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

Šķīdība $N_2^{gas}+H_2O+\Delta G=N_{2aq}$ palielina slāpekļa enerģiju no G_{N2}^{gas}=**-9,55** $^{kJ}/_{mol}$ līdz G_{N2aq}=**18,7** $^{kJ}/_{mol}$. [8]

Publicētā Albertija slāpekļa šķīdumā **absolūtā** brīvā enerģija vienā molā ir G_{N2aqua}=**18,7** $^{kJ}/_{mol}$, ja tīras gāzes mol daļa ir viens $[N_2^{gas}]$=1. Ūdenī Elements slāpeklis $N_2^{gas}+H_2O=N_{2aqua}$ ir vāji šķīstošs ar 0,00175 $^{g}/_{100g\_H2O}$ izšķīdināto daudzumu $K_{sp}=[N_{2aqua}]$=0,00175/100,00175*996/28,02=0,000622045 M un blīvumu 996 g/L. [1] Šķīdības konstante mol daļās ir mazāka par vienu $K_{eq}=K_{sp}/[H_2O]$=0,000622045/55,3=$10^{-4,9489}$. Prigožina šķīdības atraktors ir endoergonisks , pozitīvs ΔG_{eq}=-R•T•ln(K_{eq})=-8,3144*298,15*ln(10^(-4,9489))=**28,25** $^{kJ}/_{mol}$.

Hesa summā brīvās enerģijas izmaiņa ir $\Delta G_{sp\_N2aqua}=G_{N2aqua}-(G_{N2}^{gas}+G_{H2O})$=**18,7**-($G_{N2}^{gas}$ **-0**)=**28,25** $^{kJ}/_{mol}$ sakrītoša absolūtajā enerģijas skalā. Mola $G_{N2}^{gas}=G_{N2aqua}-(\Delta G_{sp\_N2aqua}+G_{H2O})$=**18,7**-(**28,25**+0)=**-9,55** $^{kJ}/_{mol}$ slāpekļa gāzes enerģijas saturs ir negatīvs relatīvi zem destilētā ūdens nulles G_{H2O}=0 $^{kJ}/_{mol}$. Izšķīdināta slāpekļa mola enerģiju palielina aktivējot saturu pozitīvi līdz G_{N2aqua}=**18,7** $^{kJ}/_{mol}$. Tas ir ķīdums N_{2aq} pie pH=7,36 [8].

Veidošanās $N_{2aq}+3H_{2aq}>2NH_{3aq}$ ūdenī ar enerģijām G_{N2aq}=**18,7** $^{kJ}/_{mol}$; G_{H2aq}=**103,2** $^{kJ}/_{mol}$; G_{NH3aq}=**91,1** $^{kJ}/_{mol}$ ir eksoergoniska $2\Delta G°_{NH3aq}=2G_{NH3aq}-(G_{N2aq}+3G_{H2aq})$=2***91,1056**-(**18,7**+3***103,24**)=2*-**73,1** $^{kJ}/_{mol}$ un gāzveida $N_2^{gas}+3H_2^{gas}>2NH_3^{gas}$ veidošanās G_{N2}^{gas}=**-9,55** $^{kJ}/_{mol}$; G_{H2}^{gas}=**85,64** $^{kJ}/_{mol}$, G_{NH3}^{gas}=**107,3** $^{kJ}/_{mol}$ ir eksoergoniska $2\Delta G°_{NH3}^{gas}=2G_{NH3}^{gas}-(G_{N2}^{gas}+3*G_{H2}^{gas})=2*G_{NH3}^{gas}$-(**-9,55**+3***85,64**)=-32,8=2*-16,4 $^{kJ}/_{mol}$ arī. Veidojoties no elementiem G_{N2}^{gas}=**-9,55** $^{kJ}/_{mol}$, G_{H2}^{gas}=**85,64** $^{kJ}/_{mol}$ exoergoniskā patvaļīgā reakcijā enerģijas saturs molam

$2\Delta G°_{NH3}^{gas}=2G_{NH3}^{gas}-(G_{N2}^{gas}+3*G_{H2}^{gas})$= 2***107,285**-(**-9,55**+3***85,64**)=2*-16,4 $^{kJ}/_{mol}$ amonjaka saglabājas pozitīvs $2G_{NH3}^{gas}=2\Delta G°_{NH3}^{gas}+(G_{N2}^{gas}+3*G_{H2}^{gas})$=2*-16,4+(**-9,55**+3***85,64**)=214,57=2***107,285** $^{kJ}/_{mol}$. [1,8]

Šķīšana $NH_3^{gas}+H_2O=NH_{3aq}$ enerģiju samazina līdz G_{NH3aq}=**91,1** $^{kJ}/_{mol}$ [8] no G_{NH3}^{gas}=**107,285** $^{kJ}/_{mol}$. $\Delta G_{eq}=G_{NH3aq}-(G_{NH3}^{gas}+G_{H2O})$=**91,1**-(**107,3**+0)=**-16,2** $^{kJ}/_{mol}$. $K_{eq}*[H_2O]=[NH_{3aq}]$=**688,87***55,3=38094,5 M. Atraktora konstante ir $[NH_{3aq}]/[NH_3^{gas}]/[H_2O]=K_{eq}$=exp(-$\Delta G_{eq}$/R/T)=exp(**16200**/8,3144/298,15)=**688,87**.

