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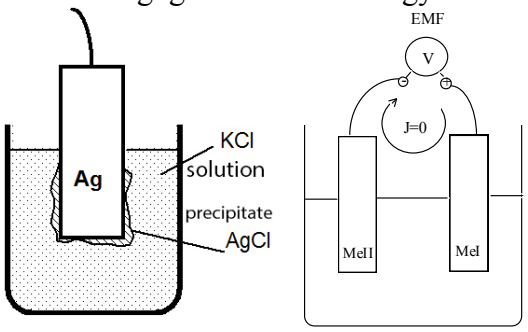
II type Prigogine attractors for electrodes of metals Ag, Hg, Pb, Al, Ca, Mg with precipitates.

Prigogine absolute energy attractors for dissolution, protolysis, and oxidation of silver compounds.



K^+Cl^- solution, counter-ions Cl^- of AgCl insoluble salt. Nernst's half reactions for electrode of silver metal Ag. Electric potential in volt measurement by couple of electrodes **E**lectric **M**otion **F**orce EMF in Volts. Between the indicator electrodes MeI and the reference electrode MeII connected in a closed electrical circuit, the potential of the MeI indicator electrode EI is calculated as the sum: EI=EMS+EII. The standard reference electrode EII serves as a constant value of potential and chloride concentration.

The silver I-type electrode: **Ag**(s)+H_2O=**Ag**$^+$+e^- absolute potential is expression standard potential $E°_{Classic}$=0.7996 V [1], water logarithm -0.103 and sum $\Delta E°$=0.10166-0.37239:

$E_{Ag/Ag+}=E°_{classic}-0.0591/1*lg(1/[H_2O]^1)+\Delta E°=0.7996+0.103+0.10166-0.37239=$**0,631865** V.

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

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

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

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

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

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

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

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

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

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

Solubility equilibrium on mol fractions **Ag**Cl(s)+2H_2O=Cl^-+**Ag**$^+$ absolute constant :

$K_{Absolute\mathbf{AgCl}}=K_{sp\mathbf{AgCl}}/[H_2O]^{\wedge}2=[\mathbf{Ag}^+]*[Cl^-]/[\mathbf{AgCl}(s)]/[H_2O]^{\wedge}2=1.77*10^{\wedge}(-10)/55.3^{\wedge}2=10^{\wedge}(-13,2375)$;

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

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

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

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

Substance	$\Delta H°_H$ $^{kJ}/_{mol}$	$\Delta S°$ $^{J}/_{mol/K}$	$\Delta G°_H$, $^{kJ}/_{mol}$
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)	**K**$_{sp\mathbf{AgCl}}$=	$10^{\wedge}(-13,2375)$	**130,236**
Cl_2^{gas}	-109,8;AgCl$_s$	formation	**394,353**
$Cl^-_{(aq)}$	**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**
Cl$^-_{aqNaCl}$	$E°_{2Cl-Cl2}$=	**1.03756** V	**66.1832**
$Ag(NH_3)_2^+$	$E°_{Ag(NH3)2+}$	**-0,06995**	**224,9895**
Ag$_2$O(s)	-31,1	121,3	-11,2
Ag$_2$O(s)	formation	-11,2	**226,069**
2Ag	$E°_{Ag/\mathbf{Ag2O}}$=	**0,02277**V	2*33,4773

ion G_{Ag+}=**103.8** $^{kJ}/_{mol}$ over G_{Ag}=**42.855** $^{kJ}/_{mol}$ element **60.945**;[8]

$G_{Ag}=G_{Ag+}-(\Delta G_{eqAg}+$**G$_{H2O}$**$)=$**103,825-(60,9655+0)=42,8595** $^{kJ}/_{mol}$; [8]

$G_{Ag}=G_{AgCl}+$**G$_{H2O}$**$-(\Delta G_{eq_Ag}+$**G$_{Cl-}$**$)=$**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]

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

$G_{Ag+}=\Delta G_{eq\_As}+(G_{Ag}+$**G$_{H2O}$**$)=$**60,95+(42,855+0)=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]

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

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

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

$G_{Cl-}=\Delta G_{sp\mathbf{AgCl}}-G_{Ag+}+(G_{AgCl}+$**2G$_{H2O}$**$)=$**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]

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

2G$_{Cl-}$ $=G_{Hg2Cl2}+$**2G$_{H2O}$**$-(\Delta G_{eq_Hg2Cl2}+2G_{Hg})=2*$**66.1832** $^{kJ}/_{mol}$;

$G_{Ag(NH3)2+}=\Delta G_{Ag/Ag(NH3)2+}-$**G$_{H2O}$**$+(G_{Ag}+2G_{NH3aq})=$**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]

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

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

Water molecule compensation **Ag**(s)+H_2O=**Ag**$^+$+e^-; **Ag**(s)+H_2O+Cl^-=**AgCl**(s)+2H_2O+e^- on summary reaction **Ag**(s)+Cl^-=**AgCl**(s)+H_2O+e^- Expression of absolute potential has standard $E°_{Classic}$=0.2223 V [1], water and $\Delta E°$: $E_{Ag/AgCl}=E°_{classic}-0.0591/1*log([H_2O]^1)+\Delta E°=0.22233-0.103+0.10166-0.37239=$**-0.1514** V;

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

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

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

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

Solubility NH_3^{gas} and **Ag** compensate each one water molecule in Nernst's half reaction products $NH_3^{gas}+H_2O=NH_{3aq}$; $Ag+H_2O=Ag^{+}+e^{-}$; $Ag+H_2O+2NH_{3aq}=Ag(NH_3)_2^{+}+2H_2O+e^{-}$; Absolute potential has standard $E°_{Classic}$=0,373 V [17], water $-0{,}0591/1*\log([H_2O]^1)$=-0,103 logarithm and sum $\Delta E°$=0,10166-0,37239:

