Equilibrium $\mathbf{K_{eq}}$, electrode standard potentials $\mathbf{E°}$ are determinants of attractors $\mathbf{\Delta G_{eq}=-R•T•\ln(K_{eq})=E°nF}$.
The electrode potential has a common zero point and proportional to the absolute free energy $\Delta \mathbf{G_{eq}=E°nF}$.

Endoergonic protolysis $H_2O+H_2O=H_3O^++OH^-$; $K_{eq}=\frac{[OH^-]\cdot[H_3O^+]}{[H_2O]\cdot[H_2O]}=3{,}26•10^{-18}$; accumulate free energy calculates from Prigogine attractor $\Delta G_{eq}=-R•T•\ln(K_{eq})$ and Hess sums $\Delta G_{eqHess}=\Sigma\Delta G_{products}-\Sigma\Delta G_{reactants}$ [1,2,3,4]
$\Delta G_{eq}=-R•T•\ln(K_{eq})$ =-8,3144*298,15*ln(3,261*10^(-18))=$G_{H3O+}+G_{OH-}$-(2* G_{H2O})=**22,44**+**77,36**-(2***0**)=99,8 $^{kJ}/_{mol}$.

Water as the final product has zero free energy $\mathbf{G_{H2O}=0}$ $^{kJ}/_{mol}$ and is the background reference in Biochemistry. It $H_2+0{,}5O_{2aq}=H_2O$ state formation zero from free elements of hydrogen G_{H2}=**85,64** $^{kJ}/_{mol}$ and G_{O2}^{gas}=**303** $^{kJ}/_{mol}$. The standard value of water formation $\Delta\mathbf{G}°_{H2O}$=237,191 $^{kJ}/_{mol}$ loses the remainder small part of the standard

$$\mathbf{G_{H2O}}=\Delta\mathbf{G}°_{H2O}+(G_{H2}+0{,}5G_{O2}^{gas})=-237{,}191+(\mathbf{85{,}64}+0{,}5*\mathbf{303})=-0{,}051\ ^{kJ}/_{mol}\ ;$$

free energy of formation of pure water and is the fraction of the protolysis products $[H_3O^+]+[OH^-]=10^{-7}$ M+10^{-7} M per mole of water, additionally reducing the standard free energy of formation $\Delta\mathbf{G}°_{H2O}$ by $\mathbf{G_{H2O}}$=-0,051 $^{kJ}/_{mol}$.

The standard value $\Delta H°_{\mathbf{H3O}}$ =-285,809 $^{kJ}/_{mol}$ Mischenko [1, 26] is confirmed by neutralization heat amount:
$\Delta H_{neutralisation}$=-55,851 $^{kJ}/_{mol}$ $\Delta H_{Hess}=2•\Delta H°_{H2O}-(\Delta H°_{H3O}+\Delta H°_{OH-})$=2*-285,83-(-285,809-230)=-55,851 $^{kJ}/_{mol}$.

Substance	$\Delta H°_H$, $^{kJ}/_{mol}$	$\Delta S°_H$, $^{J}/_{mol/K}$	$\Delta G°_H$, $^{kJ}/_{mol}$
H_2O	**-286,65**	**-453,188**	**-151,549**
H_2O	-285,85	69,9565	-237,191
OH^-	–230.00	-10,8	-157,2
H_3O^+	-285,809	-737,98	-65,780
H_3O^+	-285,809	-182,1905	-231,4889
G_{e-} H_3O^+	formation	-231,4889	**26,121**
H_3O^+	K_{eq1}=3,26•10^(-18)		**22,44**
OH^-	K_{eq1}=3,26•10^(-18)		**77,36**