Šķīšana ir eksotermiska $\Delta H_{Hydration}=\Delta H°_{NH3aq}-\Delta H°_{NH3}^{gas}-\Delta H°_{H2O}$=**-132,5608**+45,94-**286,65**=373,27 $^{kJ}/_{mol}$. Entropija samazinās $S_{Hydration}=\Delta S°_{NH3aqua}-\Delta S°_{NH3}^{gas}-\Delta S°_{H2O}$=**-739,2922**-192,77-69,9565=**-1002** $^{J}/_{mol/K}$. Šķīšana ir eksoergoniska $\Delta G_{Hydrations}=\Delta H_{Hydrations}-T*\Delta S_{Hydration}$=-373,27-**298,15***-**1,002**=**-74,5237** $^{kJ}/_{mol}$ un labvēlīga $[NH_{3aq}]/[NH_3^{gas}]/[H_2O]=K_{eq}$=exp(-$\Delta G_{Hydration}$/**R/T**) =exp(**74523,7**/8,3144/298,15)=$10^{13,056}$, jo šķīdības (hidratācijas) konstante K_{eq} ir lielāka par vienu. [8]

NH_{3aq} akva $G_{NH3}^{gas}=\Delta G_{NH3aq}-(\Delta G_{Hydrations}+G_{H2O})$=**91,1056**-(**-74,5537**+0)=**165,7** $^{kJ}/_{mol}$;[1,8]

Albertija šķīdumi amonjakam pie pH=7,36, jo amonjaks šķīst ūdeni patvaļīgi hidratējoties. [1,8]

Eksoergoniska šķīdība G_{NH3}^{gas}=**107,3** $^{kJ}/_{mol}$ $NH_3^{gas}+H_2O=NH_{3aq}$ brīvo enerģiju samazina G_{NH3aq}=**91,1** $^{kJ}/_{mol}$;

Viela	ΔH°, $^{kJ}/_{mol}$	ΔS°, $^{J}/_{mol/K}$	ΔG°, $^{kJ}/_{mol}$
N_2^{gas}	2*-42,015	format NH_3	**-9,55**
N_{2aq}	**–10,54**	**98,1**	**18,7**
N_2^{gas}	ΔG_{sp}=**28,25**	$K_{sp}=10^{-4,949}$	**-9,55**
NH_3^{gas}	$\Delta G_{Hydration}$	**-74,5537**	**165,7**
NH_3^{gas}	2*-16,4	formation	**107,285**
NH_3^{gas}	-45,9	192,77	-16,4
NH_{3aq}	**-132,5608**	**-739,2922**	**87,859**
NH_{3aq}	pK_{eq}=- 13,056		**91,1**
NH_4^+	pK_{aeq}=10,99 ΔG_{aeq}=62,73		**50,81**

G_{O2}^{gas}=**303,1** $^{kJ}/_{mol}$; G_{N2}^{gas}=**-9,55** $^{kJ}/_{mol}$; G_{H2}^{gas}=**85,6** $^{kJ}/_{mol}$;

$G_{N2}^{gas}=2G_{NH3}^{gas}-(2\Delta G°_{NH3}^{gas}+3*G_{H2}^{gas})$=**-9,55** $^{kJ}/_{mol}$;

$\Delta G=\Delta H_H-T*\Delta S_H$=**-10,54**-298,15***0,0981**= **–39,7885** $^{kJ}/_{mol}$; [8]

$G_{N2}^{gas}=G_{N2aqua}-(\Delta G°_{sp\_N2aqua}+G_{H2O})$=**18,7**-(**28,25**+0)=**-9,55** $^{kJ}/_{mol}$;

$G_{NH3}^{gas}=\Delta G_{NH3aq}-(\Delta G_{Hydrations}+G_{H2O})$=**91,1056**-(**-74,5537**+0)=**165,7** $^{kJ}/_{mol}$;[1,8]

[1,8] $2G_{NH3}^{gas}=2\Delta G°_{NH3}^{gas}+(G_{N2}^{gas}+3*G_{H2}^{gas})$=2***107,3** $^{kJ}/_{mol}$;

$\Delta G°_{NH3}^{gas}=\Delta H_H-T*\Delta S_H$=-45,9-298,15*0,19277=-103,37 $^{kJ}/_{mol}$; [1]

$\Delta G=\Delta H_H-T*\Delta S_H$=**-132,5608**-298,15*-**0,739292**=**87,859** $^{kJ}/_{mol}$; [8]

$G_{NH3aq}=G_{NH4+}+G_{OH-}-(\Delta G_{beq}+G_{H2O})$=**91,1** $^{kJ}/_{mol}$; Wikipedia [28]

$G_{NH4+}=G_{NH3aq}+G_{H3O}-(\Delta G_a+G_{H2O})$=**50,81** $^{kJ}/_{mol}$;

Klasiskā amonjaka protolītiskās bāzes $NH_{3aq}+H_2O=NH_4^++OH^-$ konstantes izteiksme neuzskaita ūdeni $K_b=[NH_4^+]*[OH^-]/[NH_{3aq}]$=10^(-4,752) ar eksponentes vērtību pK_b=4,752. [1] Termodinamisko bāzes konstanti aprēķina protolīzes līdzsvara konstantes izteiksmē, ņemot vērā ūdens koncentrāciju $[H_2O]$=55,3 M

$$K_{beq}=K_b/[H_2O]=[NH_4^+]*[OH^-]/[NH_{3aq}]/[H_2O]=10^{(-4,752)}/55,3=3,20*10^{(-7)}=10^{(-6,4947)}.$$

Amonjaka protolīzes līdzsvara konstantes eksponenta aprēķinātā vērtība ir pK_{beq}=6,4947 endoergoniska, jo absolūtās brīvās enerģijas izmaiņas Prigožina izteiksmē un Hesa izteiksmē ir pozitīvas un identiskas:

ΔG_{beq}=-R•T•ln(K_{beq})=-8,3144*298,15*ln(10^(-6,4947))=$G_{NH4+}+G_{OH-}-(G_{NH3aq}+G_{H2O})$=**37,0715** $^{kJ}/_{mol}$;

$\Delta G_{Hess\_beq}=G_{NH4+}+G_{OH-}-(G_{NH3aq}+G_{H2O})$=**50,81**+77,36-(**91,1**+**0**)=**37,0715** $^{kJ}/_{mol}$. Wikipedia [28]

$G_{NH3aq}=G_{NH4+}+G_{OH-}-(\Delta G_{Hess\_beq}+G_{H2O})$=**50,81**+77,36-(**37,0715**+**0**)=**91,1** $^{kJ}/_{mol}$.