$E°_{Ag/Ag(NH3)2+}=E°_{Classic}-0{,}0591/1*\log([H_2O]^1)+\Delta E°$=0,373-0,103+0,10166-0,37239=**-0,000725055** V;

$\Delta G_{Ag/Ag(NH3)2+}=E°_{Ag/Ag(NH3)2+}\bullet F\bullet n$=**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** $^{kJ}/_{mol}$;

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

Expression of absolute potential has standard $E°_{Classic}$=0,345 V [17], water and $\Delta E°$:

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

$\Delta G_{Ag/Ag2O}=E°_{Ag/Ag2O}\bullet F\bullet n$=**0,0227725***96485*2=**4,394** $^{kJ}/_{mol}$;

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

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

Prigogine absolute energy attractors for dissolution, protolysis, and reduction-oxidation of mercury compounds

Substance	$\Delta H°_{H}$, 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
$Hg_2SO_{4(s)}$	formation	-625,8	**55,4718**
$Hg_2SO_{4(s)}$	$K_{Absolute}$**Hg2**SO_4=	10^(-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**
$Cl-_{(aq)}$	$K_{Absolute}$**Hg2**Cl_2=	10^(-23,07)	**66,05455**
Cl$^-_{aqNaCl}$	$E°_{2Cl-Cl2}$=	**1,03756** V	**66,1832**

<===G_{Hg}=(G_{Hg2Cl2}+**G_{H2O}**-(2**G_{Cl-}**+ΔG_{eq_Hg2Cl2}))/2=**35,7641** kJ/mol;

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

G_{Hg}=(G_{Hg2SO4}-(ΔG_{Hg2SO4}+**G_{S}**$_{romb}$+**G_{S}**$_{romb}$+2G_{O2}))/2=**85,023** kJ/mol;

ΔG_{Cl-}=ΔH_H–T*ΔS_H=-90,8-298,15*0,0703=-111,76 kJ/mol;[1]

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

G_{HgO}=ΔG_{eqHgO}-2G_{H2O}+(G_{Hg}+2G_{OH})=**147,15** kJ/mol;

<====G_{Hg}=G_{HgO}+G_{H2O}-(ΔG_{eqHgO}+2G_{OH})=**35,764** kJ/mol;

G_{HgO}=ΔG_{eqHgO}-2G_{H2O}+(G_{Hg}+2G_{OH})=**147,15** kJ/mol;

ΔG_{Hg22+}=ΔH_H–T*ΔS_H=–172,4–298,15*0,0845=–197,59 kJ/mol;

2G_{e-}=ΔG_{eq_2Hg}-G_{Hg22+}+(2G_{Hg}+**G_{H2O}**)=2***20,975** kJ/mol;

G_{Hg22+}=ΔG_{eq_Hg}+(2G_{Hg}+**G_{H2O}**)=**111,55**+(2***35,8**+0)=**183,08** kJ/mol;

G_{Hg2+}=ΔG_{eq_Hg}+(G_{Hg}+**G_{H2O}**)=**121,91**+(**35,764**+0)=**157,674** kJ/mol;

ΔG_{Hg22+}=ΔH_H–T*ΔS_H=-171,1-298,15*-0,0322=-161,4996 kJ/mol;

2G_{e-}=ΔG_{eq_Hg}-G_{Hg2+}+(G_{Hg}+**G_{H2O}**)=2***21,24505** kJ/mol;

[1] ΔG_{Hg2SO4}=ΔH_H–T*ΔS_H=-743,1-298,15*0,2=-802,73kJ/mol;

G_{Hg2SO4}=ΔG_{Hg2SO4}+(G_{Hg}+**G_{S}**$_{romb}$+**G_{S}**$_{romb}$+G_{O2}^{gas})=**55,4718** kJ/mol;

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

G_{Hg2SO4}=ΔG_{eq_Hg2SO4}+(2G_{Hg}+**G_{SO4}**)=**153,99156** kJ/mol;

ΔG_{Hg22+}=ΔH_H–T*ΔS_H=-909,3-298,15*0,0201=-915,29 kJ/mol;

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

G_{HSO4-}=ΔG_{eq}**H_2SO_4**-**G_{H3O}**+(G_{H2SO4}+G_{H2O})=**27,584** kJ/mol;

G_{SO42-}=ΔG_{eq}**HSO_4**-**G_{H3O}**+(G_{HSO4-}+**G_{H2O}**)= **26,44977** kJ/mol; pH<7

G_{SO42-}=ΔG_{eq}**$HSO42-$**-3**G_{H3O}**+(G_{HSO3}+4**G_{H2O}**)=**26,44996** kJ/mol;

G_{SO4}=G_{Hg2SO4}-(2G_{Hg}+ΔG_{eq_Hg2SO4})=**26,44996** kJ/mol;

G_{HSO3}=G_{SO42-}+3**G_{H3O}**-(ΔG_{eq}**$HSO4-$**+4**G_{H2O}**)=**73,072** kJ/mol;

G_{SO42-}=ΔG_{eq}**$SO32-OH$**-**G_{H2O}**+(G_{SO32-}+2**G_{OH}**)=**54,9256** kJ/mol ;

G_{SO32-}=G_{SO42-}+2**G_{H3O}**-(ΔG_{eq}**$SO32-$**+3**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;

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

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

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

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

ΔG_{Hg22+}=ΔH_H–T*ΔS_H=-265,37-298,15*0,1916=322,4955 kJ/mol;

G_{Hg2Cl2}=ΔG_{eq_Hg2Cl2}+(2G_{Hg}+G_{Cl2}^{gas})=-210,7+(2***35,7641**+**139,1718**)=**0** kJ/mol;

[1] ΔG_{Hg22+}=ΔH_H–T*ΔS_H=-224,3-298,15*0,146=-267,83 kJ/mol;

[1] G_{HgCl2}=ΔG_{eq_HgCl2}+(G_{Hg}+G_{Cl2}^{gas})=**0,0001** kJ/mol;

