{H2O}++(2G_{Ag}+2G_{OH})$= **4,3944-226,069**-0+(2***33,4773+2*77,36**)=**0,0** $^{kJ}/_{mol}$;

$G_{Ag2O}=\Delta G_{Ag/Ag2O}-G_{H2O}-2G_{e-}+(2G_{Ag}+2G_{OH})$=**4,3944**-0-2***0**+(2***33,4773+2*77,36**)=**226,069** $^{kJ}/_{mol}$;

$$E°_{Ag/Ag(NH3)2+}=\mathbf{0,000725\ V}+\frac{[Ag(NH_3)_2^+]}{[Ag]\cdot([NH_3]-2\cdot[Ag(NH_3)_2^+])^2}E°_{2Ag/Ag2O}=\mathbf{0,02277}\ V+\frac{[Ag_2O]\cdot[H_2O]}{[Ag]^2\cdot[OH^-]^2}$$

Dzīvsudraba savienojumu šķīšanas, protolīzes un red-oks Prigožina absolūtās enerģijas atraktori.

Viela	$\Delta H°_{H,}{}^{kJ}/_{mol}$	$\Delta S°_{H,}{}^{J}/_{mol/K}$	$\Delta G°_{H,}{}^{kJ}/_{mol}$
Hg	$E°_{Hg2Cl2}$=	**-0,10565 V**	**35,7641**
Hg	$\Delta E°_{H2O2aq-HgO}$	0,751298	**35,778**
Hg Hg_2SO_4 formation		-625,8	**85,0232**
HgO_s[1]	-90,8	70,3	-58,5
Hg	Formation $_{HgO}$	-58,5	**54,2**
$HgO_{(s)}$	Formation $_{HgO}$	-58,5	**147,25**
Hg	$E°_{HgO}$=	**0,22423 V**	**35,764**
$HgO_{(s)}$	$E°_{HgO}$=	**0,22423 V**	**147,25**
Hg_2^{2+}[1]	172,4	84,5	153,5
Hg_2^{2+} G_{e-}	formation	153,5	2***20,975**
Hg_2^{2+}	$E°_{2Hg/Hg22+}$=	**0,5780675**	**183,0782**
Hg^{2+}	$E°_{Hg/Hg2+}$=	**0,6317675**	**157,674**
Hg^{2+}[1]	171,1	-32,2	164,4
Hg^{2+} G_{e-}	formation	164,4	2***21,245**
$Hg_2SO_{4(s)}$	-743,1	200,7	-625,8
Hg_2SO_4	G_{e-}formation	-625,8	-625,8
$Hg_2SO_{4(s)}$	formation	-625,8	**153,99156**
$Hg_2SO_{4(s)}$	$K_{Absolute}$**Hg2SO4**=	$10^{\wedge(-9,6725)}$	**154,3205**
$Hg_2SO_{4(s)}$	$E°_{HgSO4}$=	**0,29027** V	**153,99156**
SO_4^{2-}	-909,3	20,1	-744,5
$SO_4^{2-}G_{e-}$	[1] formation	-744,5	**80,603**
HSO_4^-	pK_{a2}=1,99	protolysis	**27,584**
SO_4^{2-}	[1] pK_{a2}=1,99	protolysis	**26,44977**
SO_4^{2-}	$E°_{HSO3-}$=	**0,10726 V**	**26,44996**
SO_4^{2-}	$E°_{HgSO4}$=	**0,29027** V	**26,44996**
HSO_3^-	$E°_{HSO3-}$=	**0,10726 V**	**73,072**
SO_4^{2-}	??? $E°_{SO32-}$=	**-1,2522 V**	**54,9256**
SO_3^{2-}	$E°_{SO32-}$=	**0,05576 V**	**60,56996**
[1] Cl_2^{gas}	-109,8;$AgCl_s$formation		**394,353**
[1] Cl_2^{gas}	$Hg_2Cl_{2(s)}$ formation	-210,7	**139,1718**
[1] Cl_2^{gas}	$HgCl_{2(s)}$ formation	-178,6	**142,8359**
$Cl_{2aqNaCl}$	$E°_{2Cl-Cl2}$=	**1,03756** V	**332,584**
$^{-14}Cl_{2aqNaCl}$	$K_{eq\_2Cl-Cl2}$=$^{-14}$	**0,64771** V	**257,366**
$Hg_2Cl_{2(s)}$	-265,37	191,6	-210,7
$Hg_2Cl_{2(s)}$	formation	-210,7	**0**
$HgCl_{2(s)}$	-224,3	146	-178,6
$HgCl_{2(s)}$	formation	-178,6	**0,0001**
$Hg_2Cl_{2(s)}$	$E°_{HgCl2}$=	**-0,10565 V**	**183,5083**
$Cl^-_{(aq)}$	-167,2	56,6	-131,2
$Cl^-_{(aq)}$ G_{e-}	formation	-131,2	**125,9652**
$Cl^-_{(aq)}$	$K_{Absolute}$**Hg2Cl2**=	$10^{\wedge(-23,07)}$	**66,05455**
Cl$^-_{aqNaCl}$	$E°_{2Cl-Cl2}$=	**1,03756** V	**66,1832**

$G_{Srhombic}$=**3,5436** $^{kJ}/_{mol}$; $G_{O2}{}^{gas}$=**303,1** $^{kJ}/_{mol}$;

$G_{Hg}=(G_{Hg2Cl2}+\mathbf{G_{H2O}}+2G_{e-}-(2\mathbf{G_{Cl-}}+\Delta\mathbf{G_{eq\_Hg2Cl2}}))/2$=**35,7641** $^{kJ}/_{mol}$;

$G_{Hg}=\Delta G_{eqRedOx\_H2O2}-G_{O2aqua}+(G_{HgO}+G_{H2O2})$=**35,778** $^{kJ}/_{mol}$;

$2G_{Hg}=G_{Hg2SO4}-(\Delta\mathbf{G}_{Hg2SO4}+\mathbf{G}_{Sromb}+2\mathbf{G}_{O2})$=2***85,0232** $^{kJ}/_{mol}$;

$\Delta G_{Cl-}=\Delta H_H-T*\Delta S_H$=-90,8-298,15*0,0703=-111,76 $^{kJ}/_{mol}$;[1]

$\mathbf{G}_{Hg}=G_{HgO}-(\Delta\mathbf{G}_{HgO}+0{,}5\mathbf{G}_{O2}{}^{gas})$=**147,25**-(-58,5+0,5***303,1**)=**54,2** $^{kJ}/_{mol}$;

$G_{HgO}=\Delta G_{eqHgO}-2G_{H2O}+(G_{Hg}+2G_{OH})$=**147,15** $^{kJ}/_{mol}$;

<=====$G_{Hg}=G_{HgO}+G_{H2O}-(\Delta G_{eqHgO}+2G_{OH})$=**35,764** $^{kJ}/_{mol}$;

$G_{HgO}=\Delta G_{eqHgO}-2G_{H2O}+(G_{Hg}+2G_{OH})$=**147,15** $^{kJ}/_{mol}$;

$\Delta G_{Hg22+}=\Delta H_H-T*\Delta S_H$=-172,4-298,15*0,0845=-197,59 $^{kJ}/_{mol}$;

$2G_{e-}=\Delta\mathbf{G}_{eq\_2Hg}-G_{Hg22+}+(2G_{Hg}+\mathbf{G_{H2O}})$=2***20,975** $^{kJ}/_{mol}$;

$G_{Hg22+}=\Delta\mathbf{G}_{eq\_Hg}+(2G_{Hg}+\mathbf{G_{H2O}})$=**111,55**+(2*35,8+0)=**183,08** $^{kJ}/_{mol}$;

$G_{Hg2+}=\Delta\mathbf{G}_{eq\_Hg}+(G_{Hg}+\mathbf{G_{H2O}})$=**121,91**+(35,764+0)=**157,674** $^{kJ}/_{mol}$;

$\Delta G_{Hg22+}=\Delta H_H-T*\Delta S_H$=-171,1-298,15*-0,0322=-161,4996 $^{kJ}/_{mol}$;

$2G_{e-}=\Delta\mathbf{G}_{eq\_Hg}-G_{Hg2+}+(G_{Hg}+\mathbf{G_{H2O}})$=2***21,24505** $^{kJ}/_{mol}$;

[1] $\Delta G_{Hg2SO4}=\Delta H_H-T*\Delta S_H$=-743,1-298,15*0,2=-802,73$^{kJ}/_{mol}$;

[1] $\Delta G_{Hg2SO4}=\Delta H_H-T*\Delta S_H$=-743,1-298,15*0,2=-802,73$^{kJ}/_{mol}$;

$G_{Hg2SO4}=\Delta\mathbf{G}_{Hg2SO4}+(2G_{Hg}+\mathbf{G}_{Sromb}+\mathbf{G}_{Sromb}+2\mathbf{G}_{O2})$=**153,99** $^{kJ}/_{mol}$;

$G_{Hg2SO4}=G_{\mathbf{Hg22+}}+\mathbf{G}_{SO42-}-(\Delta\mathbf{G}_{eqHg2SO4}+2\mathbf{G_{H2O}})$=**154,3205** $^{kJ}/_{mol}$;

$G_{Hg2SO4}=\Delta\mathbf{G}_{eq\_Hg2SO4}+(2G_{Hg}+\mathbf{G}_{SO4})$=**153,99156** $^{kJ}/_{mol}$;

$\Delta G_{Hg22+}=\Delta H_H-T*\Delta S_H$=-909,3-298,15*0,0201=-915,29 $^{kJ}/_{mol}$;

$2G_{e-}=G_{\mathbf{SO42-}}-(G_{Srombic}+2\mathbf{G_{O2}}+\Delta G°_{\mathbf{SO42}})$=**161,2062**=2***80,60** $^{kJ}/_{mol}$;

$G_{HSO4-}=\Delta G_{eq\mathbf{H2SO4}}-G_{H3O}+(G_{H2SO4}+G_{H2O})$=**27,584** $^{kJ}/_{mol}$;

$G_{\mathbf{SO42-}}=\Delta G_{eq\mathbf{HSO4}}-G_{\mathbf{H3O}}+(G_{\mathbf{HSO4-}}+G_{\mathbf{H2O}})$=**26,4509** $^{kJ}/_{mol}$; 2=pH<7

$G_{SO42-}=\Delta\mathbf{G}_{eq\mathbf{HSO42-}}-3\mathbf{G_{H3O}}+(G_{HSO3}+4\mathbf{G_{H2O}})$=**26,44996** $^{kJ}/_{mol}$;

$\mathbf{G}_{SO4}=G_{Hg2SO4}-(2G_{Hg}+\Delta\mathbf{G}_{eq\_Hg2SO4})$=**26,44996** $^{kJ}/_{mol}$;

$G_{HSO3}=G_{SO42-}+3\mathbf{G_{H3O}}-(\Delta\mathbf{G}_{eqHSO4-}+4\mathbf{G_{H2O}})$=**73,072** $^{kJ}/_{mol}$;

$G_{SO42-}=\Delta\mathbf{G}_{eqSO32-OH}-\mathbf{G_{H2O}}+(G_{SO32-}+2\mathbf{G_{OH}})$=**54,9256** $^{kJ}/_{mol}$;

$G_{SO32-}=G_{SO42-}+2\mathbf{G_{H3O}}-(\Delta\mathbf{G}_{eqSO32-}+3\mathbf{G_{H2O}})$=**60,56996** $^{kJ}/_{mol}$;

$G_{Cl2}{}^{ga}=2*(G_{AgCl}-(G_{Ag}+\Delta G°_{eq\_AgCl}))$=2***197,1765**=**394,353** $^{kJ}/_{mol}$;

$\mathbf{G}_{Cl2}=-(2\mathbf{G}_{Hg}+\Delta\mathbf{G°}_{Hg2Cl2})=-(2*\mathbf{35,7641}-210,7)=\mathbf{139,1718}$ $^{kJ}/_{mol}$;

$\mathbf{G}_{Cl2}=-(\mathbf{G}_{Hg}+\Delta\mathbf{G°}_{HgCl2})=-(\mathbf{35,7641}-178,6)=\mathbf{142,8359}$ $^{kJ}/_{mol}$;

$G_{Cl2}{}^{gas}=\Delta\mathbf{G}_{eq\_2Ci-Cl2}+(2\mathbf{G_{Cl-}})$=**200,218**+(2***66,1832**)=**332,584** $^{kJ}/_{mol}$;

$G_{Cl2}{}^{gas}=\Delta\mathbf{G}_{eq\_2Ci-Cl2}+(2\mathbf{G_{Cl-}})$=**125**+(2***66,1832**)=**257,3664** $^{kJ}/_{mol}$;

$\Delta G_{Hg22+}=\Delta H_H-T*\Delta S_H$=-265,37-298,15*0,1916=322,4955 $^{kJ}/_{mol}$;

$G_{Hg2Cl2}=\Delta\mathbf{G}_{eq\_Hg2Cl2}+(2G_{Hg}+G_{Cl2}{}^{gas})$=-210,7+(2***35,7641+139,1718**)=**0** $^{kJ}/_{mol}$;

[1] $\Delta G_{Hg22+}=\Delta H_H-T*\Delta S_H$=-224,3-298,15*0,146=-267,83 $^{kJ}/_{mol}$;

[1] $G_{HgCl2}=\Delta\mathbf{G}_{eq\_HgCl2}+(G_{Hg}+G_{Cl2}{}^{gas})$=**0,0001** $^{kJ}/_{mol}$;

$G_{Hg2Cl2}=\Delta\mathbf{G}_{eq\_Hg2Cl2}-2\mathbf{G_{H2O}}-2G_{e-}+(2\mathbf{G_{Cl-}}+2G_{Hg})$=**183,5083** $^{kJ}/_{mol}$;

$\Delta G_{Cl-}=\Delta H_H-T*\Delta S_H$=-167,08-298,15*0,0566=-183,955 $^{kJ}/_{mol}$;[1]

$G_{e-}=G_{Cl-(aq)}-(0{,}5G_{Cl2}{}^{gas}+\Delta\mathbf{G}_{eqCl})$= **125,9652** $^{kJ}/_{mol}$;

$\mathbf{G}_{Cl-}=(-G_{\mathbf{Hg22+}}+\Delta\mathbf{G}_{eqHg2Cl2}+(G_{Hg2Cl2}+3\mathbf{G_{H2O}}))/2$=**66,05455** $^{kJ}/_{mol}$;

$2\mathbf{G}_{Cl-}=G_{Hg2Cl2}+2\mathbf{G_{H2O}}-(\Delta\mathbf{G}_{eq\_Hg2Cl2}+2G_{Hg})$=2***66,1832** $^{kJ}/_{mol}$;

$2Hg+H_2O=Hg_2^{2+}+2e^-$; Absolūtā potenciāla aprēķins satur standarta potenciālu $E°_{klasisko}$=0,7973 V [1], ūdens logaritmu un ΔE°: $E°_{2Hg}=E°_{classic}-0{,}0591/2*\lg(1/[H_2O]^1)+\Delta E°$=0,7973+0,0515+0,10166-0,37239=**0,5780675** V;

$\Delta\mathbf{G}_{eq\_2Hg}=E°_{Hg}\bullet F\bullet n$=**0,5780675***96485*2=**111,55** $^{kJ}/_{mol}$,

$\Delta\mathbf{G}_{eq\_2Hg}=G_{Hg22+}+2G_{e-}-(2G_{Hg}+\mathbf{G_{H2O}})$=**183,0782**+2***0**-(2*35,7641+0)=**111,55** $^{kJ}/_{mol}$;

$G_{Hg22+}=\Delta\mathbf{G}_{eq\_Hg}-2G_{e-}+(2G_{Hg}+\mathbf{G_{H2O}})$=**111,55**-2***0**+(2*35,7641+0)=**183,0782** $^{kJ}/_{mol}$;

$2G_{e-}=\Delta\mathbf{G}_{eq\_2Hg}-G_{Hg22+}+(2G_{Hg}+\mathbf{G_{H2O}})$=**111,55-183,0782**+(2*35,7641+0)=2***0** $^{kJ}/_{mol}$;

$Hg+H_2O=Hg^{2+}+2e^-$; Absolute potential has standard $E°_{Classic}$=0.851 V [1], water logarithm and ΔE°:

$E°_{Hg}=E°_{clasiskais}-0{,}0591/2*\lg(1/[H_2O]^1)+\Delta E°$=0,851+0,0515+0,10166-0,37239=**0,6317675** V;

$\Delta\mathbf{G}_{eq\_Hg}=E°_{Hg}\bullet F\bullet n$=**0,6317675***96485*2=**121,91** $^{kJ}/_{mol}$,

$\Delta G_{eq\_Hg}=G_{Hg2+}+2G_{e-}-(G_{Hg}+G_{H2O})=157,674+0,0001-(35,7641+0)=121,91$ kJ/mol ;

$G_{Hg}=G_{Hg2+}+2G_{e-}-(+G_{H2O})=157,674+0,0001-(121,91+0)=35,7641$ kJ/mol ;

$G_{Hg2+}=\Delta G_{eq\_Hg}-2G_{e-}+(G_{Hg}+G_{H2O})=121,91-0,0001+(35,7641+0)=157,674$ kJ/mol ;

$2G_{e-}=\Delta G_{eq\_Hg}-G_{Hg2+}+(G_{Hg}+G_{H2O})=121,91-157,674+(35,7641+0)=2*0,00005$ kJ/mol ;

Formation $2Hg+H_2O=Hg_2^{2+}+2e^-$; $G_{Hg2+}=\Delta G_{eq\_Hg}+(G_{Hg}+G_{H2O})=121,91+(2*35,7641+0)=157,674$ kJ/mol ;