Vājas skābes G_{NH4+}=**50,81** $^{kJ}/_{mol}$; $NH_4^++H_2O=NH_{3aq}+H_3O^+$ G_{NH3aq}=**91,1** $^{kJ}/_{mol}$; protolīze pK_{aeq}=10,99 ir endoergoniskas ΔG_{aeq}=-RTln(K_{aeq})=-8,3144*298,15*ln(10^(-10,99))=$G_{NH3Hydration}+G_{H3O}-G_{NH4+}-G_{H2O}$=**62,73** $^{kJ}/_{mol}$ standarta enerģijas izmaiņas minimums Prigožina atraktora izteiksmē ΔG_{aeq}=-RTln(K_{aeq}). Amonija brīvās enerģijas saturs aprēķināts vienā molā ir:$G_{NH4+}=G_{NH3aq}+G_{H3O}-(\Delta G_{aeq}+G_{H2O})$=**91,1**+22,44-(**62,73**+0)=**50,81** $^{kJ}/_{mol}$.

Brīvās enerģijas saturs vienā molā amonjaka šķīdumā ir G_{NH3aq}=**91,1** $^{kJ}/_{mol}$

Endoergoniska amonjaka protolīze akumulē enerģiju produktos $G_{NH4+}+G_{OH-}$=**50,81**+77,36=**128,17** $^{kJ}/_{mol}$.

Protolīzes klasiskā skābes $NH_4^+=H^++NH_{3aqua}$ konstante $pK_a=9{,}25$ ūdeni neuzskaita tāpat kā nulli $G_{H2O}=0$ $^{kJ}/_{mol}$. Formation G_{N2aq}=**18,7** $^{kJ}/_{mol}$; G_{H2aq}=**103,2** $^{kJ}/_{mol}$; G_{N2}^{gas}=**-9,55** $^{kJ}/_{mol}$; G_{H2}^{gas}=**85,6** $^{kJ}/_{mol}$; $0{,}5N_2^{gas}+2H_2^{gas}=NH_4^++e-$;

$\Delta G°_{NH4+}=G_{NH4+}+G_{e-}-(0{,}5N_2^{gas}+2H_2^{gas})$=**50,81**+**36,315**-(**-9,55**/2+2***85,6**)=-79,3 $^{kJ}/_{mol}$; [1,8]

$G_{e-}=\Delta G°_{NH4+}-G_{NH4+}+(0{,}5N_2^{gas}+2H_2^{gas})$=-79,3-**50,81**+(**-9,55**/2+2***85,6**)=**36,315** $^{kJ}/_{mol}$; [1,8]

G_{N2}^{gas}=**-9,55** $^{kJ}/_{mol}$; G_{H2}^{gas}=**85,6** $^{kJ}/_{mol}$; G_{O2}^{gas}=**303,1** $^{kJ}/_{mol}$; $\Delta G°_{HNO3}$=**-109,55** $^{kJ}/_{mol}$, $\Delta G°_{NO2-}$=**-33,01** $^{kJ}/_{mol}$. [8]

$G_{HNO3}=\Delta G°_{HNO3}+(0{,}5G_{N2}^{gas}+1{,}5G_{O2}^{gas}+0{,}5G_{H2}^{gas})$=-80,7+(0,5*-9,55+1,5*303,1+0,5*85,6)= 411,975 $^{kJ}/_{mol}$; [1]

Ge-=$G_{NO3-}-(0{,}5G_{N2}^{gas}+1{,}5G_{O2}^{gas}+\Delta G°_{NO3-})$=**395,445**-(0,5*-9,55+1,5***303,1-109,55**)=**55,12** $^{kJ}/_{mol}$; [8]

Ge-=$G_{NO3-}-(0{,}5G_{N2}^{gas}+1{,}5G_{O2}^{gas}+\Delta G°_{NO3-})$=**395,445**-(0,5*-9,55+1,5***303,1**-111,3)=**56,87** $^{kJ}/_{mol}$; [1,8]

$G_{HNO2}=\Delta G°_{HNO2}+0{,}5G_{N2}^{gas}+G_{O2}^{gas}+0{,}5G_{H2}^{gas}$=-46+(0,5***-9,55**+**303,1**+0,5***85,6**)=**295,025** $^{kJ}/_{mol}$; [1,8]

Ge-=$G_{NO2-}-(0{,}5G_{N2}^{gas}+G_{O2}^{gas}+\Delta G°_{NO2-})$=**300,513**-(0,5***-9,55**+**303,1**-32,2)=**34,388** $^{kJ}/_{mol}$; [1,8]

Ge-=$G_{NO2-}-(0{,}5N_2^{gas}+O_2^{gas}+\Delta G°_{NO2-})$=**300,513**-(0,5***-9,55**+**303,1**-**33,01**)=**35,198** $^{kJ}/_{mol}$; [8]

Formation from elements G_{NO}^{gas}_Form=$\Delta G°_{NO}^{gas}+0{,}5G_{N2}^{gas}+G_{O2}/2$=87,6+0,5***-9,55**+**303,1**/2=**234,375** $^{kJ}/_{mol}$. [1,8]