G_{Hg2Cl2}=ΔG_{eq_Hg2Cl2}-2**G_{H2O}**-2G_{e-}+(2**G_{Cl-}**+2G_{Hg})=**183,5083** kJ/mol;

ΔG_{Cl-}=ΔH_H–T*ΔS_H=-167,08-298,15*0,0566=-183,955 kJ/mol;[1]

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

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

2**G_{Cl-}**=G_{Hg2Cl2}+2**G_{H2O}**-(ΔG_{eq_Hg2Cl2}+2G_{Hg})=2***66,1832** kJ/mol;

2Hg+H_2O=Hg_2^{2+}+2e^-; Absolute potential contains standard potential $E°_{classic}$=0,7973 V [1], water logarithm, $\Delta E°$:

$E°_{2Hg}$=$E°_{clasiskais}$-0,0591/2*lg(1/[H_2O]^1)+$\Delta E°$=0,7973+0,0515+0,10166-0,37239=**0,5780675** V;

ΔG_{eq_2Hg}=$E°_{Hg}$•F•n=**0,5780675***96485*2=**111,55** kJ/mol,

ΔG_{eq_2Hg}=G_{Hg22+}+2G_{e-}-(2G_{Hg}+**G_{H2O}**)=**183,0782**+2***0**-(2***35,7641**+**0**)=**111,55** kJ/mol ;

G_{Hg22+}=ΔG_{eq_Hg}-2G_{e-}+(2G_{Hg}+**G_{H2O}**)=**111,55**-2***0**+(2***35,7641**+**0**)=**183,0782** kJ/mol ;

2G_{e-}=ΔG_{eq_2Hg}-G_{Hg22+}+(2G_{Hg}+**G_{H2O}**)=**111,55**-**183,0782**+(2***35,7641**+**0**)=2***0** kJ/mol ;

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

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

ΔG_{eq_Hg}=$E°_{Hg}$•F•n=**0,6317675***96485*2=**121,91** kJ/mol,

ΔG_{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 $2Hg+H_2O=Hg_2^{2+}+2e^-$;

$\Delta G_{eq\_2Hg}=G_{Hg22+}+2G_{e-}-(2G_{Hg}+G_{H2O})=183,0782+2*20,975-(2*35,7641+0)=153,5$ 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 $HSO_4^-+H_2O=SO_4^{2-}+H_3O^+$ $pK_{a2}=1,99$

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

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

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

$G_{SO32-}=G_{SO42-}+2G_{H3O44}+2G_{e-}-(\Delta G_{eqSO32-}+3G_{H2O})=26,44996+2*22,44+2*0-(10,7600+3*0)=60,56996$ 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;

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

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

$\Delta G°_{Hg2Cl2}=G_{Hg2Cl2}-(2G_{Hg}+G_{Cl2})=-(2*35,7641+G_{Cl2})=-210,7=$ 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 $\Delta E°$: $E°_{HgCl2}=E°_{Classic}-0,0591/2*\lg([H_2O]^2)+\Delta E°=0,26808-0,1030+0,10166-0,37239=\underline{-0,10565}$ V;

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

$\Delta G_{eq\_Hg2Cl2}=G_{Hg2Cl2}+\mathbf{2G_{H2O}}+2G_{e^-}-(\mathbf{2G_{Cl^-}}+2G_{Hg})=\mathbf{183,5083+2*0+2*0-(2*66,1832+2*35,7641)=-20,3863}$ kJ/mol ;

$G_{Hg2Cl2}=\Delta G_{eq\_Hg2Cl2}-\mathbf{2G_{H2O}}-2G_{e^-}+(\mathbf{2G_{Cl^-}}+2G_{Hg})=\mathbf{-20,3863-2*0-2*0+(2*66,1832+2*35,7641)=183,5083}$ kJ/mol ;

$\mathbf{2G_{Cl^-}}=G_{Hg2Cl2}+\mathbf{2G_{H2O}}+2G_{e^-}-(\Delta G_{eq\_Hg2Cl2}+2G_{Hg})=\mathbf{183,508+2*0+2*0-(-20,386+2*35,76)=132,366=2*66,19}$ kJ/mol;

$G_{Hg}=(G_{Hg2Cl2}+\mathbf{G_{H2O}}+2G_{e^-}-(\mathbf{2G_{Cl^-}}+\Delta G_{eq\_Hg2Cl2}))/2=(\mathbf{183,5083}+2*\mathbf{0}+2*\mathbf{0}-(2*\mathbf{66,1832-20,3863}))/2=\mathbf{35,7641}$ kJ/mol ;

$2G_{e^-}=\Delta G_{eq\_Hg2Cl2}-G_{Hg2Cl2}-\mathbf{2G_{H2O}}+(\mathbf{2G_{Cl^-}}+2G_{Hg})=\mathbf{-20,3863-183,5083-2*0-2*0+(2*66,1832+2*35,7641)=0}$ kJ/mol ;

Solubility equilibrium attractor $Hg_2SO_{4(s)}+2H_2O=\mathbf{Hg}_2^{2+}+SO_4^{2-}$; $2\underline{Hg}+2H_2O=Hg_2^{2+}+2e^-$; absolute constant is:

$K_{Absolute\mathbf{Hg2SO4}}=K_{sp\mathbf{Hg2SO4}}/[H_2O]^{\wedge}2=[\mathbf{Hg}_2^{2+}]*[SO_4^{2-}]/[Hg_2SO_{4(s)}]/[H_2O]^{\wedge}2=6,5*10^{\wedge(-7)}/1/55,3^{\wedge}2=10^{-9,673}$;

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

$\Delta G_{eq}Hg2SO4=G_{\mathbf{Hg2}^{2+}}+\mathbf{G}_{SO4^{2-}}-(G_{Hg2SO4}+\mathbf{2G_{H2O}})=\mathbf{183,0782+26,44996-(154,3205+2*0)=55,20765}$ kJ/mol;