$\Delta G_{eq\_2Hg}=G_{Hg22+}+2G_{e-}-(2G_{Hg}+G_{H2O})=183,0782+2*20,975-(2*35,7641+0)=153,5$ kJ/mol;

$2G_{e-}=\Delta G_{eq\_2Hg}-G_{Hg22+}+(2G_{Hg}+G_{H2O})=153,5-183,0782+(2*35,7641+0)=2*20,975$ kJ/mol ;

Formation $Hg+H_2O=Hg^{2+}+2e^-$; $\Delta G_{eq\_Hg}=G_{Hg2+}+2G_{e-}-(G_{Hg}+G_{H2O})=157,674+2*G_{e-}-(35,7641+0)=164,4$ kJ/mol;

$2G_{e-}=\Delta G_{eq\_Hg}-G_{Hg2+}+(G_{Hg}+G_{H2O})=164,4-157,674+(35,7641+0)=2*21,24505$ kJ/mol;

Formation $Hg+S_{romb}+2O_2^{gas}=Hg_2SO_{4(s)}$;

$\Delta G_{Hg2SO4}=G_{Hg2SO4}-(2G_{Hg}+G_{Sromb}+GS_{romb}+2G_{O2}^{gas})=153,99156-(2*35,7641+3,5436+2*303,1)=-625,8$ kJ/mol;

$2G_{Hg}=G_{Hg2SO4}-(\Delta G_{Hg2SO4}+G_{Sromb}+2G_{O2}^{gas})=153,99-(-625,8+3,5436+2*303,1)=2*85,0232$ kJ/mol;

$G_{Hg2SO4}=\Delta G_{Hg2SO4}+(2G_{Hg}+G_{Sromb}+GS_{romb}+2G_{O2}^{gas})=-625,8+(2*35,7641+3,5436+2*303,1)=153,99156$ kJ/mol;

[1] SO_4^{2-} Formation $S_{rombic}+2O_2^{gas}+2*e-=SO_4^{2-}$;

$\Delta G°_{SO42}=G_{SO42}-(G_{Srombic}+2G_{O2}+2G_{e-})=26,44977-(3,5436+2*303,1+2*80,603)=-744,5$ kJ/mol;

$2G_{e-}=G_{SO42}-(G_{Srombic}+2G_{O2}+\Delta G°_{SO42})=26,44977-(3,5436+2*303,1-744,5)=161,20617=2*80,603$ kJ/mol;

Protolysis $HSO_4^-+H_2O=SO_4^{2-}+H_3O^+$ $pK_{a2}=1,99$

$K_{eq2}=K_{a2}/[H_2O]=10^{\wedge(-1,99)}/55,3=0,0001850$ energy change has

$\Delta G_{eqHSO4}=-R•T•\ln(K_{eq2})=-8,3144*298,15*\ln(0,000185)=G_{SO42-}+G_{H3O}-(G_{HSO4-}+G_{H2O})=21,3069$ kJ/mol. Hess expression $\Delta G_{eqHSO4}=G_{SO42-}+G_{H3O}-(G_{HSO4-}+G_{H2O})=26,44977+22,44-(27,584+0)=21,3069$ kJ/mol free energy of

$G_{HSO4-}=G_{SO42-}+G_{H3O}-(\Delta G_{eqHSO4}+G_{H2O})=26,44977+22,44-(21,3069+0)=27,5829$ J/mol and SO_4^{2-} anion mol is $G_{SO42-}=\Delta G_{eqHSO4}-G_{H3O}+(G_{HSO4-}+G_{H2O})=21,3069-22,44+(27,5829+0)=26,44977$ kJ/mol;

$2<pH<7$ $HSO_3^-+4H_2O=SO_4^{2-}+3H_3O^++2e^-$; Classic standard potential $E°_{classic}=0.172$ V [1], plus water account $-0.0591/2*\log(1/[H_2O]^4)=0.206$ and common sum $\Delta E°=+0.10166-0.37239$ absolute potential has

$E°_{HSO3-}=E°-0,0591/2*\log(1/[H_2O]^4)+\Delta E°=0,172-0,0591/2*\log(1/55,3^{\wedge4})+0,10166-0,37239=0,10726$ V;

$2<pH<7,172$ $\Delta G_{eqHSO3-}=E°_{HSO4-}•F•n=0,10726*96485*2=20,69796$ kJ/mol,

$\Delta G_{eqHSO3-}=G_{SO42-}+3G_{H3O}+2G_{e-}-(G_{HSO3}+4G_{H2O})=26,44996+3*22,44+2*0-(73,072+4*0)=20,69797$ kJ/mol ;

$G_{HSO3}=G_{SO42-}+3G_{H3O}+2G_{e-}-(\Delta G_{eqHSO4-}+4G_{H2O})=26,44996+3*22,44+2*0-(20,69796+4*0)=73,072$ kJ/mol ;

$G_{SO42-}=\Delta G_{eqHSO42-}-3G_{H3O}-2G_{e-}+(G_{HSO3}+4G_{H2O})=20,69796-3*22,44-2*0+(73,072+4*0)=26,44996$ kJ/mol ;

$2G_{e-}=\Delta G_{eqHSO42-}-3G_{H3O}-G_{SO42-}+(G_{HSO3}+4G_{H2O})=20,69796-3*22,44-26,44996+(73,072+4*0)=2*0$ kJ/mol ;

$pH>7,172$ $SO_3^{2-}+3H_2O=SO_4^{2-}+2H_3O^++2e^-$; Classic standard potential $E°_{classic}=0,172$ V [1] , plus water account $-0.0591/2*\log(1/[H_2O]^3)=0.15449$ and common sum $\Delta E°=+0.10166-0.37239$ absolute standard potential is

$E°_{H2SO3}=E°_{Classic}-0,0591/2*\log(1/[H_2O]^3)+\Delta E°=0,172-0,0591/2*\log(1/55,3^{\wedge3})+0,10166-0,37239=0,055763$ V;

$\Delta G_{eqHSO3}=E°_{HSO3}•F•n=0,055763*96485*2=10,7600$ kJ/mol;

$\Delta G_{eqSO32-}=G_{SO42-}+2G_{H3O}+2G_{e-}-(G_{SO32-}+3G_{H2O})=26,44996+2*22,44+2*0-(60,56996+3*0)=10,7600$ kJ/mol ;

$G_{SO42-}=\Delta G_{eqSO32-}-2G_{H3O}-2G_{e-}+(G_{SO32-}+3G_{H2O})=10,7600-2*22,44-2*0+(60,56996+3*0)=26,44996$ kJ/mol ;

$G_{SO32-}=G_{SO42-}+2G_{H3O}+2G_{e-}-(\Delta G_{eqSO32-}+3G_{H2O})=26,44996+2*22,44+2*0-(10,7600+3*0)=60,56996$ kJ/mol ;

$2G_{e-}=\Delta G_{eqSO32-}-2G_{H3O}-G_{SO42-}+(G_{SO32-}+3G_{H2O})=10,7600-2*22,44-26,44996+(60,56996+3*0)=2*0$ kJ/mol ;

Formation $2Hg+Cl_2^{gas}=Hg_2Cl_{2(s)}$; $\Delta G_{eq\_Hg2Cl2}=G_{Hg2Cl2}-(2G_{Hg}+G_{Cl2}^{gas})=0-(2*35,7641+139,1718)=-210,7$ kJ/mol;

$G_{Hg2Cl2}=\Delta G_{eq\_Hg2Cl2}+(2G_{Hg}+G_{Cl2}^{gas})=-210,7+(2*35,7641+139,1718)=0$ kJ/mol;

Formation $Hg+Cl_2^{gas}=HgCl_{2(s)}$; $\Delta G_{eq\_HgCl2}=G_{HgCl2}-(G_{Hg}+G_{Cl2}^{gas})=0,0001-(35,7641+142,836)=-178,6$ kJ/mol;

$G_{HgCl2}=\Delta G_{eq\_HgCl2}+(G_{Hg}+G_{Cl2}^{gas})=-178,6-(35,7641+142,836)=0,0001$ kJ/mol;

Formation $0,5Cl_2+e^-=Cl^-_{(aq)}$; $\Delta G_{eq\_Cl}=G_{Cl-(aq)}-(0,5G_{Cl2}^{gas}+G_{e-})=66,1832-(0,5*142,836+G_{e-})=-131,2$ kJ/mol;

$G_{e-}=G_{Cl-(aq)}-(0,5G_{Cl2}^{gas}+\Delta G_{eq\_Cl})=66,1832-(0,5*142,836-131,2)=125,9652$ kJ/mol;

$G_{Cl-(aq)}=\Delta G_{eq\_Cl}+(0,5G_{Cl2}^{gas}+G_{e-})=-131,2+(0,5*142,836+178,720)=66,1832$ kJ/mol;

Formation $0,5O_2^{gas}+Hg=HgO$; $\Delta G_{HgO}=G_{HgO}-(G_{Hg}+0,5G_{O2}^{gas})=147,25-(54,2+0,5*303,1)=-58,5$ kJ/mol;

$G_{Hg}=G_{HgO}-(\Delta G_{HgO}+0,5G_{O2}^{gas})=147,25-(-58,5+0,5*303,1)=54,2$ kJ/mol;

$G_{HgO}=\Delta G_{HgO}+(G_{Hg}+0,5G_{O2}^{gas})=-58,5-(35,778+0,5*303,1)=-58,5$ kJ/mol;

[1] Solubility $Hg_2Cl_2+3H_2O=Hg_2^{2+}+2Cl^-$; $K_{sp}=[Hg_2^{2+}]*[Cl^-]^2/[Hg_2Cl_2]/[H_2O]^{\wedge3}=1,43*10^{\wedge(-18)}/1/55,3^{\wedge3}=10^{-23,07}$;

$\Delta G_{eqHg2Cl2}=-R•T•\ln(K_{AbsoluteHg2Cl2})=-8,314*298,15*\ln(10^{\wedge(-23,1)})=131,68$ kJ/mol;

$\Delta G_{eqHg2Cl2}=G_{Hg22+}+2G_{Cl-}-(G_{Hg2Cl2}+3G_{H2O})=183,0782+2*66,1832-(183,5073+3*0)=131,68$ kJ/mol;

$G_{Cl-}=(-G_{Hg22+}+\Delta G_{eqHg2Cl2}+(G_{Hg2Cl2}+3G_{H2O}))/2=(-183,0782+131,68+(183,5073+3*0))/2=66,05455$ kJ/mol;

Formation $2Hg+Cl_2=Hg_2Cl_{2(s)}$; $\Delta G°_{Hg2Cl2}=G_{Hg2Cl2}-(2G_{Hg}+G_{Cl2})=-(2*35,7641+G_{Cl2})=-210,7=$ kJ/mol;

$\Delta G°_{Hg2Cl2}=G_{Hg2Cl2}-(2G_{Hg}+G_{Cl2})=G_{Hg2Cl2}-(2*35,7641+G_{Cl2})=-210,7=$ kJ/mol;

$G_{Cl2}=-(2G_{Hg}+\Delta G°_{Hg2Cl2})=-(2*35,7641-210,7)=139,1718$ kJ/mol;

Formation $Hg+Cl_2=HgCl_2$;

$\Delta G°_{HgCl2}$=-(**35,76**+G_{Cl2})=-178,6 $^{kJ}/_{mol}$; G_{Cl2}=-(G_{Hg}+$\Delta G°_{HgCl2}$)=-(**35,7641**-178,6)=**142,836** $^{kJ}/_{mol}$;
$2Hg+2Cl^- = Hg_2Cl_{2(s)}+2H_2O+2e^-$; Expression of absolute potential has standard $E°_{Classic}$=0,26808 V [1],
water and ΔE°: $E°_{HgCl2}=E°_{Classic}-0{,}0591/2*lg([H_2O]^2)+\Delta E°$=0,26808-0,1030+0,10166-0,37239=**-0,10565** V;

$$\Delta G_{eq\_Hg2Cl2}=E°_{Hg2Cl2}\bullet F\bullet n=\mathbf{-0{,}1056451}*96485*2=\mathbf{-20{,}3863}\ ^{kJ}/_{mol},$$

$\Delta G_{eq\_Hg2Cl2}=G_{Hg2Cl2}+\mathbf{2G_{H2O}}+2G_{e^-}-(\mathbf{2G_{Cl^-}}+2G_{Hg})$=**183,5083+2*0+2*0-(2*66,1832+2*35,7641)=-20,3863** $^{kJ}/_{mol}$;
$G_{Hg2Cl2}=\Delta G_{eq\_Hg2Cl2}-\mathbf{2G_{H2O}}-2G_{e^-}+(\mathbf{2G_{Cl^-}}+2G_{Hg})$=**-20,3863-2*0-2*0+(2*66,1832+2*35,7641)=183,5083** $^{kJ}/_{mol}$;
$\mathbf{2G_{Cl^-}}=G_{Hg2Cl2}+\mathbf{2G_{H2O}}+2G_{e^-}-(\Delta G_{eq\_Hg2Cl2}+2G_{Hg})$=**183,508+2*0+2*0-(-20,386+2*35,76)=132,366=2*66,19** $^{kJ}/_{mol}$;
$G_{Hg}=(G_{Hg2Cl2}+\mathbf{G_{H2O}}+2G_{e^-}-(\mathbf{2G_{Cl^-}}+\Delta G_{eq\_Hg2Cl2}))/2$=**(183,5083+2*0+2*0-(2*66,1832-20,3863))/2=35,7641** $^{kJ}/_{mol}$;
$2G_{e^-}=\Delta G_{eq\_Hg2Cl2}-G_{Hg2Cl2}-\mathbf{2G_{H2O}}+(\mathbf{2G_{Cl^-}}+2G_{Hg})$=**-20,3863-183,5083-2*0-2*0+(2*66,1832+2*35,7641)=0** $^{kJ}/_{mol}$;
Šķīdības līdzsvara atraktors $Hg_2SO_{4(s)}+2H_2O=\mathbf{Hg_2}^{2+}+SO_4^{2-}$; $2Hg+2H_2O=Hg_2^{2+}+2e^-$; absolūtā konstante ir :

$$K_{Absolute\mathbf{Hg2SO4}}=K_{sp\mathbf{Hg2SO4}}/[H_2O]^{\wedge}2=[\mathbf{Hg_2}^{2+}]*[SO_4^{2-}]/[Hg_2SO_{4(s)}]/[H_2O]^{\wedge}2=6{,}5*10^{\wedge(-7)}/1/55{,}3^{\wedge}2=10^{-9{,}6725};$$

$$\Delta G_{eq\mathbf{Hg2SO4}}=\mathbf{-R\bullet T\bullet ln}(K_{Absolute\mathbf{Hg2SO4}})=\mathbf{-8{,}314*298{,}15*ln}(10^{\wedge(-9{,}6725)})=\mathbf{55{,}20765}\ ^{kJ}/_{mol};$$

$\Delta G_{eq\mathbf{Hg2SO4}}=G_{\mathbf{Hg2}^{2+}}+G_{SO4^{2-}}-(G_{Hg2SO4}+\mathbf{2G_{H2O}})$=**183,0782+26,44996-(154,3205+2*0)=55,20765** $^{kJ}/_{mol}$;
$G_{Hg2SO4}=G_{\mathbf{Hg2}^{2+}}+G_{SO4^{2-}}-(\Delta G_{eq\mathbf{Hg2SO4}}+\mathbf{2G_{H2O}})$=**183,0782+26,44996-(55,20765+2*0)=154,3205** $^{kJ}/_{mol}$;
$Hg_2SO_{4(s)}+2H_2O=\mathbf{Hg_2}^{2+}+SO_4^{2-}$; $2Hg+H_2O=\mathbf{Hg_2}^{2+}+2e^-$;
$Hg_2SO_{4(s)}+2H_2O-SO_4^{2-}=\mathbf{Hg_2}^{2+}$; $2Hg+H_2O=\mathbf{Hg_2}^{2+}+2e^-$; $2Hg+H_2O=Hg_2SO_{4(s)}+2H_2O-SO_4^{2-}+2e^-$;
$2Hg+SO_4^{2-}=Hg_2SO_{4(s)}+H_2O+2e^-$; Absolūtais aprēķins satur standarta potenciālu $E°_{klasisko}$=0,6125 V [18], ūdens logaritmu un ΔE°: $E°_{HgSO4}=E°_{klasisko}-0{,}0591/2*lg([H_2O]^1)+\Delta E°$=0,6125-0,0515 +0,10166-0,37239=**0,29027** V;

$$\Delta G_{eq\_HgSO4}=E°_{HgSO4}\bullet F\bullet n=\mathbf{0{,}29027}*96485*2=\mathbf{56{,}0134}\ ^{kJ}/_{mol},$$

$\Delta G_{eq\_Hg2SO4}=G_{Hg2SO4}+2G_{e^-}-(2G_{Hg}+\mathbf{G_{SO4}})$=**153,99156-(2*35,7641+26,44996)=56,0134** $^{kJ}/_{mol}$;
$G_{Hg2SO4}=\Delta G_{eq\_Hg2SO4}-2G_{e^-}+(2G_{Hg}+\mathbf{G_{SO4}})$=**56,0134-2*0+(2*35,7641+26,44996)=153,99156** $^{kJ}/_{mol}$;
$2G_{e^-}=\Delta G_{eq\_Hg2SO4}-G_{Hg2SO4}+(2G_{Hg}+\mathbf{G_{SO4}})$=**56,0134-153,99156-(2*35,7641+26,44996)=0** $^{kJ}/_{mol}$;
$\mathbf{G_{SO4}}=G_{Hg2SO4}+2G_{e^-}-(2G_{Hg}+\Delta G_{eq\_Hg2SO4})$=**153,99156+2*0-(2*35,7641+56,0134)=26,44996** $^{kJ}/_{mol}$;