$\Delta H°_{\mathbf{H3O}}$ =-285,809 $^{kJ}/_{mol}$ Mischenko 1972 ,Himia, Leningrad [1,26]
$\Delta G_H=\Delta H_H-T*\Delta S_H$=**-286,65**-298,15*-**0,453188**=**-151,549** $^{kJ}/_{mol}$; [8]
$\Delta G_H=\Delta H_H-T*\Delta S_H$=-285,85-298,15*-0,0699565=-264,99 $^{kJ}/_{mol}$;
CRC [1] $\Delta\mathbf{G}°_{OH-}=\Delta H-T*\Delta S$=-230-298,15*-0,0108=-226,78 $^{kJ}/_{mol}$;
$\Delta\mathbf{G}°_{H3O+}=\Delta H-T*\Delta S$=-285,809-298,15*-737,98/1000=-65,780 $^{kJ}/_{mol}$;
$\Delta H-T*\Delta S$=-285,809-298,15*-0,1821905=-231,4889 $^{kJ}/_{mol}$;
$G_{e-}=\Delta\mathbf{G}°_{H3O+}-G_{H3O+}+(1{,}5*G_{H2}^{gas}+0{,}5*G_{O2}^{gas})$=**26,121** $^{kJ}/_{mol}$;
The equilibrium state $\Delta G_{eq1}=G_{H3O+}+G_{OH-}$=**22,44**+**77,36**=99,8 $^{kJ}/_{mol}$; is an attractor for all non-equilibrium states, including the maximal

$\Delta H_{Hess}=\Delta H°_{H3O+}+\Delta H°_{OH-}-2•\Delta H°_{H2O}$=-285,809-230-2*-285,85=55,851 $^{kJ}/_{mol}$.Enthalpy is from [1,8,26]
$\Delta S_{Hess}=\Delta S°_{H3O}-\Delta S°_{OH}-2•\Delta S°_{H2O}$=-182,1905-10,8-2*69,956=-332,9025 $^{J}/_{mol/K}$;Corrected $\Delta\mathbf{S}°_{H3O+}$=-182,19 $^{J/K}/_{mol}$;
$\Delta G_{Hess\_protolysis}=\Delta H_{Hess}-T•\Delta S_{Hess}$=55,851-298,15*-0,319512=**151,11** $^{kJ}/_{mol}$; Corrected $\Delta\mathbf{G}°_{H3O+}$=-231,4889 $^{kJ}/_{mol}$;
$\Delta S_{dispersed}=-\Delta H_{Hess}/_T$=-55,851/298,15=-187,325 $^{J}/_{mol/K}$;
$\Delta S_{total}=\Delta S_{Hess}+\Delta S_{dispersed}$=-319,512-187,325=-506,837 $^{J}/_{(mol\ K)}$;
$T\Delta S_{total}=\Delta G_{dispersed}$ or dissipated free energy $T•\Delta S_{total}$=-0,506837 $^{J}/_{K/mol}$•298,15 K=**-151,1058** $^{kJ}/_{mol}$.

In the entire set of non-equilibrium states $\Delta G_{eq}=-R•T•\ln(K_{non\_equilibrium})$ there is one state with the smallest absolute energy change $\Delta G_{eq}=-R•T•\ln(K_{eq})$ Prigogine attractor .

The inverse of protolysis is a neutralization reaction, a heat of reaction experiment in which pure reactants, acids H_3O^+ (HCl vai HNO_3) and hydroxides OH^- (NaOH vai KOH), react to produce pure water. The heat of reaction is calculated as the sum of the net products minus the sum of the net reactants:

$\Delta H_{Hess}=2•\Delta H°_{H2O}-(\Delta H°_{H3O}+\Delta H°_{OH-})$=2*-285,83-(-285,809-230)=-55,851 $^{kJ}/_{mol}$. The enthalpies are from {1,8,26], where temperature measurements

$$\mathbf{Q}=-\Delta H_{eksperimentāls}=\mathbf{C_{H2O}•m_{H2O}}•\Delta T/\mathbf{n}=4{,}184*200*2{,}1357935/\mathbf{0{,}032}=55{,}851\ ^{kJ}/_{mol}$$

confirm the data of $\Delta H°_{\mathbf{H3O}+}$=-285,809 $^{kJ}/_{mol}$ Mischenko 1972, Himia, Leningrad [26].