$G_{Hg2SO4}=G_{\mathbf{Hg2}^{2+}}+\mathbf{G}_{SO4^{2-}}-(\Delta G_{eq}Hg2SO4+\mathbf{2G_{H2O}})=\mathbf{183,0782+26,44996-(55,20765+2*0)=154,3205}$ kJ/mol;

$Hg_2SO_{4(s)}+2H_2O=\mathbf{Hg}_2^{2+}+SO_4^{2-}$; $2\underline{Hg}+H_2O=\mathbf{Hg_2}^{2+}+2e^-$;

$2\underline{Hg}+SO_4^{2-}=Hg_2SO_{4(s)}+H_2O+2e^-$; Absolūtais aprēķins satur standarta potenciālu $E°_{klasisko}$=0,6125 V [18], ūdens logaritmu un ΔE°: $E°_{HgSO4}=E°_{klasisko}-0,0591/2*lg([H_2O]^1)+\Delta E°=0,6125-0,0515+0,10166-0,37239=\underline{\mathbf{0,29027}}$ V;

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

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

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

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

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

$Hg+2OH^-=HgO+H_2O+2e^-$, Expression of absolute potential has standard $E°_{Classic}$=0,0977 V [1], water and ΔE°: $E°_{HgO}=E°-0,0591/2*lg([H_2O]^1)+\Delta E°=0,0977-0,0515+0,10166-0,37239=\mathbf{-0,224528}$ V;

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

$\Delta G_{eqHgO}=G_{HgO}+G_{H2O}-(G_{Hg}+2G_{OH})=G_{HgO}+\mathbf{0}-(\mathbf{35,7641}+2*77,36)=\mathbf{147,157}+\mathbf{0}-(\mathbf{35,7641}+2*77,36)=\mathbf{-43,327}$ kJ/mol;

$G_{HgO}=\Delta G_{eqHgO}-G_{H2O}+(G_{Hg}+2G_{OH})=\mathbf{-43,327-0}+(\mathbf{35,7641}+2*77,36)=\mathbf{147,157}$ kJ/mol;

Reduction $HgO+2H_2O+2e^-=Hg+2OH^-$, inverse standard potential $-E°_{HgO}=\mathbf{0,224528}$ V.

Oxidation $\mathbf{H_2O_{2aqua}+2H_2O=O_{2aqua}+2H_3O^++2e^-}$ Nernst's absolute standard potential $E°_{\mathbf{Red}H2O2}=\mathbf{0,52677}$ V;

$HgO+2H_2O+\cancel{2e^-}+\mathbf{H_2O_{2aqua}+2H_2O}=Hg+2OH^-+\mathbf{O_{2aqua}+2H_3O^+}+\cancel{2e^-}$;

$HgO+\mathbf{H_2O_{2aqua}+4H_2O}=Hg+\mathbf{O_{2aqua}}+(2OH^-+\mathbf{2H_3O^+})$; $HgO+\mathbf{H_2O_{2aqua}+4H_2O}=Hg+\mathbf{O_{2aqua}}+\mathbf{(4H_2O)}$;

$\Delta G_{eqRedOx\_H2O2}=(\Delta E°_{H2O2aqRed}-E°_{HgO})*\mathbf{F*n=(0,52677+0,224528)}*96485*2=(0,7513)*96485*2=\mathbf{144,978}$ kJ/mol;

Summary: $HgO+\mathbf{H_2O_{2aqua}}=Hg+\mathbf{O_{2aqua}}$; katalāze $G_{\mathbf{H2O2}}=\mathbf{279,3}$ kJ/mol;

$\Delta G_{eqRedOx\_H2O2}=G_{Hg}+G_{O2aqua}-(G_{HgO}+G_{H2O2})=\mathbf{35,778+330-(-58,5+279,3)=144,978}$ kJ/mol ;

HgO ; $G_{Hg}=\Delta G_{eqRedOx\_H2O2}-G_{O2aqua}+(G_{HgO}+G_{H2O2})=\mathbf{144,978-330+(-58,5+279,3)=35,778}$ kJ/mol ;

Salt $\mathbf{Na^+Cl^-}$ crystals in the hydration reaction have a solubility in water of 36 g/100 g, a density of 1,203 g/mL; w%=26,4706 %: nc=49,142/12=4,0952 M.

26,4706 grams are in 100 g X grams are in 1203 g. So are X=26,4706/100*1203=318,44 grams **NaCl** in liter.

Concentration total is $C_{M\_total}=[\mathbf{NaCl}]_{total}=m/M=318,44/58,4$ g/mol=5,45274 M;

Water mas in liter of $m_{\mathbf{H2O}}=1203-318,44=884,56$ g; Mols in liter $n_{\mathbf{H2O}}=884,56/18=49,142$mol;

Some of the **NaCl** remains undissociated as neutral molecules due to insufficient water resources, 49,142 moles.

Saturated non-dissociate [**NaCl**]=5,45274-4,0952=1,35754 M; dissociation **α**=4,0952/5,45274=0,751; 75,1 %;

Dissociation equilibrium $\mathbf{K_{dis}}=[\mathbf{Na^+}_{aq}]*[\mathbf{Cl^-}_{aq}]/[\mathbf{NaCl}]=4,0952*4,0952/1,35754=12,3537$;

Solubility product equilibrium constant $\mathbf{K}_{sp\_eq}=[\mathbf{Na^+}_{tot}]*[\mathbf{Cl^-}_{tot}]/[\mathbf{NaCl}]_{cryst}=5,45274*5,45274/1=29,73237$;

Dissociation Prigogine attractor is $\Delta G_{sp\_eq}=\mathbf{-R\bullet T\bullet ln(}K_{sp\_eq}\mathbf{)}=-8,3144*298,15*\mathbf{ln}(12,3537)=-6,232$ kJ/mol,

Thermodynamic solubility attractor is $\Delta G_{šķ}=\mathbf{-R\bullet T\bullet ln(}K_{šķ}\mathbf{)}=-8,3144*298,15*\mathbf{ln}(29,73237)=-8,409$ kJ/mol,

Thermodynamic absolute energy scale attractor is $\Delta G_H=\mathbf{\Delta H_H-T\Delta S_H}=-9,15$ kJ/mol ;

Substa	$\Delta H°_H$ 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	-

crystallin $\mathbf{Na^+Cl^-}+\mathbf{Q}=>\mathbf{Na^+}_{aq}+\mathbf{Cl^-}_{aq}+\Delta G$; **endothermic**.