$Hg+2OH^- = HgO+H_2O+2e^-$, Absolūtais aprēķins satur standarta potenciālu $E°_{klasisko}$=0,0977 V [1], ūdens logaritmu un ΔE°: $E°_{HgO}=E°-0{,}0591/2*lg([H_2O]^1)+\Delta E°$=0,0977-0,0515+0,10166-0,37239=**-0,224528** V;

$$\Delta G_{eqHgO}=E°_{HgO}\mathbf{*F*n=-0{,}224528}*96485*2=\mathbf{-43{,}327}\ ^{kJ}/_{mol};$$

$\Delta G_{eqHgO}=G_{HgO}+G_{H2O}-(G_{Hg}+2G_{OH})$=**147,157+0-(35,7641+2*77,36)=-43,327** $^{kJ}/_{mol}$;
$G_{HgO}=\Delta G_{eqHgO}-G_{H2O}+(G_{Hg}+2G_{OH})$=**-43,327-0+(35,7641+2*77,36)=147,157** $^{kJ}/_{mol}$;
$G_{Hg}=G_{HgO}+G_{H2O}-(\Delta G_{eqHgO}+2G_{OH})$=**147,157+0-(-43,327+2*77,36)=35,764** $^{kJ}/_{mol}$;
Reducēšanas $HgO+2H_2O+2e^- = Hg+2OH^-$, inversais standarta potenciāls $-E°_{HgO}$=**0,224528** V.
Oksidēšanas $\mathbf{H_2O_{2aqua}+2H_2O=O_{2aqua}+2H_3O^+}+\mathbf{2e^-}$ Nernsta absolūtais standarta potenciāls $E°_{\mathbf{RedH2O2}}$=**0,52677** V;
$HgO+2H_2O+\cancel{2e^-}+\mathbf{H_2O_{2aqua}+2H_2O}=Hg+2OH^-+\mathbf{O_{2aqua}+2H_3O^+}+\cancel{2e^-}$;
$HgO+\mathbf{H_2O_{2aqua}+4H_2O}=Hg+\mathbf{O_{2aqua}}+(2OH^-+\mathbf{2H_3O^+})$; $HgO+\mathbf{H_2O_{2aqua}+4H_2O}=Hg+\mathbf{O_{2aqua}}+\mathbf{(4H_2O)}$;
$\Delta G_{eqRedOx\_H2O2}=(\Delta E°_{H2O2aqRed}-E°_{HgO})\mathbf{*F*n}=\mathbf{(0{,}52677+0{,}224528)}*96485*2=(0{,}7513)*96485*2=\mathbf{144{,}978}\ ^{kJ}/_{mol}$;
Summā: $HgO+\mathbf{H_2O_{2aqua}}=Hg+\mathbf{O_{2aqua}}=Hg+\mathbf{O_2}^{gas}+\mathbf{H_2O}$; katalāze $\mathbf{G_{H2O2}}$=**279,3** $^{kJ}/_{mol}$;
$\Delta G_{eqRedOx\_H2O2}=G_{Hg}+G_{O2aqua}-(G_{HgO}+G_{H2O2})$=**35,778+330-(-58,5+279,3)=144,978** $^{kJ}/_{mol}$;
HgO ; $G_{Hg}=\Delta G_{eqRedOx\_H2O2}-G_{O2aqua}+(G_{HgO}+G_{H2O2})$=**144,978-330+(-58,5+279,3)=35,778** $^{kJ}/_{mol}$;

Sāls $\mathbf{Na^+Cl^-}$ kristāliem hidratācijas reakcijā ir 36 grami šķīdība ūdenī 100 gramos, blīvums 1,203 $^{g}/_{mL}$.
w%=26,4706 %: nc=49,142/12=4,0952 M.
26,4706 grami ir 100 gramos un X grami ir 1203g. Tāpēc litrā ir X=26,4706/100*1203=318,44 grami **NaC**.
Kopējā koncentrācija ir $C_{M\_total}=[\mathbf{NaCl}]_{total}$=m/M=318,44/58,4 $^{g}/_{mol}$=5,45274 M;
Ūdens masa vienā litrā ir $m_{\mathbf{H2O}}$=1203-318,44= 884,56 g; Molu skaits vienā litrā ir $n_{\mathbf{H2O}}$=884,56/18=49,142mol;
Daļa **NaCl** paliek nedisociētas neitrālas molekulas nepietiekamu ūdens resursu dēļ 49,142 moli.
Saturated non-dissociate [**NaCl**]=5,45274-4,0952=1,35754 M; disociācija **α**=4,0952/5,45274=0,751; 75,1 %;
Disociācijas līdzsvara konstante ir $\mathbf{K_{dis}}=[\mathbf{Na^+}_{aq}]*[\mathbf{Cl^-}_{aq}]/[\mathbf{NaCl}]$=4,0952*4,0952/1,35754=12,3537;
Šķīdības līdzsvara konstante ir $\mathbf{K_{šķ}}=[\mathbf{Na^+}_{tot}]*[\mathbf{Cl^-}_{tot}]/[\mathbf{NaCl}]_{cryst}$=5,45274*5,45274/1=29,73237;
Disoci\acijas Prigožina atraktors ir ΔG_{dis}= **-R•T•ln(K$_{dis}$)**=-8,3144*298,15***ln**(12,3537)=-6,232 $^{kJ}/_{mol}$,
Šķīdības Prigožina atraktors ir $\Delta G_{šķ}$= **-R•T•ln(K$_{šķ}$)**=-8,3144*298,15***ln**(29,73237)= -8,409 $^{kJ}/_{mol}$,
Termodinamiskās absolūtās enerģijas skalas atraktors ir $\Delta G_H=\Delta H_H-T\Delta S_H$=-9,15 $^{kJ}/_{mol}$;

Viela	$\Delta H°_H$ $^{kJ}/_{mol}$	$\Delta S°_H$ $^{J}/_{mol/K}$	$\Delta G°_H$ $^{kJ}/_{mol}$
$\mathbf{Na^+Cl^-}$	-411,12	72,00	-
$\mathbf{Na^+}_{aq}$	-240,10	59,00	-

kristālisks $\mathbf{Na^+Cl^-}$+**Q=>**$\mathbf{Na^+}_{aq}+\mathbf{Cl^-}_{aq}$+ΔG; **endotermiska**.
$\Delta H_{Hess}=\Delta H°_{\mathbf{Na}}+\Delta H°_{\mathbf{Cl}}-\Delta H°_{\mathbf{Na+Cl}}$= -240,1-167,2-(-411,12)=3,82 $^{kJ}/_{mol}$;
$\Delta S_{izkliedēta}=-\Delta H_H/T$=-3,82/298,15=-12,812 $^{J}/_{(mol\ K)}$;
$\Delta S_H=\Delta S°_{\mathbf{Na}}+\Delta S°_{\mathbf{Cl}}-\Delta S°_{\mathbf{NaCl}}$=59+56,50-(72)=43,5 $^{J}/_{mol/K}$; $\mathbf{\Delta G_H}=\mathbf{\Delta H_H-T\Delta S_H}$=3,82-298,15*0,0435=-9,15 $^{kJ}/_{mol}$;
$\Delta S_{kopējā}=\Delta S_{Hess}+\Delta S_{izkliedēta}$=-12,812+43,5=30,688 $^{J}/_{mol/K}$; T•$\Delta S_{kopējā}$=30,688*298,15=**9,15** $^{kJ}/_{mol}$ saistīta enerģija.

Stipri oksidētāji skābeklis **O_2** un hlors Cl_2 aqua vienā molā satur brīvo enerģiju **330** $^{kJ}/_{mol}$ un **332,58** $^{kJ}/_{mol}$.
$NaCl=Na^{+}+Cl^{-}$; $2Cl^{-}=Cl_2+H_2O+2e^{-}$; E izteisme satur $E°_{klasisko}$=1,35827 V [1] ūdens -0,04998 , summu $\Delta E°$:
$E°_{2Cl\text{-}Cl2}=E°_{klasisko}$-0,0591/2*lg([$H_2O$)+$\Delta E°$=1,35827-0,0591/2*lg(49,142)+0,10166-0,37239=**1,037558** V;

$$\Delta \mathbf{G}_{\mathbf{eq}\_2Cl\text{-}Cl2}=E°_{Hg2Cl2}\bullet F\bullet n=\mathbf{1,037558}*96485*2=\mathbf{200,218}\ ^{kJ}/_{mol},$$

$$\Delta \mathbf{G}_{\mathbf{eq}\_2Ci\text{-}Cl2}=G_{Cl2}{}^{gas}+G_{H2O}\text{-}(\mathbf{2G_{Cl\text{-}}})=\mathbf{332,5844}\text{-}(2*\mathbf{66,1832})=\mathbf{200,218}\ ^{kJ}/_{mol}\ ;$$

Saturated NaCl 5,45274 M; $(\mathbf{2G_{Cl\text{-}}})=G_{Cl2}{}^{gas}+G_{H2O}\text{-}\Delta \mathbf{G}_{\mathbf{eq}\_2Ci\text{-}Cl2}=\mathbf{332,5844}\text{-}\mathbf{200,218}=\mathbf{132,3664}=2*\mathbf{66,1832}\ ^{kJ}/_{mol}$;

$[Cl_2]$= 4*10^(-14) M; $G_{Cl2}{}^{gas}=\Delta \mathbf{G}_{\mathbf{eq}\_2Ci\text{-}Cl2}\text{-}G_{H2O}+(\mathbf{2G_{Cl\text{-}}})=\mathbf{200,218}+(2*\mathbf{66,1832})=\mathbf{332,584}\ ^{kJ}/_{mol}$;

$$\mathbf{K}_{\mathbf{eq}\_2Cl\text{-}Cl2}=[Cl_2]*[H_2O]/[Cl^{-}]\text{^}2=4*10\text{^}(-14)(gasCl2)*49,142/5,45274\text{^}2=6,611*10\text{^}(-14)(KgasCl2);$$

$$\mathbf{E}_{2Cl\text{-}Cl2}=(E°_{2Cl\text{-}Cl2}+\mathbf{RT/F/n*ln(}K_{\mathbf{eq}\_2Cl\text{-}Cl2})=(KgasCl2))=$$

$$=(\mathbf{1,037558}+8,3144*298,15/96485/2*\mathbf{ln(}6,611*10\text{^}(-14)\ (KgasCl2))=\mathbf{0,6477098\ V};$$

$$\Delta \mathbf{G}_{\mathbf{eq}\_2Cl\text{-}Cl2}=\mathbf{E}_{2Cl\text{-}Cl2}*F*n=\mathbf{0,6477098}\ (ECl2gas)*96485*2=\mathbf{125}\ ^{kJ}/_{mol};$$

$$\Delta \mathbf{G}_{\mathbf{eq}\_2Ci\text{-}Cl2}=G_{Cl2}{}^{gas}\text{-}(\mathbf{2G_{Cl\text{-}}})=\mathbf{257,3664}\text{-}(2*\mathbf{66,1832})=\mathbf{125}\ ^{kJ}/_{mol}\ ;$$

$$\mathbf{2G_{Cl\text{-}}}=G_{Cl2}{}^{gas}\text{-}\Delta \mathbf{G}_{\mathbf{eq}\_2Ci\text{-}Cl2}=\mathbf{257,3664}\text{-}\mathbf{125}=\mathbf{132,36654}=2*\mathbf{66,1832}\ ^{kJ}/_{mol}\ ;$$

$$G_{Cl2}{}^{gas}=\Delta \mathbf{G}_{\mathbf{eq}\_2Ci\text{-}Cl2}+(\mathbf{2G_{Cl\text{-}}})=\mathbf{125}+(2*\mathbf{66,1832})=\mathbf{257,3664}^{kJ}/_{mol}\ ;$$

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

Formation $Pb+S_{rombisks}+2O_2^{gas}=PbSO_4$: $\Delta G°_{PbSO4Form}=G_{PbSO4}-(G_{Pb}+G_{Srombisks}+2G_{O2})$=-813 $^{kJ}/_{mol}$; [1] Saturs molā ir $G_{PbSO4}=\Delta G°_{PbSO4Form}+(G_{Pb}+G_{Srombisks}+2G_{O2})$ =-813,0+(**282,25737+3,5436+2*303,1**)=**79,00097** $^{kJ}/_{mol}$.

Solubility https://en.wikipedia.org/wiki/Lead(II)_sulfate $PbSO_{4(s)}+2H_2O=Pb^{2+}+SO_4^{2-}$; 0,0425 $^{g}/_{1000mL\ H2O}$; $[PbSO_4]$=0,0425/303,26 $^{g}/_{mol}$=0,000140144 M; $K_{sp}=[PbSO_4]^2$=0,000140144^2=1,96403*10^(-8); $K_{PbSO4}=K_{sp}/[H_2O]^2$=1,964*10^(-8)/55,3^2=8,27314*10^(-12);

Solubility URI 2018 K_{sp}=2,53*10^(-8); $K_{PbSO4}=K_{sp}/[H_2O]^2$=2,53*10^(-8)/55,3^2=8,2731*10^(-12); $[PbSO_4]$=SQRT(2,53*10^(-8))=0,00015906 M; $K_{PbSO4}=K_{sp}/[H_2O]^2$=2,53*10^(-8)/55,3^2=6,8837*10^(-12);

25°C [1] Solubility $PbSO_{4(s)}+2H_2O=Pb^{2+}+SO_4^{2-}$; (0,0425)0,044 $^{g}/_{1000mL\ H2O}$; M_{PbSO4}=303,26 $^{g}/_{mol}$; $[PbSO_4]$=0,044/303,26=0,00014509 M; $K_{sp}=[PbSO_4]^2$=0,00014509^2=2,1051*10^(-8); $K_{PbSO4}=K_{sp}/[H_2O]^2$=2,1051*10^(-8)/55,3^2=6,8837*10^(-12);

$\Delta G_{eqPbSO4}$=**-R•T•ln(**$K_{AbsolutePbSO4}$**)=-8,314*298,15*ln(**6,8837*10^(-12)**)=63,71** $^{kJ}/_{mol}$;

$\Delta G_{eqPbSO4}=G_{Pb2+}+G_{SO42-}-(G_{PbSO4}+2G_{H2O})$=**215,4144+54,9256-(206,63+2*0)=63,71** $^{kJ}/_{mol}$;

$G_{Pb2+}=\Delta G_{eqPbSO4}-G_{SO42-}+(G_{PbSO4}+2G_{H2O})$=**63,71-54,9256+(206,63+2*0)=215,4144** $^{kJ}/_{mol}$;

$Pb(Hg)+SO_4^{2-}=PbSO_4+H_2O+2e^-$; pH=7,36 Absolūtais aprēķins satur standarta potenciālu $E°_{klasisko}$=-0,3505 V [1], ūdens logaritmu un ΔE°: $E°_{Pb/PbSO4}=E°_{klasisko}-0,0591/2*\log([H_2O])+\Delta E°$=-0,3505-0,0515+0,10166-0,37239=**-0,67273** V;

$\Delta G_{eqPb/Pb/PbSO4}=E°_{Pb/Pb/PbSO4}$***F*n=-0,67273***96485*2=**-129,8167** $^{kJ}/_{mol}$

$\Delta G_{eqPb/Pb/PbSO4}=G_{PbSO4}+G_{H2O}-(G_{Pb}+G_{SO42-})$=**207,3631**+0-(**282,2575+54,9256**)=**-129,82** $^{kJ}/_{mol}$;

$G_{PbSO4}=\Delta G_{eqPb/Pb/PbSO4}-G_{H2O}+(G_{Pb}+G_{SO42-})$=**-129,82**-0+(**282,2575+54,9256**)=**207,363** $^{kJ}/_{mol}$;

$G_{Pb}=G_{PbSO4}+G_{H2O}-(\Delta G_{eqPb/Pb/PbSO4}+G_{SO42-})$=**207,3631**+0-(**-129,82+54,9256**)=**282,2575** $^{kJ}/_{mol}$;

$Pb+SO_4^{2-}=PbSO_4+H_2O+2e^-$; pH=7,36 Absolūtais aprēķins satur standarta potenciālu $E°_{klasisko}$=-0,3588 V [1], ūdens logaritmu un ΔE°: $E°_{Pb/PbSO4}=E°_{klasisko}-0,0591/2*\log([H_2O])+\Delta E°$=-0,3588-0,0515+0,10166-0,37239=**-0,681028** V;

$\Delta G_{eqPb/Pb/PbSO4}=E°_{Pb/Pb/PbSO4}$***F*n=-0,681028***96485*2=**-131,41797** $^{kJ}/_{mol}$;

$\Delta G_{eqPb/Pb/PbSO4}=G_{PbSO4}+G_{H2O}-(G_{Pb}+G_{SO42-})$=**205,76497**+0-(**282,25737+54,9256**)=**-131,41797** $^{kJ}/_{mol}$;

$G_{PbSO4}=\Delta G_{eqPb/Pb/PbSO4}-G_{H2O}+(G_{Pb}+G_{SO42-})$=**-131,41797**-0+(**282,2575+54,9256**)=**205,76497** $^{kJ}/_{mol}$;

$G_{Pb}=G_{PbSO4}+G_{H2O}-(\Delta G_{eqPb/Pb/PbSO4}+G_{SO42-})$=**205,76497**+0-(**-131,41797+54,9256**)=**282,25737** $^{kJ}/_{mol}$;

$Pb+H_2O=Pb^{2+}+2e^-$; pH<=7,36 Absolūtais aprēķins satur standarta potenciālu $E°_{klasisko}$=-0,1262 V [1], ūdens logaritmu un ΔE°: $E°_{Pb/Pb2+}=E°_{klasisko}-0,0591/2*\log(1/[H_2O])+\Delta E°$=-0,1262+0,0515+0,10166-0,37239=**-0,34543** V;