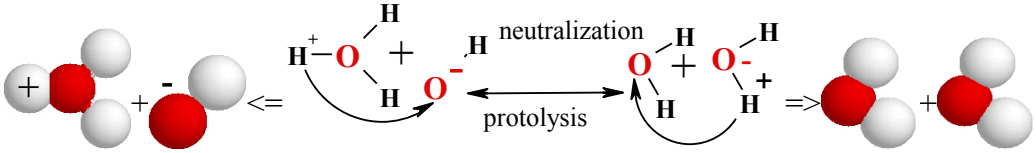
Each of the non-equilibrium reaction states tends to an equilibrium state with a minimum energy change ΔG_{eq}=99,8 $^{kJ}/_{mol}$, because in a mixture of substances at equilibrium with a constant K_{eq} value, the free energy change $\Delta G_{eq}=-R•T•\ln(K_{eq})$ is the Prigogine attractor:
$\Delta G_{eq}=-R•T•\ln(K_{eq})$=-8,3144*298,15*ln(3,261*10^(-18))=$G_{H3O+}+G_{OH-}$-(2* G_{H2O})=**22,44**+**77,36**-(2***0**)=99,8 $^{kJ}/_{mol}$, which is the minimum of the absolute value of the free energy change in water protolysis .[1,2,3,4]

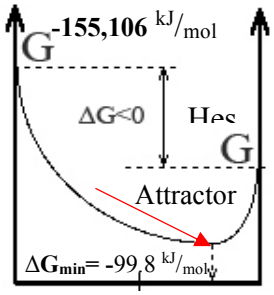
In the environment, water is activates $G_{H2O\_Biochemistry}=\Delta G_{\mathbf{H2O}Alberty}-(\Delta G°_{H2O})$=**-151,549**-(-237,191)=**85,6** $^{kJ}/_{mol}$ according to Alberty data. [8] Protolysis of water $H_3O^++OH^-$, abundant formation of hydrogen bonds, coordination with donor-acceptor bonds in organisms with water-rich biochemistry environment activates effective free energy storing $G_{H2O\_Biochemistry}$=**85,6** $^{kJ}/_{mol}$ from absolute zero of pure distilled water G_{H2O}=0 $^{kJ}/_{mol}$,

The Hessian transformation of pure substances into pure products in the prescribed order of reactions reaches the minimum energy change $\Delta G_{eq1}=-R\bullet T\bullet\ln(K_{eq1})$, an equilibrium state, the Prigogine attractor to which all non-equilibrium states tend. Neutralization is exergonic -ΔG and exothermic Q=-**ΔH**:

The inverse is a neutralization reaction, Thermochemistry experiment in which pure reactants, acids H_3O^+ (HCl vai HNO_3) and hydroxides OH^- (NaOH vai KOH), react to pure water. The maximum free energy change is calculated as the sum of pure products minus the sum of pure reactants $\Delta G_{Hess\_neutralization}=\Sigma\Delta G_{products}-\Sigma\Delta G_{reactants}$:

H3O⁺+OH⁻ =2H2O+Q=-**ΔH**+-**ΔG**, $K_{eq1}=[H_2O]^2/[H_3O^+]/[OH^-]=3.068*10^{17}$:





Homeostasis in organisms is subject of protolysis. Neutralization and water protolysis occur in solutions of proteins, ions, amino acids, carboxylic acids, carbohydrates and nucleic acids. Water protolysis in the products increases the free energy content of water and gas CO_2^{gas} from zero 0 $^{kJ}/_{mol}=G_{H2O}=G_{CO2}^{gas}$ to $\Delta G_{eq1}=-R\bullet T\bullet\ln(K_{eq1})=G_{H3O+}+G_{OH-}-2*G_{H2O}=22.44+77.36-2*0=99.8$ $^{kJ}/_{mol}$.
The free energy accumulated in protolysis is spent in the neutralization reaction to 0 $^{kJ}/_{mol}=G_{H2O}$, releasing heat Q and free energy:

A+B 50% C+D izejvielas H_3O^++OH^- **H_2O+H_2O** produkti.

$$\Delta G_{eq2}=-R\bullet T\bullet\ln(K_{eq2})=-R\bullet T\bullet\ln\left(\frac{[H_2O]\cdot[H_2O]}{[OH^-]\cdot[H_3O^+]}\right)=-8.3144*298.15*\ln(3.068*10^{17})=\mathbf{-99.8}\ ^{kJ}/_{mol}.$$