Viela	$\Delta H°_H$ $^{kJ}/_{mol}$	$\Delta S°_H$ $^{J}/_{mol/K}$	$\Delta G°_H$, $^{kJ}/_{mol}$	
HNO_2	$E°_{HNO2}$=	**0,86926** V	**295,025**	$G_{HNO2}=G_{NO3-}+3G_{H3O}-(\Delta G_{eqNO3}+4G_{H2O})$=**295,025** $^{kJ}/_{mol}$;
HNO_2	protolīze	pK_a=3,15	**295,025**	$G_{HNO2}=G_{NO2-}+G_{H3O}-(\Delta G_{eqHNO2}+G_{H2O})$=**295,025** $^{kJ}/_{mol}$;
HNO_2	-79,5	254,1	-46,0	CRC [1]
HNO_2	Formation	-46,0	**295,025**	$G_{HNO2}^{gas}=\Delta G°_{HNO2}^{gas}+0{,}5G_{N2}^{gas}+1G_{O2}^{gas}+0{,}5G_{H2}^{gas}$=**295** $^{kJ}/_{mol}$
NO_2^-	-104,6	-123,0	-32,2	[1] ΔG°=ΔH–T*ΔS=-104,6-298,15*-0,123=-33,02 $^{kJ}/_{mol}$; [1]
NO_2^- Ge-	formation	-32,2	**34,388**	Ge-=$G_{NO2-}-(0{,}5G_{N2}^{gas}+G_{O2}^{gas}+\Delta G°_{NO2-})$=**34,388** $^{kJ}/_{mol}$; [1,8]
NO_2^-	**-104,19**	**-238,7**	**-33,01**	ΔG°=ΔH–T*ΔS=**-104,19**-298,15***-0,2387**=**-33,02** $^{kJ}/_{mol}$; [8] pH=7,36
NO_2^- Ge-	formation	**-33,01**	**35,198**	Ge-=$G_{NO2-}-(0{,}5N_2^{gas}+O_2^{gas}+\Delta G°_{NO2-})$=**35,198** $^{kJ}/_{mol}$; [8]
NO_2^-	$E°_{NO2-}$=	**0,81776** V	**300,97**	$G_{NO2-}=G_{NO3-}+2G_{H3O}-(\Delta G_{eqNO2-}+3G_{H2O})$=**300,97** $^{kJ}/_{mol}$;
NO_2^-	protolysis	pK_a=3,15	**300,513**	$G_{NO2-}=\Delta G_{eqHNO2}-G_{H3O}+(G_{HNO2}+G_{H2O})$=**300,513** $^{kJ}/_{mol}$;
NO_2^-	$E°_{NO2-OH}$=	**-0,31223V**	**300,97**	$G_{NO2-}=G_{NO3-}+G_{H2O}-(\Delta G_{eqNO3-OH}+2G_{OH})$=**300,97** $^{kJ}/_{mol}$;
HNO_3	-174,1	155,6	-80,7	$\Delta G°_{NO3-}=\Delta H_H-T*\Delta S_H$=-207-298,15*0,146=-250,53 $^{kJ}/_{mol}$; [1]
HNO_3[1,8]	formation	-80,7	**242,145**	$G_{HNO3Form}=\Delta G°_{HNO3}+(0{,}5G_{N2}^{gas}+1{,}5G_{O2}^{gas}+0{,}5G_{H2}^{gas})$=**242,145** $^{kJ}/_{mol}$;
HNO_3	protolysis	pK_a=-1,4	**415,929**	$G_{HNO3}=G_{NO3-}+G_{H3O}-(\Delta G_{eqHNO3}+G_{H2O})$=**415,929** $^{kJ}/_{mol}$;
HNO_3	$E°_{NOaq}$=	**0,89226** V	**426,39255**	$G_{HNO3}=\Delta G_{eqNO(g)H3O+}-3G_{H3O}+(G_{NOaq}+5G_{H2O})$= **426,39255** $^{kJ}/_{mol}$;
NO_3^-	**-204,59**	**-318,8**	**-109,55**	ΔG=ΔH–TΔS=**-204,59**-298,15***-0,3188**=**-109,54** $^{kJ}/_{mol}$; [8] pH=7,36
NO_3^- Ge-	formation	**-109,55**	**55,12**	Ge-=$G_{NO3-}-(0{,}5G_{N2}^{gas}+1{,}5G_{O2}^{gas}+\Delta G°_{NO3-})$=**55,12** $^{kJ}/_{mol}$; [8]
NO_3^-	$E°_{NO-NO3-}$=	**0,81776 V**	**413,89**	$G_{NO3-}=\Delta G_{eqNO2-}-2G_{H3O}+(G_{NO2-}+3G_{H2O})$=**413,89** $^{kJ}/_{mol}$;
NO_3^-	$E°_{HNO2}$	**0,86926** V	**395,445**	$G_{NO3-}=\Delta G_{eqNO3}-3G_{H3O}+(G_{HNO2}+4G_{H2O})$=**395,445** $^{kJ}/_{mol}$,
NO_3^-	$E°_{NO2-OH}$=	**-0,31223V**	**395,4445**	$G_{NO3-}=\Delta G_{eqNO3-OH}-G_{H2O}+(G_{NO2-}+2G_{OH})$=**395,4445** $^{kJ}/_{mol}$;
NO_3^-	$E°_{NOaq}$=	**0,89226** V	**413,89**	$G_{NO3-}=\Delta G_{eqNO(g)H3O+}-4G_{H3O}+(G_{NOaq}+6G_{H2O})$=**413,89** $^{kJ}/_{mol}$;
NO_3^-	$E°_{NH4+H2O}$=	**0,766637**	**418,16**	$G_{NO3-}=\Delta G_{eqNH4+H2O}-10G_{H3O}+(G_{NH4+}+13G_{H2O})$=**418,16** $^{kJ}/_{moll}$;
NO_3^-	-207,4	146,4	-111,3	$\Delta G°_{NO3-}=\Delta H_H-T*\Delta S_H$=-206,85-298,15*0,1467=-250,5886 $^{kJ}/_{mol}$; [1]
NO_3^- Ge-	formation	-111,3	**56,87**	Ge-=$G_{NO3-}-(0{,}5G_{N2}^{gas}+1{,}5G_{O2}^{gas}+\Delta G°_{NO3-})$=**56,87** $^{kJ}/_{mol}$; [1,8]
NO_3^-	protolysis	pK_a=-1,4	**395,445**	$G_{NO3-}=\Delta G_{eqHNO3}-G_{H3O}+(G_{HNO3}+G_{H2O})$=**395,445** $^{kJ}/_{mol}$;
NO^{gas}	91,3	210,8	87,6	[1]
NO^{gas}	formation	87,6	**234,375**	G_{NO}^{gas}_Form=$\Delta G°_{NO}^{gas}+0{,}5G_{N2}^{gas}+0{,}5G_O^{gas}$=**234,375** $^{kJ}/_{mol}$; [1,8]
NO^{gas}	SolubilityK_{eq}=10^(-4,472)		**207,749**	$G_{NO}^{gas}=G_{NOaq}-(G_{H2O}+\Delta G_{eq})$=**233,275**-(**0**+**25,526**)=**207,749** $^{kJ}/_{mol}$;
NO_{aq}	formation	pH=7,36	**86,55**	**Biochem.Thermodynamic 2006** Massachusetts Technol. Inst.
NO_{aq}	formation	**86,55**	**233,325**	$G_{NOaq}=\Delta G°_{NOaq\_Form}+0{,}5G_{N2}^{gas}+0{,}5G_O^{gas}$=**233,325** $^{kJ}/_{mol}$; [8]
pH>1,4 NO_{aq}	$E°_{NOaq}$=	**0,89226** V	**245,381**	$G_{NOaq}=G_{NO3-}+4G_{H3O}-(\Delta G_{eqNO(g)H3O+}+6G_{H2O})$=**245,381** $^{kJ}/_{mol}$;
NH_4^+	-132,5	113,4	-79,3	$\Delta\Gamma°_{NH4+}=\Delta H_H$□$T*\Delta\Sigma_H$=–132,5–298,15*0,1134=–166,31 $^{\kappa\vartheta}/_{\mu o\lambda}$; [1]
NH_4^+ G_{e-}	formation	-79,3	**36,315**	$G_{e-}=\Delta G°_{NH4+}-G_{NH4+}+(0{,}5N_2^{gas}+2H_2^{gas})$=**36,315** $^{kJ}/_{mol}$; [1,8]
NH_4^+	pK_a=10,99	ΔG_a=62,73	**50,81**	$G_{NH4+}=G_{NH3aq}+G_{H3O}-(\Delta G_{aeq}+G_{H2O})$=**91,1**+22,44-62,73-**0**=**50,81** $^{kJ}/_{mol}$;