$\Delta G_{eqPb\downarrow Pb2+}=E°_{Pb\downarrow Pb2+}$***F*n=-0,34543***96485*2=**-66,6576** $^{kJ}/_{mol}$;

$\Delta G_{eqPb\downarrow Pb2+}=G_{Pb2+}+2G_{e-}-(G_{Pb}+G_{H2O})$=**215,4144+2*0-(282,0676+0)=-66,6576** $^{kJ}/_{mol}$**;**

$G_{Pb2+}=\Delta G_{eqPb\downarrow Pb2+}-2G_{e-}+(G_{Pb}+G_{H2O})$=**-66,6576-2*0+(282,0676+0)=215,41** $^{kJ}/_{mol}$**;**

$G_{Pb}=G_{Pb2+}+2G_{e-}-(\Delta G_{eqPb\downarrow Pb2+}+G_{H2O})$=**215,41+2*0-(-66,6576+0)=282,0676** $^{kJ}/_{mol}$**;**

$2G_{e-}=\Delta G_{eqPb\downarrow Pb2+}-G_{Pb2+}+(G_{Pb}+G_{H2O})$=**-66,6576-215,4144+(282,0676+0)=2*0** $^{kJ}/_{mol}$**;**

Formation $Pb=Pb^{2+}+2e^-$; $\Delta G°=G_{Pb2+}+2G_{e-}+-(G_{Pb})$=**215,414-(282,0676**+$2G_{e-}$)=-24,43 $^{kJ}/_{mol}$;

$2G_{e-}=\Delta G°-G_{Pb2+}+(G_{Pb})$=-24,43-**215,414+(282,0676)=42,2236=2*21,1118** $^{kJ}/_{mol}$;

Veidošanās $Pb+O_2^{gas}=\underline{PbO_2}(s)$; $G_{PbO2}=\Delta G_{PbO2}+(G_{Pb}+G_{O2}^{gas})$=-217,3+(**282,0676+303,1**)=**367,8676** $^{kJ}/_{mol}$;

$Pb^{2+}+6H_2O=\underline{PbO_2}(s)+4H_3O^++2e^-$; Absolūtais aprēķins satur standarta potenciālu $E°_{klasisko}$=1,455 V [1], ūdens logaritmu un ΔE°: $E°_{PbO2}=E°_{klasisko}-0,0591/2*\log(1/[H_2O]^6)+\Delta E°$=1,455+0,30899+0,10166-0,37239=**1,493255 V**;

$\Delta G_{eqPbO2\downarrow Pb2+}=E°_{PbO2\downarrow Pb2+}$•F•n=**1,493255***96485*2=**288,1534** $^{kJ}/_{mol}$;

$\Delta G_{eqPbO2\downarrow Pb2+}=G_{PbO2}+4G_{H3O+}-(G_{Pb2+}+6G_{H2O})$=**383,9944**+4***22,44-(185,601**+6***0)=288,1534** $^{kJ}/_{mol}$;

$G_{PbO2}=\Delta G_{eqPbO2\downarrow Pb2+}-4G_{H3O+}+(G_{Pb2+}+6G_{H2O})$=**288,1534**-4***22,44+(185,601**+6***0)=383,9944** $^{kJ}/_{mol}$;

$G_{Pb2+}=G_{PbO2}+4G_{H3O+}-(\Delta G_{eqPbO2\downarrow Pb2+}+6G_{H2O})$=**383,9944**+4***22,44-(288,1534**+6***0)=185,601** $^{kJ}/_{mol}$;

$E_{PbO2\downarrow/Pb2+}=E°_{PbO2\downarrow Pb2+}+0,0591/2\bullet\log\frac{[Pb\,O_2\downarrow]\cdot[H_3O^+]^6}{[Pb^{2+}]\cdot[H_2O]^3}$ =**1,493255** V+$0,0591/2\bullet\log\frac{[Pb\,O_2\downarrow]\cdot[H_3O^+]^6}{[Pb^{2+}]\cdot[H_2O]^3}$;

Formation $0,5Cl_2+e^-=Cl^-_{(aq)}$; $\Delta G_{eq\_Cl}=G_{Cl-(aq)}-(\ 0,5G_{Cl2}^{gas}+G_{e-})$=**66,1832**-(0,5***142,836**+G_{e-})=-131,2 $^{kJ}/_{mol}$;

$G_{e-}=G_{Cl-(aq)}-(0,5G_{Cl2}^{gas}+\Delta G_{eq\_Cl})$=**66,1832**-(0,5***142,836**-131,2)=**125,9652** $^{kJ}/_{mol}$;

$G_{Cl-(aq)}=\Delta G_{eq\_Cl}+(\ 0,5G_{Cl2}^{gas}+G_{e-})$=-131,2+(0,5***142,836+178,720**)=**66,1832** $^{kJ}/_{mol}$;

Formation $Pb+Cl_2=PbCl_{2(s)}$; $\Delta G°_{PbCl2Form}=G_{PbCl2}-(G_{Pb}+G_{Cl2})$=-314,1 $^{kJ}/_{mol}$; [1] Enerģijas saturs molā ir

$G_{PbCl2}=\Delta G°_{PbCl2Form}+(G_{Pb}+G_{Cl2})$=-314,1+(**282,25737+332,584**)=**300,74** $^{kJ}/_{mol}$.

Šķīdība $PbCl_2+3H_2O=Pb^{2+}+2Cl^-$; 10,8 $^{g}/_{1000mL\ H2O}$; M_{PbCl2}=278,1 $^{g}/_{mol}$; **25°C** $[PbCl_2]$=10,8/278,1=0,038835 M; $K_{sp}=[PbCl_2]*(2*[PbCl_2])^2=[Pb^{2+}]*(2*[Cl^-])^2$=0,03883495*(2*0,03883495)^2=0,000234276 M^3; 25°C [1]

25°C $K_{PbCl2}=K_{sp}/[H_2O]^3$=0,000234276/55,3^3=1,385327*10^(-9)=10^(-8,858447);

[1] Solubility $PbCl_2+3H_2O=Pb^{2+}+2Cl^-$; $K_{sp}=[Pb^{2+}]*[Cl^-]^2/[H_2O]^3$=1,7*10^(-5)/55,3^3=10^(-9,9977);

ΔG_{eqPb}Cl2=**-R•T•ln(**$K_{Absolute}$**Pb**Cl2**)=-8,314*298,15*ln(**10^(-9,9977)**)=57,06379** $^{kJ}/_{mol}$

$\Delta G_{eqPbCl2}=G_{Pb2+}+2G_{Cl-}-(G_{PbCl2}+3G_{H2O})$=**215,4144**+2***66,1832-(290,717**+3*0)=**57,06379** $^{kJ}/_{mol}$;

$G_{PbCl2}=G_{Pb2+}+2G_{Cl-}-(\Delta G_{eqPbCl2}+3G_{H2O})$=**215,4144**+2***66,1832-(57,06379**+3*0)=**290,717** $^{kJ}/_{mol}$;

[1] Solubility $PbSO_4+2H_2O=Pb^{2+}+SO_4^{2-}$; $K_{sp}=[Pb^{2+}]*[SO_4^{2-}]/[H_2O]^2=2{,}53*10^{\wedge(-8)}/55{,}3^{\wedge 2}=10^{\wedge(-11{,}082)}$;

$\Delta G_{eqPbSO4}=-R\bullet T\bullet \ln(K_{AbsolutePbSO4})=-8{,}314*298{,}15*\ln(10^{\wedge(-11{,}082)})=63{,}2526$ kJ/mol

$\Delta G_{eqPbSO4}=G_{Pb2+}+G_{SO42-}-(G_{Pb\,SO4}+3G_{H2O})=215{,}4144+54{,}9256-(207{,}0874+3*0)=63{,}2526$ kJ/mol;

$G_{PbSO4}=G_{Pb2+}+G_{SO42-}-(\Delta G_{eqPbSO4}+3G_{H2O})=215{,}4144+54{,}9256-(63{,}2526+3*0)=207{,}0874$ kJ/mol;

$G_{Pb2+}=\Delta G_{eqPbSO4}-G_{SO42-}+(G_{Pb\,SO4}+3G_{H2O})=63{,}2526-54{,}9256+(207{,}0874+3*0)=215{,}4144$ kJ/mol;

Substance	$\Delta H°_H$, kJ/mol	$\Delta S°_H$, J/mol/K	$\Delta G°_H$, kJ/mol
Pb	$E°_{Pb\downarrow Pb2+}=$	**-0,34543** V	**282,0676**
Pb	$E°_{Pb/PbSO4}$	**-0,68103** V	**282,25737**
Pb	$E°_{Pb\downarrow PbCl2}=$	**-0,64123** V	**292,11**
$PbSO_{4(s)}$	-919,97	148,5	-813,0
$PbSO_{4(s)}$	formation	-813,0	**79,00097**
$PbSO_{4(s)}$	$K_{sp}=$	$10^{\wedge(-11{,}082)}$	**207,0874**
$PbSO_{4(s)}$	$E°_{Pb/PbSO4}=$	**-0,68102**	**205,765**
Pb^{2+}	$E°_{PbO2\downarrow Pb2+}=$	**1,493255** V	**185,601**
Pb^{2+}	$E°_{Pb/Pb2+}=$	**-0,34543** V	**215,41**
Pb^{2+}	-1,7	10,5	-24,43
Pb^{2+} G_{e-}	formation	-24,43	2***21,1118**
Pb^{2+}	$K_{PbSO4}=$	$10^{\wedge(-11{,}082)}$	**215,414-**
$PbCl_{2(s)}$	-359,4	135,98	-314,1
$PbCl_{2(s)}$	formation	-314,1	**300,74**
$PbCl_{2(s)}$	$K_{PbCl2}=$	$10^{\wedge(-9{,}9977)}$	**290,717**
Cl_2^{gas}	$Hg_2Cl_{2(s)}$	formation	**139,1718**
Cl_2^{gas}	$HgCl_{2(s)}$	formation	**142,8**
$Cl_{2aqNaCl}$	$E°_{2Cl-Cl2}=$	**1,03756** V	**332,584**
$^{14}Cl_{2aqNaCl}$	$K_{eq\_2Cl-Cl2}=$	**0,64771** V	**257,366**
$Cl^-_{(aq)}$	-167,2	56,6	-131,2
$Cl^-_{(aq)}$ G_{e-}	formation	-131,2	**125,9652**
$Cl^-_{(aq)}$	formation	-131,2	**66,1832**
$Cl^-_{(aq)}$	$K_{AbsoluteHg2Cl}$	$10^{\wedge(-23{,}07)}$	**66,05455**
Cl^-_{aqNaCl}	$E°_{2Cl-Cl2}=$	**1,03756** V	**66,1832**
$PbI_{2(s)}$	-175,5	174,9	-173,6
$PbI_{2(s)}$	PbI_2formation	-173,6	**345,128**
$PbI_{2(s)}$	$K_{PbI2}=10^{-13{,}23695}$		**343,634**
$PbI_{2(s)}$	$E°_{Pb/PbI2}=$**-0,738725** V		**334,925**
I-	-55,19	111,3	-51,57
I- G_{e-}	formation	-51,57	**30,9442**
I-	$E°_{I-/I2}=$**-0,738725**		**97,609**
I-	$K_{PbI2}=10^{-13{,}23695}$		**102,63**
I_2	PbI_2formation	-173,6	**236,4706**
I_2	$E°_{I-/I2}=$ **0,2137725**		**245,022**
PbO_{yellow}	-217,32	68,7	-187,89
PbOred	-218,99	66,5	-188,931
$PbO_2\downarrow$	-277,4	68,6	-217,3
$PbO_2\downarrow$	$E°_{PbO2\downarrow Pb2+}=$	**1,33876V**	**383,9944**
$PbO_2\downarrow$	formation	-217,3	**367,8676**
$Pb(OH)_{2(s)}$	-515,9	-203,589	-455,2
$Pb(OH)_{2(s)}$	formation	-455,2	**215,757**
$Pb(OH)_{2(s)}$	$K_{Pb(OH)2}=8{,}4559*10^{-26}$		**227,0244**
$Pb(OH)_{2(s)}$	$K_{eq\_Pb(OH)2s}$ $1{,}07*10^{20}$		**284,8644**
$Pb(OH)_{2aq}$	$K_{Pb(OH)2aq}1{,}355*10^{-16{,}91}$		**306,839**
$HPbO_2^-$	$E°_{Pb/HPbO2-}$	**-0,8592275**	**348,532**

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$G_{Pb}=G_{Pb2+}-(\Delta G_{eqPb\downarrow Pb2+}+G_{H2O})=215{,}41-(-66{,}6576+0)=282{,}0676$ kJ/mol;

$G_{Pb}=G_{PbSO4}+G_{H2O}-(\Delta G_{eqPb/Pb/PbSO4}+G_{SO42-})=282{,}25737$ kJ/mol;

$G_{Pb}=G_{PbCl2}+2G_{H2O}-(\Delta G_{eqPb/PbCl2}+2G_{Cl-})=292{,}11$ kJ/mol;

$[1]\Delta G°=\Delta H°-T*\Delta S°=-919{,}97-298{,}15*0{,}1485=-964{,}245$ kJ/mol;

$G_{PbSO4}=\Delta G°_{PbSO4Form}+(G_{Pb}+G_{Srombisks}+2G_{O2})=79{,}00097$ kJ/mol;

$G_{PbSO4}=G_{Pb2+}+G_{SO42-}-(\Delta G_{eqPbSO4}+3G_{H2O})=207{,}0874$ kJ/mol;

$G_{PbSO4}=\Delta G_{eqPb/Pb/PbSO4}-G_{H2O}+(G_{Pb}+G_{SO42-})=205{,}76497$ kJ/mol;

$G_{Pb2+}=G_{PbO2}+4G_{H3O+}-(\Delta G_{eqPbO2\downarrow Pb2+}+3G_{H2O})=185{,}601$ kJ/mol;

$G_{Pb2+}=\Delta G_{eqPb\downarrow Pb2+}+(G_{Pb}+G_{H2O})=215{,}41$ kJ/moll;

$[1]\Delta G°=\Delta H°-T*\Delta S°=-1{,}7-298{,}15*0{,}0105=-4{,}830575$ kJ/mol;

$2G_{e-}=\Delta G°-G_{Pb2+}+(G_{Pb})=-24{,}43-215{,}414+(282{,}07)=42{,}2236$ kJ/mol;

$G_{Pb2+}=\Delta G_{eqPbSO4}-G_{SO42-}+(G_{PbSO4}+2G_{H2O})=215{,}4144$ kJ/mol;

$\Delta G_{Cl-}=\Delta H_H-T*\Delta S_H=-359{,}4-298{,}15*0{,}13598=-399{,}94$ kJ/mol;[1]

$G_{PbCl2}=\Delta G°_{PbCl2Form}+(G_{Pb}+G_{Cl2})=300{,}74$ kJ/mol;

$G_{PbCl2}=G_{Pb2+}+2G_{Cl-}-(\Delta G_{eqPb}Cl2+3G_{H2O})=290{,}717$ kJ/mol;

$G_{Cl2}=-(2G_{Hg}+\Delta G°_{Hg2Cl2})=-(2*35{,}7641-210{,}7)=139{,}1718$ kJ/mol;

$G_{Cl2}=-(G_{Hg}+\Delta G°_{HgCl2})=-(35{,}8-178{,}6)=142{,}8$ kJ/mol;

$G_{Cl2}^{gas}=\Delta G_{eq\_2Ci-Cl2}+(2G_{Cl-})=200{,}218+(2*66{,}1832)=332{,}584$ kJ/mol;

$G_{Cl2}^{gas}=\Delta G_{eq_2Ci-Cl2}+(2G_{Cl-})=125+(2*66{,}1832)=257{,}3664$kJ/mol;

$\Delta G_{Cl-}=\Delta H_H-T*\Delta S_H=-167{,}2-298{,}15*0{,}0566=-183{,}955$ kJ/mol;[1]

$G_{e-}=G_{Cl-(aq)}-(0{,}5G_{Cl2}^{gas}+\Delta G_{eqCl})=125{,}9652$ kJ/mol;

$G_{Cl-(aq)}=\Delta G_{eq\_Cl}+(0{,}5G_{Cl2}^{gas}+G_{e-})=66{,}1832$ kJ/mol;

$G_{Cl-}=(-G_{Hg22+}+\Delta G_{eqHg2Cl2}+(G_{Hg2Cl2}+3G_{H2O}))/2=66{,}05455$ kJ/mol;

$2G_{Cl-}=G_{Hg2Cl2}+2G_{H2O}-(\Delta G_{eq\_Hg2Cl2}+2G_{Hg})=2*66{,}1832$ kJ/mol;

$\Delta G_{Cl-}=\Delta H_H-T*\Delta S_H=-175{,}5-298{,}15*0{,}1749=-227{,}65$ kJ/mol;[1]

$G_{PbI2}=\Delta G°_{PbI2Form}+(G_{Pb}+G_{I2})=345{,}128$ kJ/mol;

$G_{PbI2}=G_{Pb2+}+2G_{I-}-(\Delta G_{eqPbI2}+3G_{H2O})=343{,}634$ kJ/mol;

$G_{PbI2}=\Delta G_{eqPb/PbI2}-2G_{H2O}+(G_{Pb}+2G_{I-})=334{,}925$ kJ/mol;

$\Delta G_{Cl-}=\Delta H_H-T*\Delta S_H=-55{,}19-298{,}15*0{,}1113=-88{,}374$ kJ/mol;[1]