Table 2 Values of standard enthalpy $\Delta H°_{Hess298}$, $\Delta S°_{Hess\ 298}$ and free energy $\Delta G°_{Hess298}$ for the formation of free elements H_2^{gas}, O_2^{gas}, the values of which are assumed to be zero $\Delta H°=0$ $^{kJ}/_{mol}$. 298.15 K. [1,8,26]
$\Delta H°_{H3O+}$=-285,809$^{kJ}/_{mol}$ Mischenko 1972, Himia, Leningrad [26,1]

Formation of elements	Substance	Name of substance	$\Delta H°_{298}$, $^{kJ}/_{mol}$	$\Delta S°_{298}$, $^{J}/_{mol/K}$	$\Delta G°_{298}$, $^{kJ}/_{mol}$
$H_{2gas}+0,5O_{2gas}=H_2O$	H_2O	Water	–285,85	69,9565	-237,191
$1,5H_{2gas}+0,5O_{2gas}=H_3O^+$	H_3O^+	Hydroxonium ion	–285,809	-182,1905	-231,4889
$0,5H_{2gas}+0,5O_{2gas}=OH^-$	OH^-	Hydroxide anion	–230,00	-10,8	-157,2

H_3O^++OH^-=2H_2O exothermic reaction ΔH=-55,851 $^{kJ}/_{mol}$ enthalpy change is negative exothermic:
$\Delta H_{Hess}=2\bullet\Delta H°_{H2O}-(\Delta H°_{H3O}+\Delta H°_{OH-})=2*-285,83-(-285,809-230)=-55,851$ $^{kJ}/_{mol}$. Enthalpy is from4 [1,8,26]
Thermal energy dissipation from one mol reactants in exothermic reaction over one Kelvin degree.
$\Delta S_{dissipated}=-\Delta H_{Hess}/T=55851/298,15=187,325$ $^{J}/_{mol/K}$;
Endoergonic change is negative over one Kelvin degree and mol; Koriģēts $\Delta S°_{H3O+}$=-182,1905 $^{J/K}/_{mol}$;
Exoergonic free energy dissipation of one mol reactants in exothermic reaction over one Kelvin degree.
$\Delta S_{Hess}=2\bullet\Delta S°_{H2O}-(\Delta S°_{H3O}+\Delta S°_{OH})=2*69,956-(-182,191-10,8)=332,9025$ $^{J}/_{mol/K}$;
$\Delta G_{Hess\_neutralization}=\Delta H_{Hess}-T\bullet\Delta S_{Hess}=-55,851-298,15*0,3329025=\mathbf{-155,1058}$ $^{kJ}/_{mol}$; $\Delta G°_{H3O+}$=-231,4889 $^{kJ}/_{mol}$;
$\Delta S_{total}=\Delta S_{Hess}+\Delta S_{dissipated}=332,9025+187,325=520,2275$ $^{J}/_{mol/K}$;
ΔG_{bound} as thermally dissipated free energy in products $T\bullet\Delta S_{total}=520,2275$ $^{J}/K/_{mol}\bullet 298,15$ K=**155,1058** $^{kJ}/_{mol}$.
Each complete set of non-equilibrium reaction states all tend to the equilibrium state with the absolute minimum of the energy change $\Delta G_{eq2}=\mathbf{-99,8}$ $^{kJ}/_{mol}$, because in a mixture of substances at equilibrium with a constant value of K_{eq2}, the free energy change $\Delta G_{eq2}=-R\bullet T\bullet\ln(K_{eq2})$ is the Prigogine attractor:

$$\Delta G_{eq2}=-R\bullet T\bullet\ln(K_{eq2})=2*G_{H2O}-(G_{H3O+}+G_{OH-})=2*\mathbf{0}-(\mathbf{22,44}+\mathbf{77,36})=\mathbf{-99,8}\ ^{kJ}/_{mol},$$

which is the absolute (positive) value at minimum of the free energy change | **-99.8** |=**99,8** $^{kJ}/_{mol}$. [1,2,3,4]
Free energy change minimum confirms attractor of Prigogine $\Delta G_{eq2}=-R\bullet T\bullet\ln(K_{eq2})$.