$\Delta H_{Hess}=\Delta H°_{\mathbf{Na}}+\Delta H°_{\mathbf{Cl}}-\Delta H°_{\mathbf{Na+Cl}}=-240,1-167,2-(-411,12)=3,82$ kJ/mol ;

$\Delta S_{dissipated}=-\Delta H_H/T=-3,82/298,15=-12,812$ J/(mol K;

$\mathbf{\Delta S_H=\Delta S°_{Na}+\Delta S°_{Cl}-\Delta S°_{NaCl}}=59+56,50-(72)=43,5$ J/mol/K; $\mathbf{\Delta G_H=\Delta H_H-T\Delta S_H}=3,82-298,15*0,0435=-9,15$ kJ/mol ;

$\Delta S_{total}=\Delta S_{Hess}+\Delta S_{dissipated}=-12,812+43,5=30,688$ J/mol/K; $T\bullet\Delta S_{total}=30,688*298,15=\mathbf{9,15}$ kJ/mol bound energy.

Strong oxidizing agents oxygen $\mathbf{O_2}$ and chlorine Cl_2 aqua have free energies **330** kJ/mol un **332,58** kJ/mol.

$NaCl=Na^++Cl^-$; $2Cl^-=Cl_2+H_2O=2e^-$; Potential contains $E°_{classic}$=1,35827 V [1] water -0,04998 and sum ΔE°:

$E°_{2Cl-Cl2}=E°_{classic}-0,0591/2*lg([H_2O)+\Delta E°=1,35827-0,0591/2*lg(49,142)+0,10166-0,37239=\mathbf{1,037558}$ V;

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

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

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

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

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

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

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

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

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

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

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

Prigogine absolute energy attractors for dissolution, protolysis, and reduction-oxidation of lead compounds

Formation $Pb+S_{rombic}+2O_2^{gas}=PbSO_4$: $\Delta G°_{PbSO4Form}=G_{PbSO4}-(G_{Pb}+G_{Srombic}+2G_{O2})$=-813 $^{kJ}/_{mol}$; [1]

Molar content is $G_{PbSO4}=\Delta G°_{PbSO4Form}+(G_{Pb}+G_{Srombic}+2G_{O2})$ =-813,0+(**282,25737+3,5436**+2***303,1**)=**79,0** $^{kJ}/_{mol}$.

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 Expression of potential has standard $E°_{classic}$=-0,3505 V [1], water logarithm and ΔE°: $E°_{Pb/PbSO4}=E°_{classic}$-0,0591/2*log($[H_2O]$)+ΔE°=-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 Expression of potential has standard $E°_{classic}$=-0,3588 V [1], water logarithm and sum ΔE°: $E°_{Pb/PbSO4}=E°_{classic}$-0,0591/2*log($[H_2O]$)+ΔE°=-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 Expression of potential has standard $E°_{classic}$=-0,1262 V [1], water logarithm and ΔE°: $E°_{Pb/Pb2+}=E°_{classic}$-0,0591/2*log(1/$[H_2O]$)+ΔE°=-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**+$2G_{e-}$-(**282,0676**)=-24,43 $^{kJ}/_{mol}$;

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

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

$Pb^{2+}+6H_2O=PbO_2(s)+4H_3O^++2e^-$; Expression of potential has standard $E°_{classic}$=1,455 V [1], water logarithm and ΔE°: $E°_{PbO2}=E°_{classic}$-0,0591/2*log(1/$[H_2O]^6$)+ΔE°=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** $^{kJ}/_{mol}$;

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

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] Energy content of mol

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

25°C [1] 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 $K_{PbCl2}=K_{sp}/[H_2O]^3$=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);

$\Delta G_{eqPbCl2}$=**-R•T•ln($K_{AbsolutePbCl2}$)=-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 $PbSO_4^{2-}+2H_2O=Pb^{2+}+SO_4^{2-}$; $K_{sp}=[Pb^{2+}]*[SO_4^{2-}]/[H_2O]^2=2{,}53*10^{\wedge(-8)}/55{,}3^{\wedge2}=10^{\wedge(-11{,}082)}$;

$\Delta G_{eqPbSO4}$=**-R•T•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-	$E°_{I-/I2}$=	**0,2137725**	**97,60945**
I-	$K_{PbI2}=10^{-13{,}23695}$		**102,63**
I_2	PbI_2formation	-173,6	**236,4706**
I_2	$E°_{I-/I2}$=	**0,21377** V	**245,022**
PbOyellow	-217,32	68,7	-187,89
PbOred	-218,99	66,5	-188,931
$PbO_2\downarrow$	-277,4	68,6	-217,3
$PbO_2\downarrow$	$E°_{PbO2\downarrow Pb2+}$=	**1,493255** V	**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**
$HPbO_2^-$	$E°_{Pb/HPbO2-}$	**-0,859228**	**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 $^{kJ}/_{mol}$**;**

$G_{PbSO4}=\Delta G°_{PbSO4Form}+(G_{Pb}+G_{Srombic}+2G_{O2})$**=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+(282,067)=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]

$G_{PbCl2}=\Delta G°_{PbCl2}+(G_{Pb}+G_{Cl2})$**=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]