$Ge-=G_{I-}-(0{,}5G_{I2}+)=101{,}8852-(0{,}5*245{,}022-51{,}57)=30{,}9442$ kJ/mol;

$2G_{I-}=G_{PbI2}+2G_{H2O}-(G_{Pb}+\Delta G_{eqPb/PbI2})=195{,}219=2*97{,}609$ kJ/mol;

$2G_{1-}=\Delta G_{eqPbI2}-G_{Pb2+}+(G_{PbCl2}+3G_{H2O})=205{,}264=2*102{,}63$ kJ/mol;

$G_{I2}=G_{PbI2(s)}-(G_{Pb}+\Delta G°_{PbI2Form})=236{,}4706$ kJ/mol;

$G_{I2}=\Delta G_{eqI-/I2}-G_{H2O}+(2G_{I-})=41{,}2517-0+(2*101{,}8852)=245{,}022$ kJ/mol;

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[1] $\Delta G_{Cl-}=\Delta H_H-T*\Delta S_H=-277{,}4-298{,}15*0{,}0686=-297{,}853$ kJ/mol;

$G_{PbO2}=\Delta G_{eqPbO2\downarrow Pb2+}-4G_{H3O+}+(G_{Pb2+}+3G_{H2O})=383{,}1644$ kJ/mol;

$G_{PbO2}=\Delta G_{PbO2}+(G_{Pb}+G_{O2}^{gas})=-217{,}3+(282{,}0676+303{,}1)=367{,}87$ kJ/mol;

[34] $\Delta S°=(\Delta H°-\Delta G°)/T=(-515{,}9+455{,}2)/298{,}15=-203{,}589$ J/mol/K;

$G_{Pb(OH)2}=\Delta G°_{Pb(OH)2}+(G_{Pb}+G_{O2}+G_{H2}^{gas})=215{,}757$ kJ/mol;

$G_{Pb(OH)2}=G_{Pb2+}+2G_{OH-}-(\Delta G_{eqPb(OH)2}+3G_{H2O})=227{,}0244$ kJ/mol;

$G_{Pb(OH)2(s)}=G_{Pb2+}+G_{H2O}-(\Delta G_{eq\_Pb(OH)2s}+2G_{H3O+})=284{,}8644$ kJ/mol;

$G_{Pb(OH)2}=\Delta G_{eqPb+2+H2O}-2G_{H3O+}+(G_{Pb2+}+4G_{H2O})=306{,}839$ kJ/mol;

$G_{HPbO2-}=\Delta G_{eqPb/HPbO2-}-G_{H2O}+(G_{Pb+2}+3G_{OH-})=348{,}532$ kJ/mol;

$Pb+SO_4^{2-}=PbSO_4+H_2O+2e^-$; pH=7,36 $E°_{classic}=-0{,}3588$ V [1]

$E°_{Pb/PbSO4}=E°_{klasisko}-0{,}0591/2*\log([H_2O])+\Delta E°=-0{,}3588-0{,}0515+0{,}10166-0{,}37239=-0{,}681028$ V

$\Delta G_{eqPb/Pb/PbSO4}=E°_{Pb/Pb/PbSO4}*F*n=-0{,}681028*96485*2=-131{,}41797$ kJ/mol;

$\Delta G_{eq\underline{Pb}/Pb/PbSO4}=G_{PbSO4}+G_{H2O}-(G_{Pb}+G_{SO42-})=$**205,76497**+0-(**282,25737**+**54,9256**)=**-131,41797** $^{kJ}/_{mol}$;

$G_{PbSO4}=\Delta G_{eq\underline{Pb}/Pb/PbSO4}-G_{H2O}+(G_{Pb}+G_{SO42-})=$**-131,41797**-0+(**282,2575**+**54,9256**)=**205,76497** $^{kJ}/_{mol}$;

$G_{Pb}=G_{PbSO4}+G_{H2O}-(\Delta G_{eq\underline{Pb}/Pb/PbSO4}+G_{SO42-})=$**205,76497**+0-(**-131,41797**+**54,9256**)=**282,25737** $^{kJ}/_{mol}$;

$Pb+2Cl^{-}=PbCl_2+2H_2O+2e^{-}$; pH=7,36 Absolūtais potenciāls satur $E°_{klasisko}$=-0,2675 V [1], ūdens logaritmu un ΔE°:

$E°_{Pb/Pb2+}=E°_{klasisko}$-0,0591/2*log($[H_2O]^2$)+ΔE°=-0,2675-0,103+0,10166-0,37239=**-0,641225** V;

$\Delta G_{eq\underline{Pb}\downarrow PbCl2}=E°_{\underline{Pb}\downarrow PbCl2}$***F*n**=**-0,641225***96485*2=**-123,737** $^{kJ}/_{mol}$;

$\Delta G_{eqPb/PbCl2}=G_{PbCl2}+2G_{H2O}-(G_{Pb}+2G_{Cl-})=$**300,74**+2***0**-(**292,11**+2***66,1832**)=**-123,737** $^{kJ}/_{mol}$;

$G_{Pb}=G_{PbCl2}+2G_{H2O}-(\Delta G_{eqPb/PbCl2}+2G_{Cl-})=$**300,74**+2***0**-(**-123,737**+2***66,1832**)=**292,11** $^{kJ}/_{mol}$;

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

$\Delta G°_{Pb(OH)2}=G_{Pb(OH)2}-(G_{Pb}+G_{O2}+G_{H2}^{gas})=G_{Pb(OH)2}-($**282,25737**+**303,1**+**85,6**$)=$-455,2 $^{kJ}/_{mol}$;

$G_{Pb(OH)2}=\Delta G°_{Pb(OH)2}+(G_{Pb}+G_{O2}+G_{H2}^{gas})=$-455,2+(**282,25737**+**303,1**+**85,6**)=**215,757** $^{kJ}/_{mol}$;

[1] 25°C. $K_{sp}=[Pb^{2+}]*4*[OH]^2=1,43*10^{\wedge(-20)}$; $(K_{sp}/4)^{1/3}=[Pb(OH)_2]=(1,43/4*10^{\wedge(-20)})^{\wedge(1/3)}=1,52906*10^{\wedge(-7)}$ M;

Solubility $Pb(OH)_{2(s)}+3H_2O=Pb^{2+}+2OH^{-}$; $K_{Pb(OH)2}=K_{sp}/[H_2O]^3=1,43*10^{\wedge(-20)}/55,3^{\wedge3}=8,45592*10^{\wedge(-26)}$;

$\Delta G_{eqPb(OH)2}=$**-R•T•ln(**$K_{AbsolutePb(OH)2}$**)=-8,314*298,15*ln(**$8,45592*10^{\wedge(-26)}$**)=143,11** $^{kJ}/_{mol}$;

$\Delta G_{eqPb(OH)2}=G_{Pb2+}+2G_{OH-}-(G_{Pb(OH)2}+3G_{H2O})=$**215,4144**+2*77,36-(**227,0244**+2*0)=**143,11** $^{kJ}/_{mol}$;

$G_{Pb(OH)2}=G_{Pb2+}+2G_{OH-}-(\Delta G_{eqPb(OH)2}+3G_{H2O})=$**215,4144**+2*77,36-(**143,11**+2*0)=**227,0244** $^{kJ}/_{mol}$;

$G_{Pb2+}=\Delta G_{eqPb(OH)2}-2G_{OH-}+(G_{Pb(OH)2}+3G_{H2O})=$**143,11**-2*77,36+(**227,0244**+2*0)=**215,4144** $^{kJ}/_{mol}$;

$Pb+3OH^{-}=HPbO_2^{-}+H_2O+2e$-; pH=7,36 Expression of potential has standard $E°_{classic}$=-0,537 V [1], ūdens logaritmu -0,0591/2*log(55,3)=-0,0515 un summu ΔE°=+0,10166-0,37239:

$E°_{Pb/HPbO2-}=E°_{classic}$-0,0591/2*log($[H_2O]$)+ΔE°=-0,537-0,0591/2*log(55,3)+0,10166-0,37239=**-0,85923** V;

$\Delta G_{eqPb/HPbO2-}=E°_{I-/I2}$***F*n**=**-0,85923***96485*2=**-165,80513** $^{kJ}/_{mol}$;

$\Delta G_{eqPb/HPbO2-}=G_{HPbO2-}+G_{H2O}-(G_{Pb}+3G_{OH-})=$**348,532**+0-(**282,25737**+3*77,36)=**-165,80513** $^{kJ}/_{mol}$;

$G_{HPbO2-}=\Delta G_{eqPb/HPbO2-}-G_{H2O}+(G_{Pb}+3G_{OH-})=$**-165,80513**-0+(**282,25737**+3*77,36)=**348,532** $^{kJ}/_{mol}$;

Neutralisation protolysis reaction favored – spontaneouse equilibrium: $Pb(OH)_{2(s)}+2H_3O^{+}=Pb^{2+}+4H_2O$; [31]

$K_{prot\_Pb(OH)2+2H3O+}=10^{\wedge(13,06)}$; $K_{eq\_Pb(OH)2+2H3O+}=K_{prot}*[H_2O]^4=10^{\wedge(13,06)}*55,3^{\wedge4}=1,07374*10^{\wedge20}$;

$\Delta G_{eq\_Pb(OH)2+2H3O+}=$**-R•T•ln(**$K_{eq\_Pb(OH)2+2H3O+}$**)=**-8,314*298,15*ln($1,07374*10^{\wedge20}$)=**-114,33** $^{kJ}/_{mol}$;

$\Delta G_{eq\_Pb(OH)2+2H3O+}=G_{Pb2+}+4G_{H2O}-(G_{Pb(OH)2(s)}+2G_{H3O+})=$**215,4144**+0-(**284,8644**+2***22,44**)=**-114,33** $^{kJ}/_{mol}$;

$G_{Pb(OH)2(s)}=G_{Pb2+}+4G_{H2O}-(\Delta G_{eq\_Pb(OH)2+2H3O+}+2G_{H3O+})=$**215,4144**+0-(**-114,33**+2***22,44**)=**284,8644** $^{kJ}/_{mol}$;

Lead Pb(II) ion hydrolytic protolysis reaction unfavored – non spontaneous $Pb^{2+}+4H_2O=Pb(OH)_{2aq}+2H_3O^{+}$; [31]

$K_{protPb+2+H2O}=10^{\wedge(-16,91)}$; $K_{eqPb+2+H2O}=K_{protPb+2+H2O}/[H_2O]^4=10^{\wedge(-16,91)}/55,3^{\wedge4}=1,315526*10^{\wedge(-24)}$;

$\Delta G_{eqPb+2+H2O}=$**-R•T•ln(**$K_{eqPb+2+H2O}$**)=**-8,314*298,15*ln($1,315526*10^{\wedge(-24)}$**)=136,3048** $^{kJ}/_{mol}$;

$\Delta G_{eqPb+2+H2O}=G_{Pb(OH)2aq}+2G_{H3O+}-(G_{Pb2+}+4G_{H2O})=$**306,839**+2***22,44**-(**215,4144**+4***0**)=**136,3048** $^{kJ}/_{mol}$;

$G_{Pb(OH)2aq}=\Delta G_{eqPb+2+H2O}-2G_{H3O+}+(G_{Pb2+}+4G_{H2O})=$**136,3048**-2***22,44**+(**215,4144**+4***0**)=**306,839** $^{kJ}/_{mol}$;

Formation $Pb+I_2=PbI_{2(s)}$; $\Delta G°_{PbI2Form}=G_{PbI2}-(G_{Pb}+G_{I2})=$**345,128**-(**282,25737**+**236,4706**)=-173,6 $^{kJ}/_{mol}$;

[1] Molar content is $G_{I2}=G_{PbI2(s)}-(G_{Pb}+\Delta G°_{PbI2Form})=$**345,128**-(**282,25737**-173,6)=**236,4706** $^{kJ}/_{mol}$.

$G_{PbI2}=\Delta G°_{PbI2Form}+(G_{Pb}+G_{I2})=$-173,6+(**282,25737**+**236,4706**)=**345,128** $^{kJ}/_{mol}$; Solubility

$PbI_2+3H_2O=Pb^{2+}+2I^{-}$; 0,76 $^{g}/_{1000g\ H2O}$; M_{PbCl2}=461,01 $^{g}/_{mol}$; 25°C $[PbI_2]$=0,76/461,01=0,0355987 M; [1]

[1] **25°C** $K_{PbI2}=K_{sp}/[H_2O]^3=9,8*10^{\wedge(-9)}/55,3^{\wedge3}=10^{\wedge(-13,23695)}$;

$\Delta G_{eqPbI2}=$**-R•T•ln(**$K_{AbsolutePb}Cl2$**)=-8,314*298,15*ln(**$10^{\wedge(-13,23695)}$**)=75,5524** $^{kJ}/_{mol}$

$\Delta G_{eqPbI2}=G_{Pb2+}+2G_{I-}-(G_{PbI2}+3G_{H2O})=$**215,4144**+2***102,63**-(**345,128**+3***0**)=**75,5464** $^{kJ}/_{mol}$;

$2G_{I-}=\Delta G_{eqPbI2}-G_{Pb2+}+(G_{PbI2}+3G_{H2O})=$**75,5464-215,4144**+(**345,128**+3*0)=**205,26**=2***102,63** $^{kJ}/_{mol}$;

$G_{PbI2}=G_{Pb2+}+2G_{I-}-(\Delta G_{eqPbI2}+3G_{H2O})=$**215,4144**+2***102,63**-(**75,5464**+3*0)=**345,128** $^{kJ}/_{mol}$;

$3I^{-}=I^{-}+I_2+H_2O+2e$-; Absolūtais aprēķins satur standarta potenciālu $E°_{klasisko}$=0,536 V [1], ūdens log -0,0515 un ΔE°: $E°_{I-/I2}=E°_{klasisko}$-0,0591/2*log($[H_2O]^1$)+ΔE°=0,536-0,0591/2*log($55,3^{\wedge1}$)+0,10166-0,37239=**0,2137725 V**;

$\Delta G_{eqI-/I2}=E°_{I-/I2}$***F*n**=**0,2137725***96485*2=**41,25168** $^{kJ}/_{mol}$;

$\Delta G_{eq\underline{I-/I2}}=G_{\underline{I2}}+G_{H2O}-(2G_{I-})=$**245,022**+2***0**-(2***y**)=**41,25168** $^{kJ}/_{mol}$;

$G_{\underline{I2}}=\Delta G_{eq\underline{I-/I2}}-G_{H2O}+(2G_{I-})=$**41,25168-0**+(2***101,8852**)=**245,022** $^{kJ}/_{mol}$;

$2G_{I-}=G_{\underline{I2}}+G_{H2O}-(\Delta G_{eq\underline{I-/I2}})=$**245,022+0-(41,25168)=203,77=2*101,8852** $^{kJ}/_{mol}$;

$Pb+2I^{-}=PbI_2+2H_2O+2e^{-}$; pH=7,36 Absolūtais aprēķins satur standarta potenciālu $E°_{klasisko}$=-0,365 V [1], ūdens logaritmu un ΔE°: $E°_{Pb/PbI2}=E°_{klasisko}$-0,0591/2*log($[H_2O]^2$)+ΔE°=-0,365-0,103+0,10166-0,37239=**-0,738725** V;

$\Delta G_{eq\underline{Pb}/PbI2}=E°_{\underline{Pb}/PbI2}$***F*n**=**-0,738725** *96485*2=**-142,55** $^{kJ}/_{mol}$;

$\Delta G_{eqPb/PbI2}=G_{PbI2}+2G_{H2O}-(G_{Pb}+2G_{I-})=$**334,925**+2***0**-(**282,25737**+2***97,609**)=**-142,55** $^{kJ}/_{mol}$;

$G_{PbI2}=\Delta G_{eqPb/PbI2}-2G_{H2O}+(G_{Pb}+2G_{I-})=$**-142,55**-2***0**+(**282,25737**+2***97,609**)=**334,925** $^{kJ}/_{mol}$;

$2G_{I-}=G_{PbI2}+2G_{H2O}-(G_{Pb}+\Delta G_{eqPb/PbI2})=$**334,925**+2***0**-(**282,25737-142,55**) =**195,2176**=2***97,609** $^{kJ}/_{mol}$;

Formation $0,5I_2+e$-=I-; $\Delta G°_{I-}=G_{I-}-(0,5G_{I2}+Ge-)=$**101,8852**-(0,5***245,022**+Ge-)=-51,57 $^{kJ}/_{mol}$;

$Ge-=G_{I-}-(0,5G_{I2}+)=$**101,8852**-(0,5***245,022**-51,57)=**30,9442** $^{kJ}/_{mol}$;

Alumīnija savienojumu šķīšanas, protolīzes un reducēšanas-oksidēšanas Prigožina absolūtās enerģijas atraktori.
Al+ H_2O=Al^{3+}+3e^-; Absolūtā potenciāla aprēķins satur standarta potenciālu $E°_{klasisko}$=-1,676 V [1], ūdens logaritmu un ΔE°: $E°_{Al/Al3+}$=$E°_{classic}$-0,0591/3*log(1/[H_2O])+ΔE°=-1,676+0,03433+0,10166-0,37239=**-1,9124** V;

$$\Delta G_{eq Al/Al3+}=E°_{Al/Al3+}\bullet F\bullet n=\mathbf{-1,912398}*96485*3=\mathbf{-553,55316}\ ^{kJ}/_{mol};$$

$$\Delta G_{eq Al/Al3+}=G_{Al3+}+3G_{e-}-(G_{Al}+G_{H2O})=\mathbf{256,5103}+3*\mathbf{0}-(\mathbf{810,0635}+\mathbf{0})=\mathbf{-553,55316}\ ^{kJ}/_{mol};$$

$$G_{Al3+}=\Delta G_{eq Al/Al3+}-3G_{e-}+(G_{Al}+G_{H2O})=\mathbf{-553,55316}-3*\mathbf{0}+(\mathbf{810,0635}+\mathbf{0})=\mathbf{256,5103}\ ^{kJ}/_{mol};$$

$$G_{Al}=G_{Al3+}+3G_{e-}-(\Delta G_{eq Al/Al3+}+G_{H2O})=\mathbf{256,5103}+3*\mathbf{0}-(\mathbf{-553,55316}+\mathbf{0})=\mathbf{810,0635}\ ^{kJ}/_{mol};$$

$$3G_{e-}=\Delta G_{eq Al/Al3+}-G_{Al3+}+-(G_{Al}+G_{H2O})=\mathbf{-553,55316}-\mathbf{256,5103}+(\mathbf{810,0635}+\mathbf{0})=\mathbf{0,0}\ ^{kJ}/_{mol};$$