Slāpekļa savienojumu **Nernsta oksidēšanas** un **inversie reducēšanas** absolūtie potenciāli un Prigožina atraktori. $HNO_2+4H_2O=NO_3^-+3H_3O^++2e^-$; pH<3,15; Absolūtais aprēķins satur standarta potenciālu $E°_{klasisko}$=0,934 V [18], ūdens logaritmu un ΔE°: $E°_{NO3}=E°_{klasisko}-0{,}0591/2*\lg(1/[H_2O]^4)+\Delta E°$=0,934+0,206+0,10166-0,37239=**0,8693** V;

$$E_{NO3}=E°_{NO3}+0{,}0591/2\bullet\log\frac{[NO_3^-]\cdot[H_3O^+]^3}{[HNO_2]\cdot[H_2O]^4}=\mathbf{0{,}86926}\ V+0{,}0591/2\bullet\log\frac{[NO_3^-]\cdot[H_3O^+]^3}{[HNO_2]\cdot[H_2O]^4}$$

$\Delta G_{eqNO3}=E°_{NO3}\bullet F\bullet 2$=**0,86926***96485*2=**167,74** $^{kJ}/_{mol}$,

$\Delta G_{eqNO3}=G_{NO3-}+3G_{H3O}+2G_{e-}-(G_{HNO2}+4G_{H2O})=\mathbf{395{,}445}+3*22{,}44+2*\mathbf{0}-(\mathbf{295{,}025}+4*0)=\mathbf{167{,}74}$ kJ/mol,

$G_{HNO2}=G_{NO3-}+3G_{H3O}+2G_{e-}-(\Delta G_{eqNO3}+4G_{H2O})=\mathbf{395{,}445}+3*22{,}44+2*\mathbf{0}-(\mathbf{167{,}74}+4*0)=\mathbf{295{,}025}$ kJ/mol;

$G_{NO3-}=\Delta G_{eqNO3}-3G_{H3O}-2G_{e-}+(G_{HNO2}+4G_{H2O})=\mathbf{167{,}74}-3*22{,}44-2*\mathbf{0}+(\mathbf{295{,}025}+4*0)=\mathbf{395{,}445}$ kJ/mol.

$2G_{e-}=\Delta G_{eqNO3}-G_{NO3-}-3G_{H3O}++(G_{HNO2}+4G_{H2O})=\mathbf{167{,}74-395{,}445}-3*22{,}44+(\mathbf{295{,}025}+4*0)=2*\mathbf{0}$ kJ/mol,

Skābes un protolīzes konstanti $K_{eq}=K_a/[H_2O]$ aprēķina dalot klasisko skābes konstanti ar ūdeni $[H_2O]=55{,}3$ M.