$\Delta G_{e-}=G_{Cl-(aq)}-(0{,}5G_{Cl2}^{gas}+\Delta G_{eqCl})$= **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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ecampusontario.pressbooks.pub/ $K_{Pb(OH)2\_SO4}$

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

$G_{PbO2}=\Delta G_{eqPbO2\downarrow Pb2+}-4G_{H3O+}+(G_{Pb2+}+3G_{H2O})$= **383,9944** $^{kJ}/_{mol}$;

$G_{PbO2}=\Delta G_{PbO2}+(G_{Pb}+G_{O2}^{gas})$=-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]

$E°_{Pb/PbSO4}=E°_{classic}$-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;

$Pb+2Cl^{-}=PbCl_{2s}+2H_2O+2e^{-}$; pH=7,36 Potential has $E°_{classic}$=-0,2675 V [1], water logarithm and sum ΔE°:

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

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

$\Delta G_{eqPb/PbCl2}=G_{PbCl2}+2G_{H2O}-(G_{Pb}+2G_{Cl-})=$**368,623**+2***0**-(**282,2575**+2***101,885**)=**-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]

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

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

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

$G_{Pb(OH)2(s)}=G_{Pb2+}+G_{H2O}-(\Delta G_{eq\_Pb(OH)2+2H3O+}+2G_{H3O+})=$**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 [1]

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

[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•**$\ln(K_{AbsolutePbCl2})$**=-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;

$3I^{-}=I^{-}+I_2+H_2O+2e$-; Expression of potential has standard $E°_{classic}$=0,536 V [1], water logarithm and sum ΔE°: $E°_{I-/I2}=E°_{classic}$-0,0591/2*log($[H_2O]^1$)+ΔE°=0,536-0,0591/2*log($55,3^{\wedge1}$)+0,10166-0,37239=**0,21377 V**;

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

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

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

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

$Pb+2I^{-}=PbI_2+2H_2O+2e^{-}$; pH=7,36 Expression of potential has standard $E°_{classic}$=-0,365 V [1], water logarithm and ΔE°: $E°_{Pb/PbI2}=E°_{classic}$-0,0591/2*log($[H_2O]^2$)+ΔE°=-0,365-0,103+0,10166-0,37239=**-0,738725** V;

$\Delta G_{eqPb/PbI2}=E°_{Pb/PbI2}$***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;

Prigogine absolute energy attractors for dissolution, protolysis, and reduction-oxidation of aluminum compounds

Al+ H_2O=Al^{3+}+3e^-; Expression of potential has standard $E°_{classic}$=-1,676 V [1], water logarithm and $\Delta E°$:

$E°_{Al/Al3+}=E°_{classic}-0{,}0591/3*\log(1/[H_2O])+\Delta E°=-1{,}676+0{,}03433+0{,}10166-0{,}37239=$**-1,9124** V;

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

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

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

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

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

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

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

$3G_{e-}=\Delta G°_{Al3+}-G_{Al(H2O)3+}+(G_{Al}+G_{H2}+0{,}5G_{O2})=$-485-**493,6605**+(**810,0635**+0,5***303,1**+**85,6**)=3***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**
$Al(H_2O)^{3+}$	$K_{eq}=K_b/[H_2O]$	$10^{-6,742725}$	**493,6605**
$AlOH^{2+}{}_{aq}$	formation	-694,1	**264,6115**
$AlOH^{2+}G_{e-}$	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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$G_{H2O}=$**0** kJ/mol;

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

$G_{Al3+}=\Delta G_{eqAl/Al3+}+(G_{Al}+G_{H2O})=$**256,51** kJ/mol;

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

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

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

$G_{[Al(H2O)]3+}=\Delta G_{[Al(H2O)]3+}-G_{OH}+(G_{AlOH2+}+G_{H2O})=$**256,5103** kJ/mol;

$G_{AlOH2+}=\Delta G°_{AlOH2+}-2G_{e-}+(G_{Al}+0{,}5G_{O2}+0{,}5G_{H2})=$**264,61** kJ/mol;

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

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

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

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

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

$G_{Cl2}=-(G_{Hg}+\Delta G°_{HgCl2})=-($**35,8**-178,6)=**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]

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

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

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

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

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

[78]

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

$G_{H2AlO3}=\Delta G_{eqH2AlO3Al}-G_{H2O}+(G_{Al}+4G_{OH})=$**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^-; $\Delta G°_{AlOH2+}=G_{AlOH2+}+2G_{e-}-(G_{Al}+0{,}5G_{O2}+0{,}5G_{H2})=$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$G_{Al(OH)3}=G_{Al(H2O)3+}+3G_{OH-}-(\Delta G_{eqAl(OH)3}+4G_{H2O})=$**493,6605**+3*77,36-(**226,5505**+4*0)=**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 $Al+1,5Cl_2=AlCl_3$; $\Delta G°_{Al2Cl3}=G_{AlCl3}-(G_{Al}+1,5G_{Cl2}^{gas})=\mathbf{394,1635}-(\mathbf{810,0635}+1,5*\mathbf{142,8})=-630,1$ $^{kJ}/_{mol}$;

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

3e-; $G_{Al}=G_{AlCl3}-(\Delta G°_{Al2Cl3}+1,5G_{Cl2}^{gas})=\mathbf{394,1635}-(-630,1+1,5*\mathbf{142,8})=\mathbf{810,0635}$ $^{kJ}/_{mol}$;

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 $E°_{classic}$=-2,33 V [1], ūdens logaritmu un ΔE°: $E°_{H2AlO3-Al}=E°_{classic}-0,0591/3*\log([H_2O])+\Delta E°=-2,33+0,0343+0,10166-0,37239=\mathbf{-2,63506}$ 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;

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

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

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

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

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

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

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

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

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

Prigogine absolute energy attractors for dissolution, protolysis, and reduction-oxidation of calcium compounds.
Metal calcium $Ca_{(s)}+H_2O=Ca^{2+}+2e^-$; 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,