[1] Formation Al+H_2^{gas}+0,5O_2^{gas}=$Al(H_2O)^{3+}$+3e^-;

$$\Delta G°_{Al3+}=G_{Al(H2O)3+}+3G_{e-}-(G_{Al}+G_{H2}^{gas}+0,5G_{O2}^{gas})=\mathbf{493,6605}+3*\mathbf{22,851}-(\mathbf{810,0635}+0,5*\mathbf{303,1}+\mathbf{85,6})=-485\ ^{kJ}/_{mol};$$

$$G_{Al(H2O)3+}=\Delta G°_{Al3+}-3G_{e-}+(G_{Al}+G_{H2}^{gas}+0,5G_{O2}^{gas})=-485-3*\mathbf{22,851}+(\mathbf{810,0635}+0,5*\mathbf{303,1}+\mathbf{85,6})=\mathbf{493,6605}\ ^{kJ}/_{mol};$$

$$3G_{e-}=\Delta G°_{Al3+}-G_{Al(H2O)3+}+(G_{Al}+G_{H2}+0,5G_{O2})=-485-\mathbf{493,6605}+(\mathbf{810,0635}+0,5*\mathbf{303,1}+\mathbf{85,6})=3*\mathbf{22,85}\ ^{kJ}/_{mol};$$

Substance	$\Delta H°_H$, $^{kJ}/_{mol}$	$\Delta S°_H$, $^{J}/_{mol/K}$	$\Delta G°_H$, $^{kJ}/_{mol}$
Al	-	28,3 [1]	-
Al(3e-)	$E°_{Al/Al3+}$=	**-1,9124** V	**810,0635**
$Al(H_2O)^{3+}$	$E°_{Al/Al3+}$=	**-1,9124** V	**256,51**
$Al(H_2O)^{3+}$	-531,0	-321,7	-485,0
Al^{3+} $3G_{e-}$	formation	-485,0	3***22,851**
$Al(H_2O)^{3++}$	formation	-485,0	**493,6605**
$Al(H_2O)^{3+}$	$K_{eq}=K_b/_{[H2O]}$	$10^{-6,742725}$	**493,6605**
$AlOH^{2+}{}_{aq}$	formation	-694,1	**532,535**
$AlOH^{2+}G_{e-}$	formation	-694,1	2***22,851**
Al_2O_3	-1675,7	50,92	-1582,3
Al_2O_3	formation	-1582,3	**492,477**
$AlCl_3$	-705,6	109,3	-630,1
$AlCl_3$	Formation	-630,1	**394,1635**
Cl_2^{gas}	$HgCl_{2(s)}$formation		**142,8**
$Cl_{-(aq)}$	-167,2	56,6	-131,2
$Cl^-_{(aq)}$ G_{e-}	formation	-131,2	**125,9652**
$Cl_{-(aq)}$	formation	-131,2	**66,1832**
α-$Al(OH)_3$	-1276	70,1	-1153
Al 3e-	formation	-1153	**810,0635**
α-$Al(OH)_3$	formation	-1153	**240,1135**
γ-$Al(OH)_3$	-1293		-1154,9
$Al(OH)_3$	$K_{Al(OH)3}$=	$1,9*10^{-33}$	**499,19**
$H_2AlO_3^-$	$E°_{H2AlO3Al}$=	**-2,63506**	**356,7725**
$NaAlO_2$↓	-1133,2	70,4	-

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$$G_{H2O}=\mathbf{0}\ ^{kJ}/_{mol};$$

$$G_{Al}=G_{Al3+}-(\Delta G_{eq Al/Al3+}+G_{H2O})=\mathbf{241,5817}-(\mathbf{-553,55316})=\mathbf{810,0635}\ ^{kJ}/_{mol};$$

$$G_{Al3+}=\Delta G_{eq Al/Al3+}+(G_{Al}+G_{H2O})=\mathbf{256,51}\ ^{kJ}/_{mol};$$

$$\Delta G°_{Al3+}=\Delta H°_H-T*\Delta S°_H=-538,4-298,15*-0,325=-441,5\ ^{kJ}/_{mol};\mathbf{[1]}$$

$$3G_{e-}=\Delta G°_{Al3+}-G_{Al3+}+(G_{Al})=-485-\mathbf{241,5817}+(\mathbf{795,13486})=3*\mathbf{22,851}\ ^{kJ}/_{mol};$$

$$G_{Al(H2O)3+}=\Delta G°_{Al3+}-3G_{e-}+(G_{Al}+G_{H2}+0,5G_{O2})=\mathbf{493,6605}\ ^{kJ}/_{mol};$$

$$G_{[Al(H2O)]3+}=\Delta G_{[Al(H2O)]3+}-G_{OH}+(G_{AlOH2+}+G_{H2O})=\mathbf{493,6605}\ ^{kJ}/_{mol};$$

$$G_{AlOH2+}=G_{[Al(H2O)]3+}+G_{OH}-(\Delta G_{[Al(H2O)]3+}+G_{H2O})=\mathbf{532,535}\ ^{kJ}/_{mol};$$

$$2G_{e-}=\Delta G°_{AlOH2+}-G_{AlOH2+}+(G_{Al}+0,5G_{O2}+0,5G_{H2})=2*\mathbf{22,851}\ ^{kJ}/_{mol};$$

$$\Delta G°_{Al3+}=\Delta H°_H-T*\Delta S°_H=-1675,6-298,15*0,05092=-1690,8\ ^{kJ}/_{mol};$$

$$G_{Al2O3}=\Delta G°_{Al2O3}+(2G_{Al}+1,5G_{O2}^{gas})=\mathbf{492,477}\ ^{kJ}/_{mol};$$

[31] $\Delta G°_{AlCl3}=\Delta H°-T*\Delta S°=-705,6-298,15*0,1093=-738,2\ ^{kJ}/_{mol};$

[31] $G_{AlCl3}=\Delta G°_{Al2Cl3}+(G_{Al}+1,5G_{Cl2}^{gas})=\mathbf{394,1635}\ ^{kJ}/_{mol};$

$$G_{Cl2}=-(G_{Hg}+\Delta G°_{HgCl2})=-(\mathbf{35,8}-178,6)=\mathbf{142,8}\ ^{kJ}/_{mol};$$

$$\Delta G_{Cl-}=\Delta H_H-T*\Delta S_H=-167,2-298,15*0,0566=-183,955\ ^{kJ}/_{mol};[1]$$

$$G_{e-}=G_{Cl-(aq)}-(0,5G_{Cl2}^{gas}+\Delta G_{eq Cl})=\mathbf{125,9652}\ ^{kJ}/_{mol};$$

$$G_{Cl-(aq)}=\Delta G_{eq\_Cl}+(0,5G_{Cl2}^{gas}+G_{e-})=\mathbf{66,1832}\ ^{kJ}/_{mol};$$

[78] $\Delta G°_{AlCl3}=\Delta H°_H-T*\Delta S°_H=-1276-298,15*0,0701=-690\ ^{kJ}/_{mol};$

$$G_{Al}=G_{Al(OH)3}-(\Delta G°_{Al(OH)3}+1,5G_{O2}^{gas}+1,5G_{H2}^{gas})=\mathbf{810,0635}\ ^{kJ}/_{mol};$$

$$G_{Al(OH)3}=\Delta G°_{Al(OH)3}+(G_{Al}+1,5G_{O2}^{gas}+1,5G_{H2}^{gas})=\mathbf{240,1135}\ ^{kJ}/_{mol};$$

[78]

$$G_{Al(OH)3}=G_{Al3+}+3G_{OH-}-(\Delta G_{eq Al(OH)3}+4G_{H2O})=\mathbf{499,19}\ ^{kJ}/_{mol};$$

$$G_{H2AlO3}=\Delta G_{eq H2AlO3Al}-G_{H2O}+(G_{Al}+4G_{OH})=\mathbf{356,7725}\ ^{kJ}/_{mol};$$

CRC [1] Veidošanās no brīviem elementiem $NaAlO_2$↓;

[1] Formation Al+0,5O_2^{gas}+0,5H_2^{gas})=$AlOH^{2+}$+2e^-; $\Delta G°_{AlOH2+}=G_{AlOH2+}+2G_{e-}-(G_{Al}+0,5G_{O2}+0,5G_{H2})=$

$$=\mathbf{264,6115}+2*\mathbf{22,851}-(\mathbf{810,0635}+0,5*\mathbf{303,1}+0,5*\mathbf{85,6})=-694,1\ ^{kJ}/_{mol};$$

$$G_{AlOH2+}=\Delta G°_{AlOH2+}-2G_{e-}+(G_{Al}+0,5G_{O2}+0,5G_{H2})=$$

$$=-694,1-2*\mathbf{22,851}+(\mathbf{810,0635}+0,5*\mathbf{303,1}+0,5*\mathbf{85,6})=\mathbf{264,6115}\ ^{kJ}/_{mol};$$

$$2G_{e-}=\Delta G°_{AlOH2+}-G_{AlOH2+}+(G_{Al}+0,5G_{O2}+0,5G_{H2})=$$

$$=-694,1-\mathbf{264,6115}+(\mathbf{810,0635}+0,5*\mathbf{303,1}+0,5*\mathbf{85,6})=\mathbf{45,702}=2*\mathbf{22,851}\ ^{kJ}/_{mol};$$

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

$$\Delta G°_{Al(OH)3}=G_{Al(OH)3}-(G_{Al}+1,5G_{O2}^{gas}+1,5G_{H2}^{gas})=\mathbf{240,1135}-(\mathbf{810,0635}+1,5*\mathbf{303,1}+1,5*\mathbf{85,6})=-1153\ ^{kJ}/_{mol};$$

$$G_{Al(OH)3}=\Delta G°_{Al(OH)3}+(G_{Al}+1,5G_{O2}^{gas}+1,5G_{H2}^{gas})=-1153+(\mathbf{810,0635}+1,5*\mathbf{303,1}+1,5*\mathbf{85,6})=\mathbf{240,1135}\ ^{kJ}/_{mol};$$

$$G_{Al}=G_{Al(OH)3}-(\Delta G°_{Al(OH)3}+1,5G_{O2}^{gas}+1,5G_{H2}^{gas})=\mathbf{240,1135}-(-1153+1,5*\mathbf{303,1}+1,5*\mathbf{85,6})=\mathbf{810,0635}\ ^{kJ}/_{mol};$$

Solubility products https://owl.oit.umass.edu/departments/Chemistry/appendix/ksp.html

$Al(OH)_{3(s)}$+4H_2O=Al^{3+}+3OH^-; 3^3=27;

$$K_{sp}=[Al^{3+}]*[OH^-]^3=[Al^{3+}]*(3*[Al^{3+}])^3=[Al^{3+}]^4*3^3=1,9*10^{(-33)}=10^{(-32,72125)};$$

$$\text{Dissolute } [Al(OH)_3]=(1,9*10^{(-33)}/27)^{(1/4)}=2,896326*10^{(-9)}\ M;$$

$$K_{Al(OH)3}=K_{sp}/[H_2O]^4=1,9*10^{(-33)}/55,3^4=2,03167*10^{(-40)}=10^{(-39,692)}=K_{Al(OH)3}$$

$$\Delta G_{eq Al(OH)3}=\mathbf{-R\bullet T\bullet ln}(K_{Al(OH)3})=\mathbf{-8,314*298,15*ln}(2,03167*10^{(-40)})=\mathbf{226,5505}\ ^{kJ}/_{mol};$$

$$\Delta G_{eq Al(OH)3}=G_{Al(H2O)3+}+3G_{OH-}-(G_{Al(OH)3}+4G_{H2O})=\mathbf{493,6605}+3*77,36-(\mathbf{499,19}+4*0)=\mathbf{226,5505}\ ^{kJ}/_{mol};$$

$$G_{Al(OH)3}=G_{Al(H2O)3+}+3G_{OH-}-(\Delta G_{eq Al(OH)3}+4G_{H2O})=\mathbf{493,6605}+3*77,36-(\mathbf{226,5505}+4*0)=\mathbf{499,19}\ ^{kJ}/_{mol};$$

Formation $2Al+1,5O_2^{gas}=Al_2O_3$;

$\Delta G°_{Al2O3}=G_{Al2O3}-(2G_{Al}+1,5G_{O2}^{gas})=\mathbf{492,477}-(2*\mathbf{810,0635}+1,5*\mathbf{303,1})=-1582,3\ ^{kJ}/_{mol}$;

$G_{Al2O3}=\Delta G°_{Al2O3}+(2G_{Al}+1,5G_{O2}^{gas})=-1582,3+(2*\mathbf{810,0635}+1,5*\mathbf{303,1})=\mathbf{492,477}\ ^{kJ}/_{mol}$;

Formation $Al+1,5Cl_2=AlCl_3$; $\Delta G°_{Al2Cl3}=G_{AlCl3}-(G_{Al}+1,5G_{Cl2}^{gas})=\mathbf{394,1635}-(\mathbf{810,0635}+1,5*\mathbf{142,8})=-630,1\ ^{kJ}/_{mol}$;

$G_{AlCl3}=\Delta G°_{Al2Cl3}+(G_{Al}+1,5G_{Cl2}^{gas})=-630,1+(\mathbf{810,0635}+1,5*\mathbf{142,8})=\mathbf{394,1635}\ ^{kJ}/_{mol}$;

Solubility $AlCl_3$; w%=31,1% 31,1g/131 g=X/1000g. 31,1g/131g*1000g=X=g

$\underline{Al}+4OH^-=H_2AlO_3^-+H_2O+3e^-$; Absolūtā potenciāla aprēķins satur standarta potenciālu $E°_{klasisko}$=-2,33 V [1], ūdens logaritmu un ΔE°: $E°_{H2AlO3-Al}=E°_{klasisko}-0,0591/3*\log([H_2O])+\Delta E°=-2,33+0,0343+0,10166-0,37239=\mathbf{-2,63506}$ V;

$\Delta\mathbf{G}_{eq\underline{H2AlO3Al}}=E°_{\underline{H2AlO3Al}}\bullet F\bullet n=\mathbf{-2,63506}*96485*3=\mathbf{-762,731}\ ^{kJ}/_{mol}$; -0,0591/3*log(1/55,3)=+0,0343;

$\Delta\mathbf{G}_{eq\underline{H2AlO3Al}}=G_{\underline{H2AlO3}}+G_{\mathbf{H2O}}-(G_{Al}+\mathbf{4}G_{\mathbf{OH}})=\mathbf{356,7725}+0-(\mathbf{810,0635}+4*\mathbf{77,36})=\mathbf{-762,731}\ ^{kJ}/_{mol}$;

$G_{\underline{H2AlO3}}=\Delta\mathbf{G}_{eq\underline{H2AlO3Al}}-G_{\mathbf{H2O}}+(G_{Al}+\mathbf{4}G_{\mathbf{OH}})=\mathbf{-762,731}-0+(\mathbf{810,0635}+4*\mathbf{77,36})=\mathbf{356,7725}\ ^{kJ}/_{mol}$;

$$E_{AlO2-/\underline{Al}\downarrow}=E°_{AlO2-/\underline{Al}\downarrow}+0,0591/3\bullet\log\frac{[H_2AlO_3^-][H_2O]}{[Al]\cdot[OH^-]^4}=\mathbf{-2,63506}\text{ V}+0,0591/3\bullet\log\frac{[H_2AlO_3^-][H_2O]}{[Al]\cdot[OH^-]^4};$$

Base dissociation pK_b=5,0 [1] (protolysis) equilibrium constant $Al(OH)^{2+}+H_2O=Al(H_2O)]^{3+}+OH^-$;

$K_{eq}=K_b/[H_2O]=[Al(H_2O)]^{3+}]*[OH^-]/[AlOH^{2+}]/[H_2O]=10^{\wedge(-5,0)}/55,3=10^{\wedge(-6,742725)}$;

$\Delta\mathbf{G}_{eq[Al(H2O)]3+}=\mathbf{-R\bullet T\bullet ln}(K_{eq[Al(H2O)]3+}=\mathbf{-8,314*298,15*ln}(10^{\wedge(-6,742725)})=\mathbf{38,4854}\ ^{kJ}/_{mol}$;

$\Delta\mathbf{G}_{[Al(H2O)]3+}=G_{[Al(H2O)]3+}+G_{OH}-(G_{AlOH2+}+G_{\mathbf{H2O}})=\mathbf{493,6605}+\mathbf{77,36}-(\mathbf{532,535}+\mathbf{0})=\mathbf{38,4854}\ ^{kJ}/_{mol}$;

$G_{AlOH2+}=G_{[Al(H2O)]3+}+G_{OH}-(\Delta\mathbf{G}_{[Al(H2O)]3+}+G_{\mathbf{H2O}})=\mathbf{493,6605}+\mathbf{77,36}-(\mathbf{38,4854}+\mathbf{0})=\mathbf{532,535}\ ^{kJ}/_{mol}$;

$G_{[Al(H2O)]3+}=\Delta\mathbf{G}_{[Al(H2O)]3+}-G_{OH}+(G_{AlOH2+}+G_{\mathbf{H2O}})=\mathbf{38,4854}-\mathbf{77,36}+(\mathbf{532,535}+\mathbf{0})=\mathbf{493,6605}\ ^{kJ}/_{mol}$;

Kalcija savienojumu šķīšanas, protolīzes un reducēšanas-oksidēšanas Prigožina absolūtās enerģijas atraktori.
Metal calcium $Ca_{(s)}+H_2O=Ca(H_2O)^{2+}+2e^-$; Absolute potential $E°_{classic}$=-2,868 V [1], $E°_{Ca/Ca2+}$=**-3,08723** V
$Ca_{(s)}+H_2O=Ca(H_2O)^{2+}+2e^-$; Absolute potential $E°_{classic}$=-2,868 V [1], water logarithm 0,0515 and sum ΔE°:
$E°_{Ca/Ca2+}=E°_{classic}$-0,0591/2*log(1/[$H_2O$]^1)+ΔE°=-2,868-0,0591/2*log(1/55,3^1)+0,10166-0,37239=**-3,08723** V.