1. $HNO_2+H_2O=NO_2^-+H_3O^+$; $pK_a=3{,}15$; $K_{eq}=K_a/[\mathbf{H_2O}]=10^{\wedge(-3{,}15)}/55{,}3=0{,}0000128$; Prigožina endoergonisks atraktors ir $\Delta G_{eqHNO2}=-R\bullet T\bullet\ln(K_{eq})=-8{,}3144*298{,}15*\ln(0{,}0000128)=G_{NO2-}+G_{H3O}-(G_{HNO2}+G_{H2O})=\mathbf{27{,}928}$ kJ/mol

un Hesa izteiksme arī $\Delta G_{eqHNO2}=G_{NO2-}+G_{H3O}-(G_{HNO2}+G_{H2O})=\mathbf{300{,}513+22{,}44-(295{,}025+0)=27{,}928}$ kJ/mol;

$G_{NO2-}=\Delta G_{eqHNO2}-G_{H3O}+(G_{HNO2}+G_{H2O})=\mathbf{27{,}928-22{,}44+(295{,}025+0)=300{,}513}$ kJ/mol;

$G_{HNO2}=G_{NO2-}+G_{H3O}-(\Delta G_{eqHNO2}+G_{H2O})=\mathbf{300{,}513+22{,}44-(27{,}928+0)=295{,}025}$ kJ/mol;

2. $HNO_3+H_2O=NO_3^-+H_3O^+$;$pK_a=-1{,}4$; $K_{eq}=K_a/[\mathbf{H_2O}]=10^{\wedge(1{,}4)}/55{,}3=0{,}4542$; Prigožina endoergonisks atraktors ir pozitīvs $\Delta G_{eqHNO3}=-R\bullet T\bullet\ln(K_{eq})=-8{,}3144*298{,}15*\ln(0{,}4542)=G_{NO3-}+G_{H3O}-(G_{HNO3}+G_{H2O})=\mathbf{1{,}956}$ kJ/mol

un Hesa izteiksme arī $\Delta G_{eqHNO3}=G_{NO3-}+G_{H3O}-(G_{HNO3}+G_{H2O})=\mathbf{395{,}445+22{,}44-(415{,}929+0)=1{,}956}$ kJ/mol;

$G_{HNO3}=G_{NO3-}+G_{H3O}-(\Delta G_{eqHNO3}+G_{H2O})=\mathbf{395{,}445+22{,}44-(1{,}956+0)=415{,}929}$ kJ/mol;

$G_{NO3-}=\Delta G_{eqHNO3}-G_{H3O}+(G_{HNO3}+G_{H2O})=\mathbf{1{,}956-22{,}44+(415{,}929+0)=395{,}445}$ kJ/mol;

$NO_2^-+2OH^-=NO_3^-+H_2O+\mathbf{2e^-}$; pH>7 Absolūtais aprēķins satur standarta potenciālu $E°_{klasisko}=0{,}01$ V [1], ūdens logaritmu un $\Delta E°$: $E°_{NO3-OH}=E°_{klasisko}-0{,}0591/2*\lg([H_2O])+\Delta E°=0{,}01-0{,}0515+0{,}10166-0{,}37239=\mathbf{-0{,}31223}$ V;

$$E_{NO3-OH}=E°_{NO3-OH}+0{,}0591/2\bullet\log\frac{[NO_3^-]\cdot[H_2O]}{[NO_2^-]\cdot[OH^-]^2}=\mathbf{-0{,}3122}\ \text{V}+0{,}0591/2\bullet\log\frac{[NO_3^-]\cdot[H_2O]}{[NO_2^-]\cdot[OH^-]^2}$$

$\Delta G_{eqNO3-OH}=E°_{NO3-OH}\bullet F\bullet 2=\mathbf{-0{,}3122}*96485*2=\mathbf{-60{,}245}$ kJ/mol;

$\Delta G_{eqNO3-OH}=G_{NO3-}+G_{H2O}+2G_{e-}-(G_{NO2-}+2G_{OH})=\mathbf{395{,}445}+0+2*\mathbf{0}-(\mathbf{300{,}97}+2*77{,}36)=\mathbf{-60{,}245}$ kJ/mol;

$G_{NO3-}=\Delta G_{eqNO3-OH}-G_{H2O}-2G_{e-}+(G_{NO2-}+2G_{OH})=\mathbf{-60{,}2455}-0-2*\mathbf{0}+(\mathbf{300{,}97}+2*77{,}36)=\mathbf{395{,}4445}$ kJ/mol;

$G_{NO2-}=G_{NO3-}+G_{H2O}+2G_{e-}-(\Delta G_{eqNO3-OH}+2G_{OH})=\mathbf{395{,}445}+0+2*\mathbf{0}-(\mathbf{-60{,}245}+2*77{,}36)=\mathbf{300{,}97}$ kJ/mol;

$2G_{e-}=\Delta G_{eqNO3-OH}-G_{NO3-}-G_{H2O}++(G_{NO2-}+2G_{OH})=\mathbf{-60{,}245-395{,}445}-0+(\mathbf{300{,}97}+2*77{,}36)=2*\mathbf{0}$ kJ/mol;

$NO_2^-+3H_2O=NO_3^-+2H_3O^++\mathbf{2e^-}$; pH>3,15 Absolūtais aprēķins satur standarta potenciālu $E°_{klasisko}=0{,}934$ V [1], ūdens logaritmu un $\Delta E°$: $E°_{NO2-}=E°-0{,}0591/2*\lg(1/[H_2O]^3)+\Delta E°=0{,}934+0{,}1545+0{,}10166-0{,}37239=\mathbf{0{,}817763}$ V

$\Delta G_{eqNO2-}=E°_{NO2-}\bullet F\bullet 2=\mathbf{0{,}817763}*96485*2=\mathbf{157{,}8}$ kJ/mol;

$\Delta G_{eqNO2-}=G_{NO3-}+2G_{H3O}-(G_{NO2-}+3G_{H2O})=\mathbf{413{,}89}+2*22{,}44-(\mathbf{300{,}97}+3*0)=\mathbf{157{,}8}$ kJ/mol;

$G_{NO3-}=\Delta G_{eqNO2-}-2G_{H3O}+(G_{NO2-}+3G_{H2O})=\mathbf{157{,}8}-2*22{,}44+(\mathbf{300{,}97}+3*0)=\mathbf{413{,}89}$ kJ/mol;

$G_{NO2-}=G_{NO3-}+2G_{H3O}-(\Delta G_{eqNO2-}+3G_{H2O})=\mathbf{413{,}89}+2*22{,}44-(\mathbf{157{,}8}+3*0)=\mathbf{300{,}97}$ kJ/mol;