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

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

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

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

Substance	$\Delta H°_H$, kJ/mol	$\Delta S°_H$, J/mol/K	$\Delta G°_H$, kJ/mol
G_{Ca} $CaO_{(s)}$	formation	-603,3	**647,319**
Ca G_{Ca}	$E°_{Ca/Ca2+}$=	**-3,08723** V	**553,91**
$CaG_{e-}G_{Ca}$	G_e=**22,9745**	**51,5763**	**647,319**
$Ca(H_2O)^{2+}$	$E°_{Ca/Ca2+}$=	**-3,08723** V	**51,5763**
$Ca(H_2O)^{2+}$	$K_{eq}CaCO_3$	=10^-11,959	**77,5403**
$Ca(H_2O)^{2+}$	pK_b12,6[1]	=10$^{-14,3427}$	**284,96**
Ca^{2+}	-542 ,8	-53,1	-553,6
$Ca(H_2O)^{2+}$	formation	-553,6	**284,96**
Ca^+	$E°_{Ca/Ca+}$=	**-3,967735**	**264,492**
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-	-167,2	56,5	-131,2
$Cl-_{(aq)}$	formation	-131,2	**66,1832**
$Cl-_{(aq)}$	K_{Absolu}**Hg2**$Cl2$	10^(-23,07)	**66,05455**
Cl$^-_{aqNaCl}$	$E°_{2Cl-Cl2}$=	**1,03756** V	**66,1832**
Cl-	**K_{eq}**$CaCl_2$=	10^-2,03095	**95,559**
Cl-	K_{sp}**Ag**Cl=	$10^{-13,24}$	**101,885**
$CaCl_{2(s)}$	-795,4	108,4	-748,8
$CaCl_{2(s)}$	formation	-748,8	**231,103**
$CaO_{(s)}$	format G_{CaO}	**195,569**	-603,3
$Ca(OH)_{2(s)}$	-985,2	83,4	-897,5
$Ca(OH)_{2(s)}$	formation	-897,5	**138,56**
$Ca(OH)_{2(s)}$	$K_{eq}Ca(OH)]2$=	10^(-10,5275)	**146,2086**
$CaOH^+$	formation	-718,4	**101,0705**
$CaOH^+$	$K_{sp}CaCO_3$=	10^(-10,2164)	**114,061**
$CaOH^+$	$K_b/[H_2O]$=	10^(-14,3427)	**280,4563**
$CaOH^+$	$K_{sp}/[H_2O]^3$=	10^(-16,895)	**280,4563**
Ge- $CaOH^+$	formation	-718,4	**22,2184**
$CaSO_{4(s)}$	-1434,5	106,5	-1322,0
$CaSO_{4(s)}$	formation	-1322,0	**94,9951**
$CaSO_{4(s)}$	$K_{sp}/[H_2O]^3$=	10^(-16,895)	**261,3904**
SO_4^{2-}	$E°_{SO32-}$=	**0,05576**	**54,9256**
$CaCO_{3(s)}$	-1207,6	91,7	-1129,1
$CaCO_{3(s)}$	formation	-1081,4	**111,829**
CO_3^{2-}	-677,1	-56,9	-527,8
G_{e-} CO_3^{2-}	formation	-527,8	2*42,2185
CO_3^{2-}	K_{eq}=	$10^{-12,0727}$	**102,547**
HCO_3^-	-692	91,2	-586,8
G_{e-}=HCO_3^-	formation	-586,8	**54,15**
G_{HCO3-}	**56,08**	G_{H3O+}=	**22,44**

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

$G_{Ca}=G_{Ca2+}-(\Delta G_{eq\_Ca}+G_{H2O})$=**-41,8317-(-595,743+0)=553,91** kJ/mol;

$G_{Ca}=G_{Ca(H2O)2+}-(\Delta G_{eq\_Ca}+G_{H2O})$=**51,5763-(-595,743+0)=647,32** kJ/mol;

$G_{Ca(H2O)2+}=\Delta G_{eq\_Ca}+(G_{Ca}+G_{H2O})$=**51,5763** kJ/mol;

$G_{Ca(H2O)2+}=\Delta G_{eqCaCO3}-G_{CO23-}+(G_{CaCO3}+G_{H2O})$=**77,5403** kJ/mol;

$G_{Ca(H2O)2+}=G_{Ca(OH)+}+G_{H3O+}-(\Delta G_{[Ca(H2O)]2+}+G_{H2O})$=**284,96** kJ/mol;

[1] $\Delta G°=\Delta H°_H-T*\Delta S°_H$=-542,8-298,15*-0,0531=-526,968 kJ/mol;

$G_{Ca(H2O)2+}=\Delta G°_{Ca2+}-2G_{e-}+(G_{Ca}+0,5*G_{O2}+G_{H2})$=**284,96** kJ/mol;

$G_{Ca+}=\Delta G_{eq\_Ca}+(G_{Ca}+G_{H2O})$=**-382,827+(647,319+0)=264,49** 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;

$\Delta G_{Cl-}=\Delta H-T*\Delta S$=-167,2-298,15*0,0565=-184,05 kJ/mol;[1]

$G_{Cl-(aq)}=\Delta G_{eq\_Cl}+(0,5G_{Cl2}{}^{gas}+G_{e-})$=**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;

$2G_{Cl-}=\Delta G_{eqCaCl2}-G_{Ca(H2O)2+}+(G_{CaCl2}+3G_{H2O})$=2***95,5594** kJ/mol;

$G_{Cl-}=(-G_{Hg22+}+\Delta G_{eqHg2Cl2}+(G_{Hg2Cl2}+3G_{H2O}))/2$=**101,885** kJ/mol;

[1]$\Delta G°=\Delta H°-T*\Delta S°$=-795,4-298,15*0,1084=-827,71946 kJ/mol;