$\Delta G E_{eq\_Ca}=E°_{Ca2+}•F•2$=**-3,08723***96485*2=**-595,743** $^{kJ}/_{mol}$,

$\Delta G E_{eq\_Ca}=G_{Ca(H2O)2+}-(G_{Ca}+G_{H2O})$=**51,5763-(647,319+0)=-595,743** $^{kJ}/_{mol}$;

$G_{Ca(H2O)2+}=\Delta G E_{eq\_Ca}+(G_{Ca}+G_{H2O})$=**-595,743+(647,319+0)=51,5763** $^{kJ}/_{mol}$;

$G_{Ca}=G_{Ca(H2O)2+}-(\Delta G_{eq\_Ca}+G_{H2O})$=**51,5763-(-595,743+0)=647,319** $^{kJ}/_{mol}$;

Viela	$\Delta H°_H$, $^{kJ}/_{mol}$	$\Delta S°_H$, $^{J}/_{mol/K}$	$\Delta G°_H$, $^{kJ}/_{mol}$	**Biochem. Thermodynam. 2006** Massachusetts Technology Inst.
G_{Ca} $CaO_{(s)}$	formation	-603,3	**647,319**	$G_{Ca}=G_{CaO}-(\Delta G°_{CaO}+0,5G_{O2})$=**647,319** $^{kJ}/_{mol}$;
Ca G_{Ca}	$E°_{Ca/Ca2+}$=	**-3,08723** V	**592,399**	$G_{Ca}=G_{Ca2+}-(\Delta G_{eqCa}+G_{H2O})$=**-3,3437-(-595,743+0)=592,399** $^{kJ}/_{mol}$;
$CaG_{e^-}G_{Ca}$	G_e=**22,9545**	**51,5763**	**647,319**	$G_{Ca}=G_{Ca(H2O)2+}-(\Delta G_{eq\_Ca}+G_{H2O})$=**51,5763-(-595,743+0)=647,32** $^{kJ}/_{mol}$;
$Ca(H_2O)^{2+}$	$E°_{Ca/Ca2+}$=	**-3,08723** V	**51,5763**	$G_{Ca2+}=\Delta G E_{eq\_Ca}+(G_{Ca}+G_{H2O})$=**-3,3437** $^{kJ}/_{mol}$;
$\underline{Ca^{2+}}$	$K_{eq}CaCO3$	$=10^{\wedge-11,959}$	**-41,8317**	$G_{Ca2+}=\Delta G_{eqCaCO3}-G_{CO23-}+(G_{CaCO3}+G_{H2O})$=**-41,8317** $^{kJ}/_{mol}$;
$Ca(H_2O)^{2+}$	pK_b12,6[1]	$=10^{-14,3427}$	**51,5763**	$G_{[Ca(H2O)]2+}=G_{Ca(OH)+}+G_{H3O+}-(\Delta G_{[Ca(H2O)]2+}+G_{H2O})$=**51,5763** $^{kJ}/_{mol}$;
$Ca(H_2O)^{2+}$	Solubil K_{sp}	$=10^{-11,959}$	**77,5403**	$G_{Ca2+}=\Delta G_{eqCaCO3}-G_{CO23-}+(G_{CaCO3}+G_{H2O})$=**77,5403** $^{kJ}/_{mol}$;
$Ca(H_2O)^{+}$	$E°_{Ca/Ca+}$=	**-3,967735**	**264,492**	$G_{Ca+}=\Delta G_{eq\_Ca}+(G_{Ca}+G_{H2O})$=**-382,827+(647,319+0)=264,49** $^{kJ}/_{mol}$;
$\underline{Ca^{2+}}$	-542 ,8	-53,1	-553,6	$\Delta G°=\Delta H°_H-T*\Delta S°_H$=-542,8-298,15*-0,0531=-526,968 $^{kJ}/_{mol}$;
$Ca(H_2O)^{2+}$	formation	-553,6	**284,96**	$G_{Ca(H2O)2+}=\Delta G°_{Ca2+}-2G_{e^-}+(G_{Ca}+0,5*G_{O2}+G_{H2})$=**284,96** $^{kJ}/_{mol}$;
Cl_2^{gas}	$Hg_2Cl_{2(s)}$	formation	**139,1718**	$G_{Cl2}=-(2G_{Hg}+\Delta G°_{Hg2Cl2})=-(2*35,7641-210,7)$=**139,1718** $^{kJ}/_{mol}$;
Cl_2^{gas}	$HgCl_{2(s)}$	formation	**142,8**	$G_{Cl2}=-(G_{Hg}+\Delta G°_{HgCl2})=-(35,8-178,6)$=**142,8** $^{kJ}/_{mol}$;
$Cl_{2aqNaCl}$	$E°_{2Cl-Cl2}$=	**1,03756** V	**332,584**	$G_{Cl2}^{gas}=\Delta G_{eq\_2Ci-Cl2}+(2G_{Cl^-})$=**200,218+(2*66,1832)=332,584** $^{kJ}/_{mol}$;
$^{14}Cl_{2aqNaCl}$	**K_{eq}** $_{2Cl-Cl2}$=	**0,64771** V	**257,366**	$G_{Cl2}^{gas}=\Delta G_{eq\_2Ci-Cl2}+(2G_{Cl^-})$=**125+(2*66,1832)=257,3664** $^{kJ}/_{mol}$;
Cl-	-167,2	56,5	-131,2	$\Delta G_{Cl^-}=\Delta H-T*\Delta S$=-167,2-298,15*0,0565=-184,05 $^{kJ}/_{mol}$;[1]
$Cl^-_{(aq)}$	formation	-131,2	**66,1832**	$G_{Cl-(aq)}=\Delta G_{eq\_Cl}+(0,5G_{Cl2}^{gas}+G_{e^-})$=**66,1832** $^{kJ}/_{mol}$;
$Cl^-_{(aq)}$	$K_{AbsoluHg2Cl2}$	$10^{\wedge(-23,07)}$	**66,05455**	$G_{Cl^-}=(-G_{Hg22+}+\Delta G_{eqHg2Cl2}+(G_{Hg2Cl2}+3G_{H2O}))/2$=**66,05455** $^{kJ}/_{mol}$;
Cl^-_{aqNaCl}	$E°_{2Cl-Cl2}$=	**1,03756** V	**66,1832**	$2G_{Cl^-}=G_{Hg2Cl2}+2G_{H2O}-(\Delta G_{eq\_Hg2Cl2}+2G_{Hg})$=2***66,1832** $^{kJ}/_{mol}$;
Cl-	**K_{eq}**$CaCl2$=	$10^{\wedge-2,03095}$	**95,559**	$2G_{Cl^-}=\Delta G_{eqCaCl2}-G_{Ca(H2O)2+}+(G_{CaCl2}+3G_{H2O})$=2***95,5594** $^{kJ}/_{mol}$;
Cl-	K_{spAgCl}=	$10^{-13,24}$	**101,885**	$G_{Cl^-}=(-G_{Hg22+}+\Delta G_{eqHg2Cl2}+(G_{Hg2Cl2}+3G_{H2O}))/2$=**101,885** $^{kJ}/_{mol}$;
$CaCl_{2(s)}$	-795,4	108,4	-748,8	[1]$\Delta G°=\Delta H°-T*\Delta S°$=-795,4-298,15*0,1084=-827,71946 $^{kJ}/_{mol}$;
$CaCl_{2(s)}$	formation	-748,8	**231,103**	$G_{CaCl2}=\Delta G_{FormaCaCl2}+(G_{Ca}+G_{Cl2}^{gas})$=**231,103** $^{kJ}/_{mol}$;
$CaO_{(s)}$	format G_{CaO}	**195,569**	-603,3	[1] $G_{CaO}=\Delta G°_{CaO}+(G_{Ca}+0,5G_{O2})$=**195,569** $^{kJ}/_{mol}$;
$Ca(OH)_{2(s)}$	-985,2	83,4	-897,5	[1]$\Delta G°=\Delta H°-T*\Delta S°$=-985,2-298,15*0,0834=-1010,0657 $^{kJ}/_{mol}$;
$Ca(OH)_{2(s)}$	formation	-897,5	**138,56**	[1] $G_{Ca(OH)2}=\Delta G_{formCa(OH)2}+(G_{Ca}+G_{O2}+G_{H2})$=**138,56** $^{kJ}/_{mol}$;
$Ca(OH)_{2(s)}$	$K_{eqCa(OH)]2}$=	$10^{\wedge(-10,5275)}$	**146,2086**	$G_{Ca(OH)]2}=G_{Ca(H2O)]32+}+2G_{OH^-}-(\Delta G_{Ca(OH)]2}+3G_{H2O})$=**146,2086** $^{kJ}/_{mol}$;
$CaOH^+$	formation	-718,4	**101,0705**	$G_{CaOH}=\Delta G°_{CaOH+}-G_{e^-}+(G_{Ca}+0,5*G_{O2}+0,5*G_{H2})$=**101,0705** $^{kJ}/_{mol}$;
$CaOH^+$	$K_{spCaCO3}$=	$10^{\wedge(-10,2164)}$	**114,061**	$G_{CaOH+}=\Delta G_{eqCaCO3}-G_{HCO3-}+(G_{CaCO3}+G_{H2O})$=**114,061** $^{kJ}/_{mol}$;
$CaOH^+$	$K_b/[H_2O]$=	$10^{\wedge(-14,3427)}$	**280,4563**	$G_{Ca(OH)+}=G_{[Ca(H2O)]2+}+G_{OH^-}-(\Delta G_{[Ca(H2O)]2+}+G_{H2O})$=**280,4563** $^{kJ}/_{mol}$;
$CaOH^+$	$K_{sp}/[H_2O]^3$=	$10^{\wedge(-16,895)}$	**280,4563**	$G_{Ca(OH)+}=G_{[Ca(H2O)]2+}+G_{OH^-}-(\Delta G_{[Ca(H2O)]2+}+G_{H2O})$=**280,4563** $^{kJ}/_{mol}$;
Ge- $CaOH^+$	formation	-718,4	**22,2184**	$G_{e^-}=\Delta G°_{CaOH+}-G_{CaOH}+(G_{Ca}+0,5*G_{O2}+0,5*G_{H2})$=**22,2184** $^{kJ}/_{mol}$;
$CaSO_{4(s)}$	-1434,5	106,5	-1322,0	[1]$\Delta G°=\Delta H°-T*\Delta S°$=-1434,5-298,15*-0,1063=-1402,8067 $^{kJ}/_{mol}$;
$CaSO_{4(s)}$	formation	-1322,0	**94,9951**	$G_{CaSO4}=\Delta G°_{CaSO4}+(G_{Ca}+G_{Srhomb}+2G_{O2})$=**94,9951** $^{kJ}/_{mol}$;
$CaSO_{4(s)}$	$K_{sp}/[H_2O]^3$=	$10^{\wedge(-16,895)}$	**261,3904**	$G_{CaSO4}=G_{CaOH+}+G_{SO42-}+G_{H3O+}-(\Delta G_{eqCaSO4}+3G_{H2O})$=**261,39** $^{kJ}/_{mol}$;;
SO_4^{2-}	$E°_{SO32-}$=	**0,05576**	**54,9256**	$G_{SO4-}=\Delta G_{eqH2SO3}-2G_{H3O+}+(G_{HSO3}+3G_{H2O})$=**54,9256** $^{kJ}/_{mol}$;
$CaCO_{3(s)}$	-1207,6	91,7	-1129,1	[1]$\Delta G°=\Delta H°-T*\Delta S°$=-1220,0-298,15*-0,110=-1187,2035 $^{kJ}/_{mol}$;
$CaCO_{3(s)}$	formation	-1081,4	**111,829**	$G_{CaCO3}=\Delta G°_{CaCO3}+(G_{Ca}+1,5G_{O2}+G_{Cgraph})$=**111,829** $^{kJ}/_{mol}$;
CO_3^{2-}	-677,1	-56,9	-527,8	[1]$\Delta G°=\Delta H°-T*\Delta S°$=-677,1-298,15*-0,0569=-1187,2035 $^{kJ}/_{mol}$;
G_{e^-} CO_3^{2-}	formation	-527,8	2***42,2185**	$2G_{e^-}=G_{CO32-}-(G_{Cgr}+1,5G_{O2}+\Delta G°_{CO32-})$=**84,437**=2***42,2185** $^{kJ}/_{mol}$;
CO_3^{2-}	K_{eq}=	$10^{-12,0727}$	**102,547**	$G_{CO32-}=\Delta G_{eqHCO3}-G_{H3O+}+(G_{HCO3-}+G_{H2O})$=**102,547** $^{kJ}/_{mol}$;
HCO_3^-	-692	91,2	-586,8	[1]$\Delta G°=\Delta H°-T*\Delta S°$=-692-298,15*0,0912=-719,19 $^{kJ}/_{mol}$;
$G_{e^-}=HCO_3^-$	formation	-586,8	**54,15**	$G_{e^-}=G_{HCO3}-(0,5G_{H2}+1,5G_{O2}+G_{Cgraph}+\Delta G°_{HCO3})$=**54,15** $^{kJ}/_{mol}$;
G_{HCO3-}	**56,08**	G_{H3O+}=	**22,44**	G_{HCO3-}=**56,08** $^{kJ}/_{mol}$; G_{H3O+}=**22,44** $^{kJ}/_{mol}$;

Metal calcium $Ca_{(s)}+H_2O=Ca(H_2O)^{+}+e^-$ Absolute potential $E°_{classic}$=-3,80 V [1], water 0,102995 and sum ΔE°:
$E°_{Ca/Ca+}=E°_{classic}$-0,0591/1*log(1/[H_2O]^1)+ΔE°=-3,80-0,0591/1*log(1/55,3)+0,10166-0,37239=**-3,967735** V.

$\Delta G_{eq}=E°_{Ca2+}•F•1$=**-3,96773494473989***96485*1=**-382,827** $^{kJ}/_{mol}$,

$\Delta G_{eq}=G_{Ca(H2O)+}-(G_{Ca}+G_{H2O})=284,96-(647,319+0)=-382,827$ kJ/mol;

$G_{Ca(H2O)+}=\Delta G_{eq\_Ca}+(G_{Ca}+G_{H2O})=-382,827+(647,319+0)=264,492$ kJ/mol;

$Ca(H_2O)^{2+}$ [1] Formation $Ca+0,5*O_2+H_2=Ca(H_2O)^{2+}+2e^-$;

$\Delta G°_{Ca2+}=G_{Ca(H2O)2+}+2G_{e-}-(G_{Ca}+0,5*G_{O2}+G_{H2})=284,92+2*22,9745-(647,319+0,5*303,1+85,64)=-553,6$ kJ/mol;

$G_{Ca}=G_{Ca(H2O)2+}+2G_{e-}-(\Delta G°_{Ca2+})=284,92+2*22,9745-(-553,6+0,5*303,1+85,64)=647,279$ kJ/mol;

$G_{Ca(H2O)2+}=\Delta G°_{Ca2+}-2G_{e-}+(G_{Ca}+0,5*G_{O2}+G_{H2})=-553,6-2*22,9745+(647,319+0,5*303,1+85,6)=284,92$ kJ/mol;

$2G_{e-}=\Delta G°_{Ca2+}-G_{Ca(H2O)2+}+(G_{Ca}+0,5*G_{O2}+G_{H2})=-553,6-284,92+(647,319+0,5*303,1+85,64)=2*22,9745$ kJ/mol;

Metal $Ca_s+2OH^-=Ca(OH)_{2s}+2e^-$ Absolute potential $E°_{classic}=-3,02$ V [1], water logarithm 0,0515 and sum $\Delta E°$:

$E°_{Ca/Ca(OH)2s}=E°_{classic}-0,0591/2*\log(1/[H_2O]^1)+\Delta E°=-3,02-0,0591/2*\log(1/55,3)+0,10166-0,37239=-3,2392$ V.