[1] Formation $G_{NO}=\Delta G°_{NO}+0{,}5N_2^{gas}+0{,}5O_2^{gas}=87{,}6+(0{,}5*\mathbf{-9{,}55}+0{,}5*\mathbf{303{,}1})=\mathbf{234{,}375}$ kJ/mol ;

[18] Formation $G_{NOaq}=\Delta G°_{NOaq\_Form}+0{,}5G_{N2}^{gas}+0{,}5G_O^{gas}=\mathbf{86{,}55}+(0{,}5*\mathbf{-9{,}55}+0{,}5*\mathbf{303{,}1})=\mathbf{233{,}325}$ kJ/mol ;

$M_{NO}=30{,}006$ g/mol; Šķīdība $NO^{(g)}$ 0,0056 g/99,6g (20 C) ; w%=0,0056/(0,0056+99,6)*100=0,00562%; ūdenī $[NO_{aq}]=(0{,}00562/100*996)/30{,}006=0{,}001865$ M, ja tīras gāzes mol daļa ir viens $[NO^{(g)}]=1$;

Šķīdības $NO^{gas}+H_2O=NO_{aq}$ konstante $\mathbf{K_{eq}}=[NO_{aq}]/[NO^{(g)}]/[H_2O]=0{,}001865/1/55{,}3=10^{\wedge(-4{,}472)}$.

Prigožina standarts ir $\Delta G_{eq}=\mathbf{-R\bullet T\bullet\ln(K_{eq})}=-8{,}3144*298{,}15*\ln(10^{\wedge(-4{,}472)})=-8{,}3144\bullet298{,}15\bullet-10{,}297=\mathbf{25{,}526}$ kJ/mol.

Hesa standartam ir $\Delta G_{eq}=G_{NOaq}-(G_{H2O}+G_{NO}^{gas})=\mathbf{233{,}275}-(\mathbf{0}+G_{NO}^{gas})=\mathbf{25{,}526}$ kJ/mol. Enerģijas saturs molā ir $G_{NO}^{gas}=G_{NOaq}-(G_{H2O}+\Delta G_{eq})=\mathbf{233{,}275}-(\mathbf{0}+\mathbf{25{,}526})=\mathbf{207{,}749}$ kJ/mol ar Prigožina standartu $\Delta G_{eq}=\mathbf{25{,}526}$ kJ/mol.

$NO_{aq}+6H_2O=NO_3^-+4H_3O^++\mathbf{3e^-}$; pH>-1,4; Expression of potential has standard $E°_{Classic}=0{,}957$ V [1], water logarithm, $\Delta E°$: $E°_{NO(g)H3O+}=E°_{classic}-0{,}0591/3*\lg(1/[H_2O]^6)+\Delta E°=0{,}957+0{,}206+0{,}10166-0{,}37239=\mathbf{0{,}89226}$ V;

$$E_{NO(g)H3O+}=E°_{NO-NO3-}+0{,}0591/3\bullet\log\frac{[NO_3^-]\cdot[H_3O^+]^4}{[NO_{aq}]\cdot[H_2O]^6}=\mathbf{0{,}89226}\ \text{V}+0{,}0197\bullet\log\frac{[NO_3^-]\cdot[H_3O^+]^4}{[NO_{aq}]\cdot[H_2O]^6}$$

$\Delta G_{eqNO(g)H3O+}=E°_{NO(g)H3O+}\bullet F\bullet 3=\mathbf{0{,}89226}*96485*3=\mathbf{258{,}2691}$ kJ/mol;

$\Delta G_{eqNO(g)H3O+}=G_{NO3-}+4G_{H3O}+3G_{e-}-(G_{NOaq}+6G_{H2O})=\mathbf{413{,}89}+4*22{,}44+3*\mathbf{0}-(\mathbf{245{,}381}+6*0)=\mathbf{258{,}2691}$ kJ/mol;

$G_{NOaq}=G_{NO3-}+4G_{H3O}+3G_{e-}-(\Delta G_{eqNO(g)H3O+}+6G_{H2O})=\mathbf{413{,}89}+4*22{,}44+3*\mathbf{0}-(\mathbf{258{,}2691}+6*0)=\mathbf{245{,}381}$ kJ/mol;

$G_{NO3-}=\Delta G_{eqNO(g)H3O+}-4G_{H3O}-3G_{e-}+(G_{NOaq}+6G_{H2O})=\mathbf{258{,}2691}-4*22{,}44-3*\mathbf{0}+(\mathbf{245{,}381}+6*0)=\mathbf{413{,}89}$ kJ/mol;

$3G_{e-}=\Delta G_{eqNO(g)H3O+}-G_{NO3-}-4G_{H3O}+(G_{NOaq}+6G_{H2O})=\mathbf{258{,}269-413{,}89}-4*22{,}44+(\mathbf{245{,}381}+6*0)=3*\mathbf{0{,}000}$ kJ/mol;

Solubility of gas NO^{gas} compensate water molecule from $6H_2O$ to $5H_2O$:and $NO_3^-+H_3O^+=HNO_3+H_2O$**;**

$NO_{aq}+5H_2O=HNO_3+3H_3O^++\mathbf{3e^-}$; pH<-1,4; Expression of potential has standard $E°_{Classic}=0{,}957$ V [1], water logarithm, $\Delta E°$: $E°_{NO(g)H3O+}=E°_{classic}-0{,}0591/3*\lg(1/[H_2O]^5)+\Delta E°=0{,}957+0{,}17166+0{,}10166-0{,}37239=\mathbf{0{,}857928}$ V;

$$E_{NO(g)H3O+}=E°_{NO-NO3-}+0{,}0591/3\bullet\log\frac{[HNO_3]\cdot[H_3O^+]^3}{[NO_{aq}]\cdot[H_2O]^5}=\mathbf{0{,}857928}\ \text{V}+0{,}0197\bullet\log\frac{[HNO_3]\cdot[H_3O^+]^3}{[NO_{aq}]\cdot[H_2O]^5}$$