$G_{CaCl2}=\Delta G_{FormaCaCl2}+(G_{Ca}+G_{Cl2}{}^{gas})$=**231,103** kJ/mol;

[1] $G_{CaO}=\Delta G°_{CaO}+(G_{Ca}+0,5G_{O2})$=**195,569** kJ/mol;

[1]$\Delta G°=\Delta H°-T*\Delta S°$=-985,2-298,15*0,0834=-1010,0657 kJ/mol;

[1] $G_{Ca(OH)2}=\Delta G_{formCa(OH)2}+(G_{Ca}+G_{O2}+G_{H2})$=**138,56** kJ/mol;

$G_{Ca(OH)]2}=G_{Ca(H2O)]32+}+2G_{OH-}-(\Delta G_{Ca(OH)]2}+3G_{H2O})$=**146,2086** kJ/mol;

$G_{CaOH}=\Delta G°_{CaOH+}-G_{e-}+(G_{Ca}+0,5*G_{O2}+0,5*G_{H2})$=**101,0705** kJ/mol;

$G_{CaOH+}=\Delta G_{eqCaCO3}-G_{HCO3-}+(G_{CaCO3}+G_{H2O})$=**114,061** kJ/mol;

$G_{Ca(OH)+}=G_{[Ca(H2O)]2+}+G_{OH-}-(\Delta G_{[Ca(H2O)]2+}+G_{H2O})$=**280,4563** kJ/mol;

$G_{Ca(OH)+}=G_{[Ca(H2O)]2+}+G_{OH-}-(\Delta G_{[Ca(H2O)]2+}+G_{H2O})$=**280,4563** kJ/mol;

$G_{e-}=\Delta G°_{CaOH+}-G_{CaOH}+(G_{Ca}+0,5*G_{O2}+0,5*G_{H2})$=**22,2184** kJ/mol;

[1]$\Delta G°=\Delta H°-T*\Delta S°$=-1434,5-298,15*-0,1063=-1402,8067 kJ/mol;

$G_{CaSO4}=\Delta G°_{CaSO4}+(G_{Ca}+G_{Srhomb}+2G_{O2})$=**94,9951** kJ/mol;

$G_{CaSO4}=G_{CaOH+}+G_{SO42-}+G_{H3O+}-(\Delta G_{eqCaSO4}+3G_{H2O})$=**261,39** kJ/mol;;

$G_{SO4-}=\Delta G_{eqH2SO3}-2G_{H3O}+(G_{HSO3}+3G_{H2O})$=**54,9256** kJ/mol;

[1]$\Delta G°=\Delta H°-T*\Delta S°$=-1220,0-298,15*-0,110=-1187,2035 kJ/mol;

$G_{CaCO3}=\Delta G°_{CaCO3}+(G_{Ca}+1,5G_{O2}+G_{Cgraph})$=**111,829** kJ/mol;

[1]$\Delta G°=\Delta H°-T*\Delta S°$=-677,1-298,15*-0,0569=-1187,2035 kJ/mol;

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

$G_{CO32-}=\Delta G_{eqHCO3}-G_{H3O+}+(G_{HCO3-}+G_{H2O})$=**102,547** kJ/mol;

[1]$\Delta G°=\Delta H°-T*\Delta S°$=-692-298,15*0,0912=-719,19 kJ/mol;

$G_{e-}=G_{HCO3-}-(0,5G_{H2}+1,5G_{O2}+G_{Cgraph}+\Delta G°_{HCO3})$=**54,15** kJ/mol;

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,

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

$G_{H3O+}+G_{HCO3-}=22{,}44+56{,}08=G_{šķCO2}+G_{CAHCO3-}=18{,}38$ 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 $CaCO_{3(s)}+2H_2O=Ca(H_2O)^{2+}+CO_3^{2-}$; $K_{sp}=[Ca^{2+}]*[CO_3^{2-}]/[H_2O]^2=3{,}36*10^{\wedge(-9)}/55{,}3^{\wedge2}=10^{\wedge(-11{,}959)}$;

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

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

[1] Solubility $CaCO_{3(s)}+H_2O=CaOH^++HCO_3^-$; $K_{sp}=[CaOH^+]*[HCO_3^{2-}]/[H_2O]^1=3{,}36*10^{\wedge(-9)}/55{,}3^{\wedge1}=10^{\wedge(-10{,}2164)}$;

$\Delta G_{eqCaCO3}=-R•T•\ln(K_{eqCaCO3}=-8{,}314*298{,}15*\ln(10^{\wedge(-10{,}2164)})=58{,}312$ 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;$114{,}725$

$G_{CaCO3}=G_{CaOH+}+G_{HCO3-}-(\Delta G_{eqCaCO3}+G_{H2O})=114{,}061+56{,}08-(58{,}312+2*0)=30{,}945$ 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 $HCO_3^-+H_2O=H_3O^++CO_3^{2-}$; $pK_a=10{,}33$ $K_{eq}=K_a/[H_2O]=10^{\wedge(-10{,}33)}/55{,}3=10^{\wedge(-12{,}07273)}$;

$\Delta G_{eqHCO3-}=-R•T•\ln(K_{eqHCO3-})=-8{,}314*298{,}15*\ln(10^{\wedge(-12{,}07273)})=68{,}907$ 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 $CaSO_{4(s)}+3H_2O=CaOH^++SO_4^{2-}+H_3O^+$;

$K_{sp}=[CaOH^+]*[SO_4^{2-}]*[H_3O^+]/[CaSO_{4(s)}]/[H_2O]^3=4{,}93*10^{\wedge(-5)}*10^{\wedge(-7{,}36)}/1/55{,}3^{\wedge3}=10^{\wedge(-16{,}895)}$;

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

$CaOH^+$ [1] 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•T•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•T•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** $^{kJ}/_{mol}$;

[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;

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

$\Delta G_{eqCaCl2}$=**-R•T•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**+2$G_{Cl-}$-(**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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