$\Delta G_{Ca/Ca(OH)2s}=E°_{Ca2+}•F•2=-3,23923247*96485*2=-625,0747$ kJ/mol,

$\Delta G_{Ca/Ca(OH)2s}=G_{Ca}+2G_{OH}-(G_{Ca(OH)2s}+G_{H2O})=-633,586+2*77,36-(146,2086+0)=-625,0747$ kJ/mol;

$G_{Ca}=\Delta G_{Ca/Ca(OH)2s}-2G_{OH}+(G_{Ca(OH)2s})=-625,0747-2*77,36+(146,2086)=-633,586$ kJ/mol;

$G_{H3O+}+G_{HCO3-}=22,44+56,08=G_{šk\,CO2}+G_{CAHCO3-}=18,38$ kJ/mol$+60,14$ kJ/mol$=78,52$ kJ/mol;

Formation $Ca+1,5O_2+C_{gr}=CaCO_{3(s)}$; $G_{O2}=303,1$ kJ/mol; $G_{gr}=91,26$ kJ/mol; $G_{HCO3-}=56,08$ kJ/mol ;

$\Delta G°_{CaCO3}=G_{CaCO3}-(G_{Ca}+1,5G_{O2}+G_{Cgraph})=0-(647,319+1,5*303,1+91,26)=-1081,4$ kJ/mol;

$G_{CaCO3}=\Delta G°_{CaCO3}+(G_{Ca}+1,5G_{O2}+G_{Cgraph})=-1081,4+(647,319+1,5*303,1+91,26)=111,829$ kJ/mol;

Formation $0,5H_2+C_{gr}+1,5O_2+e^-=HCO_3^-$;

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

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

[1] Solubility $CaCO_{3(s)}+2H_2O=Ca(H_2O)^{2+}+CO_3^{2-}$; $K_{sp}=[Ca^{2+}]*[CO_3^{2-}]/[H_2O]^2=3,36*10^{(-9)}/55,3^2=10^{(-11,959)}$;

$\Delta G_{eqCaCO3}=-R•T•\ln(K_{eqCaCO3})=-8,314*298,15*\ln(10^{(-11,959)})=68,2583$ kJ/mol;

$\Delta G_{eqCaCO3}=G_{Ca(OH2)2+}+G_{CO23-}-(G_{CaCO3}+G_{H2O})=77,5403+102,547-(111,829+2*0)=68,2583$ kJ/mol;

$G_{CaCO3}=G_{Ca(OH2)2+}+G_{CO23-}-(\Delta G_{eqCaCO3}+G_{H2O})=77,5403+102,547-(68,2583+2*0)=111,829$ kJ/mol;

$G_{Ca(H2O)2+}=\Delta G_{eqCaCO3}-G_{CO23-}+(G_{CaCO3}+G_{H2O})=68,2583-102,547+(111,829+2*0)=77,5403$ kJ/mol;

[1] Solubility $CaCO_{3(s)}+H_2O=CaOH^++HCO_3^-$; $K_{sp}=[CaOH^+]*[HCO_3^{2-}]/[H_2O]^1=3,36*10^{(-9)}/55,3^1=10^{(-10,2164)}$;

$\Delta G_{eqCaCO3}=-R•T•\ln(K_{eqCaCO3}=-8,314*298,15*\ln(10^{(-10,2164)})=58,312$ kJ/mol;

$\Delta G_{eqCaCO3}=G_{CaOH+}+G_{HCO3-}-(G_{CaCO3}+G_{H2O})=114,061+56,08-(111,829+2*0)=58,312$ kJ/mol;

$G_{CaCO3}=G_{CaOH+}+G_{HCO3-}-(\Delta G_{eqCaCO3}+G_{H2O})=114,061+56,08-(58,312+2*0)=30,945$ kJ/mol;

$G_{CaOH+}=\Delta G_{eqCaCO3}-G_{HCO3-}+(G_{CaCO3}+G_{H2O})=58,312-56,08+(111,829+2*0)=114,061$ kJ/mol;

Protolysis $HCO_3^-+H_2O=H_3O^++CO_3^{2-}$; $pK_a=10,33$ $K_{eq}=K_a/[H_2O]=10^{(-10,33)}/55,3=10^{(-12,07273)}$;

$\Delta G_{eqHCO3-}=-R•T•\ln(K_{eqHCO3-})=-8,314*298,15*\ln(10^{(-12,07273)})=68,907$ kJ/mol;

$\Delta G_{eqHCO3-}=G_{H3O+}+G_{CO32-}-(G_{HCO3-}+G_{H2O})=102,547+22,44-(56,08+0)=68,907$ kJ/mol;

$G_{CO32-}=\Delta G_{eqHCO3}-G_{H3O+}+(G_{HCO3-}+G_{H2O})=68,907-22,44-(56,08+0)=102,547$ kJ/mol;

Formation $C_{gr}+1,5O_2+2G_{e-}=CO_3^{2-}$; $G_{gr}=91,26$ kJ/mol; $G_{O2}=303,1$ kJ/mol; $G_e=42,2185$ kJ/mol;

$\Delta G°_{CO32-}=G_{CO32-}-(G_{Cgr}+1,5G_{O2}+2G_{e-})=102,547-(91,26+1,5*303,1+2*42,2185)=-527,8$ kJ/mol;

$2G_{e-}=G_{CO32-}-(G_{Cgr}+1,5G_{O2}+\Delta G°_{CO32-})=102,547-(91,26+1,5*303,1+2*-527,8)=84,437=2*42,2185$ kJ/mol;

Formation $Ca+S_{romb}+2O_2=CaSO_{4(s)}$; $G_{Srhomb}=3,5436$ kJ/mol;

$\Delta G°_{CaSO4}=G_{CaSO4}-(G_{Ca}+G_{Srhomb}+2G_{O2})=0-(647,319+3,5436+2*303,1)=-1322$ kJ/mol;

$G_{CaSO4}=\Delta G°_{CaSO4}+(G_{Ca}+G_{Srhomb}+2G_{O2})=-1322+(647,319+3,5436+2*303,1)=-64,9374$ kJ/mol;

[1] Solubility $CaSO_{4(s)}+3H_2O=CaOH^++SO_4^{2-}+H_3O^+$;

$K_{sp}=[CaOH^+]*[SO_4^{2-}]*[H_3O^+]/[CaSO_{4(s)}]/[H_2O]^3=4,93*10^{(-5)}*10^{(-7,36)}/1/55,3^3=10^{(-16,895)}$;

$\Delta G_{eqCaSO4}=-R•T•\ln(K_{eqCaSO4}=-8,314*298,15*\ln(10^{(-16,895)})=96,4315$ kJ/mol;

$\Delta G_{eqCaSO4}=G_{CaOH+}+G_{SO42-}+G_{H3O+}-(G_{CaSO4}+3G_{H2O})=280,4563+54,9256+22,44-(261,3904+3*0)=96,4315$ kJ/mol;;

$G_{CaSO4}=G_{CaOH+}+G_{SO42-}+G_{H3O+}-(\Delta G_{eqCaSO4}+3G_{H2O})=280,4563+54,9256+22,44-(96,4315+3*0)=261,3904$ kJ/mol;;

$G_{CaOH+}=\Delta G_{eqCaSO4}-G_{SO42-}-G_{H3O+}+(G_{CaSO4}+3G_{H2O})=96,4315-54,9256-22,44+(261,3904+3*0)=280,4563$ kJ/mol;;

CaO Formation $Ca+0,5O_2=CaO$; $\Delta G°_{CaO}=G_{CaO}-(G_{Ca}+0,5G_{O2})=195,569-(647,319+0,5*303,1)=-603,3$ kJ/mol;

$G_{CaO}=\Delta G°_{CaO}+(G_{Ca}+0,5G_{O2})=-603,3+(647,319+0,5*303,1)=195,569$ kJ/mol;

$G_{Ca}=G_{CaO}-(\Delta G°_{CaO}+0,5G_{O2})=195,569-(-603,3+0,5*303,1)=647,319$ kJ/mol;

$CaOH^+$ Formation $Ca+0,5*O_2+0,5H_2=CaOH^++e^-$; $\Delta G°_{CaOH+}=G_{CaOH}+G_{e-}-(G_{Ca}+0,5*G_{O2}+0,5*G_{H2})=$

$=101,0715+22,2185-(647,319+0,5*303,1+0,5*85,64)=-718,4$ kJ/mol;

$G_{CaOH}=\Delta G°_{CaOH+}-G_{e-}+(G_{Ca}+0,5*G_{O2}+0,5*G_{H2})=-718,4-22,2185+(647,32+0,5*303,1+0,5*85,64)=101,0705$ kJ/mol;

$G_{e-}=\Delta G°_{CaOH+}-G_{CaOH}+(G_{Ca}+0,5*G_{O2}+0,5*G_{H2})=-718,4-101,071+(647,32+0,5*303,1+0,5*85,64)=22,2184$ kJ/mol;

$Ca(OH)_{2(s)}$; Formation $Ca+O_2+H_2=Ca(OH)_{2(s)}$; $\Delta G°_{Ca(OH)2}=G_{Ca(OH)2}-(G_{Ca}+G_{O2}+G_{H2})=-897,5$ kJ/mol;

$\Delta G_{formCa(OH)2}=G_{Ca(OH)2}-(G_{Ca}+G_{O2}+G_{H2})=138,56-(647,32+303,1+85,64)=-897,5$ kJ/mol;

$G_{Ca(OH)2}=\Delta G_{formCa(OH)2}+(G_{Ca}+G_{O2}+G_{H2})=-897,5+(647,32+303,1+85,64)=138,56$ kJ/mol; [1]

$G_{Ca}=G_{Ca(OH)2}-(\Delta G_{formCa(OH)2}+G_{O2}+G_{H2})=138,56-(-897,5+303,1+85,64)=647,32$ kJ/mol;

Base dissociation $pK_b=12,6$ [1] (protolysis) equilibrium constant $Ca(OH)^++H_2O=[Ca(H_2O)]^{2+}+OH^-$;

$K_{eq}=K_b/[H_2O]=[Ca(H_2O)]^{2+}]*[OH^-]/[Ca(OH)^+]/[H_2O]=10^{\wedge(-12,6)}/55,3=10^{\wedge(-14,3427)}$;

$\Delta G_{eq[Ca(H2O)]2+}=-R\bullet T\bullet ln(K_{eq[Ca(H2O)]2+}=-8,314*298,15*ln(10^{\wedge(-14,3427)})=81,8637$ $^{kJ}/_{mol}$;

$\Delta G_{Ca(H2O)2+}=G_{Ca(H2O)2+}+G_{OH}-(G_{Ca(OH)+}+G_{H2O})=284,96+77,36-(280,4563+0)=81,8637$ $^{kJ}/_{mol}$;

$G_{Ca(OH)+}=G_{Ca(H2O)2+}+G_{OH-}-(\Delta G_{[Ca(H2O)]2+}+G_{H2O})=284,96+77,36-(81,8637+0)=280,4563$ $^{kJ}/_{mol}$;

$G_{[Ca(H2O)]2+}=\Delta G_{[Ca(H2O)]2+}-G_{OH}+(G_{Ca(OH)+}+G_{H2O})=81,8637-77,36+(280,4563+0)=284,96$ $^{kJ}/_{mol}$;

[1] Solubility $Ca(OH)_{2(s)}+3H_2O=Ca(H_2O)_3^{2+}+2OH^-$;

$K_{eqCa(OH)2}=[Ca(H_2O)_3^{2+}]*[OH^-]^2/[Ca(OH)_{2s}]/[H_2O]^3=5,02*10^{\wedge(-6)}/1/55,3^{\wedge3}=2,96844*10^{\wedge(-11)}=10^{\wedge(-10,5275)}$;

$\Delta G_{eqCa(OH)2}=-R\bullet T\bullet ln(K_{eqCa(OH)2}=-8,314*298,15*ln(10^{\wedge(-10,5275)})=60,0877$ $^{kJ}/_{mol}$;

$\Delta G_{eqCa(OH)2}=G_{Ca(H2O)32+}+2G_{OH}-(G_{Ca(OH)2}+3G_{H2O})=51,5763+2*77,36-(146,20857+3*0)=60,08773$ $^{kJ}/_{mol}$;

$G_{Ca(OH)]2}=G_{Ca(H2O)32+}+2G_{OH}-(\Delta G_{eqCa(OH)]2}+3G_{H2O})=51,5763+2*77,36-(60,08773+3*0)=146,20857$ $^{kJ}/_{mol}$;

$Ca(H_2O)^{2+}$ Formation $Ca+0,5*O_2+H_2=Ca(H_2O)^{2+}+2e^-$;

$\Delta G°_{Ca2+}=G_{Ca(H2O)2+}+2G_{e-}-(G_{Ca}+0,5*G_{O2}+G_{H2})=284,96+2*22,9545-(647,319+0,5*303,1+85,64)=-553,6$ $^{kJ}/_{mol}$;

$G_{Ca}=G_{Ca(H2O)2+}+2G_{e-}-(\Delta G°_{Ca2+})=284,96+2*22,9545-(-553,6+0,5*303,1+85,64)=647,319$ $^{kJ}/_{mol}$;

$G_{Ca(H2O)2+}=\Delta G°_{Ca2+}-2G_{e-}+(G_{Ca}+0,5*G_{O2}+G_{H2})=-553,6-2*22,9545+(647,319+0,5*303,1+85,6)=284,96$ $^{kJ}/_{mol}$;

[1] Formation $Ca+Cl_2^{gas}=CaCl_2$; $\Delta G_{FormatCaCl2}=G_{CaCl2}-(G_{Ca}+G_{Cl2}^{gas})=231,103-(647,319+332,584)=-748,8$ $^{kJ}/_{mol}$;

$G_{CaCl2}=\Delta G_{FormatCaCl2}+(G_{Ca}+G_{Cl2}^{gas})=-748,8+(647,319+332,584)=231,103$ $^{kJ}/_{mol}$;

$G_{Ca}=G_{CaCl2}-(\Delta G_{FormatCaCl2}+G_{Cl2}^{gas})=231,103-(-748,8+332,584)=647,319$ $^{kJ}/_{mol}$;

Subility $CaCl_{2(s)}+3H_2O=Ca^{2+}+2Cl^-$; 81,3 $^{g}/_{1000mL\ H2O}$; $M_{PbCl2}=110,984$ $^{g}/_{mol}$; **25°C** density 1,46923 $^{g}/_{mL}$; [1] https://www.engineeringtoolbox.com/calcium-chloride-water-d_1186.html

1469,23 g/L; w%=81,3/(81,3+99,6)*100%=44,941956%;

44,941956/100g=X/1469,23; X=44,941956/100*1469,23=660,3 g; $[CaCl_2]=660,3/110,984=5,949506$ M;

$mH_2O=1469-660,3=808,7$; $nH_2O=808,7/18,015=44,890369$ M;

Solubility $CaCl_{2(s)}+3H_2O=Ca(H_2O)^{2+}+2Cl^-$; $K_{sp}=[Ca^{2+}]*[Cl]^2=5,949506*(2*5,949506)^2=842,36965$;

$K_{eqCaCl2}=K_{sp}/[H_2O]^{\wedge3}=842,36965/44,89^{\wedge3}=0,00931223=9,31*10^{\wedge(-3)}=10^{\wedge(-2,03095)}$

$\Delta G_{eqCaCl2}=-R\bullet T\bullet ln(K_{eqCaCl2}=-8,314*298,15*ln(0,00931223)=11,592$ $^{kJ}/_{mol}$;

$\Delta G_{eqCaCl2}=Ca(H_2O)^{2+}+2G_{Cl-}-(G_{CaCl2}+3G_{H2O})=51,5763+2G_{Cl-}-(231,103+3*0)=11,592$ $^{kJ}/_{mol}$;

$2G_{Cl-}=\Delta G_{eqCaCl2}-G_{Ca(H2O)2+}+(G_{CaCl2}+3G_{H2O})=11,592-51,5763+(231,103+3*0)=191,119=2*95,5594$ $^{kJ}/_{mol}$;

Substance	$\Delta H°_H$, $^{kJ}/_{mol}$	$\Delta S°_H$, $^{J}/_{mol/K}$	$\Delta G°_H$, $^{kJ}/_{mol}$
Mg^{2+}	-466,9	-138,1	-454,8
$MgOH^+$	-	-	-626,7
$Mg(OH)_{2(s)}$	-924,5	63,2	-833,5

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$\Delta G°=\Delta H°_H-T*\Delta S°_H=-466,9-298,15*-0,1381=-425,7255$ $^{kJ}/_{mol}$;

$\Delta G°=\Delta H°_H-T*\Delta S°_H=-924,5-298,15*0,0632=-943,34$ $^{kJ}/_{mol}$;

Base dissociation $pK_b=11,4$ [1] (protolysis) equilibrium constant $Mg(OH)^+ + H_2O=[Mg(H_2O)]^{2+}+OH^-$;

$K_{eq}=K_b/[H_2O]=[[Mg(H_2O)]^{2+}]*[OH^-]/[Mg(OH)^+]/[H_2O]=10^{\wedge(-11,4)}/55,3=10^{\wedge(-14,3427)}$;

[1] Solubility $Mg(OH)_{2s}+3H_2O=Mg(H_2O)_3^{2+}+2OH^-$;

$K_{sp}=[Mg^{2+}]*[OH^-]^2/[Mg(OH)_{2s}]/[H_2O]^3=5,61*10^{\wedge(-12)}/1/55,3^{\wedge3}=10^{\wedge(-25,149)}$;

[1] Solubility $MgCO_{3(s)}+2H_2O=MgOH^+ + HCO_3^-$;

$K_{sp}=[MgOH^+]*[HCO_3^{2-};]/[MgCO_{3s}]/[H_2O]^2=2,24*10^{\wedge(-11)}/1/155,3^{\wedge2}=10^{\wedge(-25,149)}$;

Base dissociation $pK_b=14,8$ [1] (protolysis) equilibrium constant $Na(OH)+H_2O=[Na(H_2O)]^+ + OH^-$;

$K_{eq}=K_b/[H_2O]=[[Na(H_2O)]^+]*[OH^-]/[Na(OH)]/[H_2O]=10^{\wedge(-14,8)}/55,3=10^{\wedge(-14,3427)}$;

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