$\Delta G_{eqNO(g)H3O+}=E°_{NO(g)H3O+}\bullet F\bullet 3=\mathbf{0{,}857928}*96485*3=\mathbf{248{,}33155}$ kJ/mol;

$\Delta G_{eqNO(g)H3O+}=G_{HNO3}+3G_{H3O}+3G_{e-}-(G_{NOaq}+5G_{H2O})=\mathbf{426{,}39255}+3*22{,}44+3*\mathbf{0}-(\mathbf{245{,}381}+5*0)=\mathbf{248{,}33155}$ kJ/mol;

$G_{NOaq}=G_{HNO3}+3\mathbf{G_{H3O}}+3G_{e-}-(\Delta\mathbf{G_{eq}}{}_{NO(g)H3O+}+5\mathbf{G_{H2O}})=\mathbf{426{,}39255}+3*22{,}44+3*\mathbf{0}-(\mathbf{248{,}33155}+5*0)=\mathbf{245{,}381}$ $^{kJ}/_{mol}$;

$G_{HNO3}=\Delta\mathbf{G_{eq}}{}_{NO(g)H3O+}-3\mathbf{G_{H3O}}-3G_{e-}+(G_{NOaq}+5\mathbf{G_{H2O}})=\mathbf{248{,}33155}-3*22{,}44-3*\mathbf{0}+(\mathbf{245{,}381}+5*0)=\mathbf{426{,}39255}$ $^{kJ}/_{mol}$;

$3G_{e-}=\Delta\mathbf{G_{eq}}{}_{NO(g)H3O+}-G_{HNO3}-3\mathbf{G_{H3O}}+(G_{NOaq}+5\mathbf{G_{H2O}})=\mathbf{248{,}3316}-\mathbf{426{,}3926}-3*22{,}44+(\mathbf{245{,}381}+5*0)=3*\mathbf{0{,}00}$ $^{kJ}/_{mol}$;

$NH_4^++13H_2O=NO_3^-+10H_3O^++\mathbf{8e^-}$; Absolūtais aprēķins satur standarta potenciālu $E°_{klasisko}=0{,}87$ V [17], ūdens logaritmu un $\Delta E°$: $E°_{NH4+H2O}=E°_{klasisko}-0{,}0591/8*\lg(1/[H_2O]^{13})+\Delta E°=0{,}87+0{,}16737+0{,}10166-0{,}37239=\mathbf{0{,}766637}$ V;

$$pH>1{,}4\ E_{NH4+H2O}=E°_{NH4+H2O}+0{,}0591/8\bullet\log\frac{[NO_3^-]\cdot[H_3O^+]^{10}}{[NH_4^+]\cdot[H_2O]^{13}}=\mathbf{0{,}766637}\text{ V}+0{,}00739\bullet\log\frac{[NO_3^-]\cdot[H_3O^+]^{10}}{[NH_4^+]\cdot[H_2O]^{13}}$$

$\Delta\mathbf{G_{eq}}{}_{NH4+H2O}=E°_{NH4+H2O}\bullet F\bullet 8=\mathbf{0{,}766637}*96485*8=\mathbf{591{,}75}$ $^{kJ}/_{mol}$,

$\Delta\mathbf{G_{eq}}{}_{NH4+H2O}=G_{NO3-}+10\mathbf{G_{H3O}}+8G_{e-}-(\mathbf{G_{NH4+}}+13\mathbf{G_{H2O}})=\mathbf{418{,}16}+10*22{,}44+8*\mathbf{0}-(\mathbf{50{,}81}+13*\mathbf{0})=\mathbf{591{,}75}$ $^{kJ}/_{mol}$;

$G_{NO3-}=\Delta\mathbf{G_{eq}}{}_{NH4+H2O}-10\mathbf{G_{H3O}}-8G_{e-}+(\mathbf{G_{NH4+}}+13\mathbf{G_{H2O}})=\mathbf{591{,}75}-10*22{,}44-8*\mathbf{0}+(\mathbf{50{,}81}+13*\mathbf{0})=\mathbf{418{,}16}$ $^{kJ}/_{mol}$;

$\mathbf{G_{NH4+}}=G_{NO3-}+10\mathbf{G_{H3O}}+8G_{e-}-(\Delta\mathbf{G_{eq}}{}_{NH4+H2O}+13\mathbf{G_{H2O}})=\mathbf{418{,}16}+10*22{,}44+8*\mathbf{0}-(\mathbf{591{,}75}+13*\mathbf{0})=\mathbf{50{,}81}$ $^{kJ}/_{mol}$;

$8G_{e-}=\Delta\mathbf{G_{eq}}{}_{NH4+H2O}-G_{NO3-}-10\mathbf{G_{H3O}}+(\mathbf{G_{NH4+}}+13\mathbf{G_{H2O}})=\mathbf{591{,}75}-\mathbf{418{,}16}-10*22{,}44+(\mathbf{50{,}81}+13*\mathbf{0})=8*\mathbf{0{,}0}$ $^{kJ}/_{mol}$;

Formation $0{,}5N_2^{gas}+2H_2^{gas}=NH_4^++\mathbf{e^-}$;

$\Delta G°_{NH4+}=G_{NH4+}+G_{e-}-(0{,}5N_2^{gas}+2H_2^{gas})=-79{,}3+\mathbf{50{,}81}-(0{,}5*\mathbf{-9{,}55}+2*\mathbf{85{,}6})=-79{,}3$ $^{kJ}/_{mol}$;

$G_{e-}=\Delta G°_{NH4+}-G_{NH4+}+(0{,}5N_2^{gas}+2H_2^{gas})=-79{,}3-\mathbf{50{,}81}+(0{,}5*\mathbf{-9{,}55}+2*\mathbf{85{,}6})=-79{,}3$ $^{kJ}/_{mol}$;

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