$$\text{Attractor is } \Delta G_{eq2}=-R\bullet T\bullet\ln(K_{eq2})=-R\bullet T\bullet\ln\left(\frac{[H_2O]\cdot[H_2O]}{[OH^-]\cdot[H_3O^+]}\right)=-8,3144*298,15*\ln(3,068*10^{17})=\mathbf{-99,8}\ ^{kJ}/_{mol},$$

H_3O^+ formation from free elements hydrogen **H_2^{gas}**, oxygen **O_2^{gas}**, removed free electron e^-;.
1,5**H_2^{gas}**+0,5**O_2^{gas}**=**H_3O^+**+e^-; $\Delta G°_{H3O+}=\Delta H-T*\Delta S=-285,809-298,15*-182,1905/1000=-231,4889$ $^{kJ}/_{mol}$;

$$\Delta G°_{H3O+}=G_{H3O}+G_{e-}-(1,5G_{H2gas}+G_{O2gas}/2)=\mathbf{22,4}+\mathbf{26,121}-(1,5*\mathbf{85,64}+\mathbf{303,1}/2)=-231,4889\ ^{kJ}/_{mol};$$

Free electron energy content in one mol is

$$G_{e-}=\Delta G°_{H3O+}-G_{H3O+}+(1,5*G_{H2}^{gas}+0,5*G_{O2}^{gas})=-231,4889-\mathbf{22,44}+(1,5*\mathbf{85,6}+\mathbf{303,1}/2)=\mathbf{26,121}\ ^{kJ}/_{mol}.$$

Formation 0,5**O_2^{gas}**+0,5**H_2^{gas}**+e-= **OH^-**; let us calculate the free electron energy content at formation from elements $\Delta G°_{OH-}=G_{OH-}-(G_{H2}^{gas}/2+G_{O2aq}/2+G_{e-})=\mathbf{77.36}-(\mathbf{85,64}/2+\mathbf{303,1}/2+\mathbf{40,19})=-157,2$ $^{kJ}/_{mol}$; [1]

$$G_{e-}=G_{OH-}-(G_{H2}^{gas}/2+G_{O2aq}/2+\Delta G°_{OH-})=\mathbf{77.36}-(\mathbf{85,64}/2+\mathbf{303,1}/2-157,2)=\mathbf{40,19}\ ^{kJ}/_{mol};$$

Water protolysis and reverse neutralization at equilibrium free energy change $\Delta G_{eq1}= -\Delta G_{eq2}$ has the same number and opposite sign, inverse constant value $1/K_{eq2}=K_{eq1}$.

1. Protolysis $H_2O+H_2O+\Delta G_{eq1}=H_3O^++OH^-$ is endoergonic ΔG_{eq1} positive and
2. Neutralization $H_3O^++OH^-=H_2O+H_2O+\Delta G_{eq2}$ is exoergonic ΔG_{eq2} negative.

The change in free energy for pure substances $\Delta G_{Hess}=G_2-G_1$ is greater in absolute value than the Prigogine standard change at equilibrium $\Delta G_{eq}=-R\cdot T\cdot \ln(K_{eq})$ $|\Delta G_{Hess}|>|\Delta G_{eq}|$.

Hess calculation pure products minus reactants free energy content is grater than Prigogine attractor $\Delta G_{Hess}=2\cdot\Delta G°_{H2O}-(\Delta G°_{H3O}+\Delta G°_{OH-})=2*-237,191-(-217,2345-157,2)=-99,95$ $^{kJ}/_{mol}$. [1,8,26]

$$\Delta G_{eq2}=-R\cdot T\cdot\ln(K_{eq2})=-R\cdot T\cdot\ln\left(\frac{[H_2O]\cdot[H_2O]}{[OH^-]\cdot[H_3O^+]}\right)=-8,3144*298,15*\ln(3,068*10^{17})=\mathbf{-99,8}\ ^{kJ}/_{mol},\ \text{as pure :}$$

Water and ions concentrations let us calculate Prigogine attractors $\Delta G_{eq}=-R\cdot T\cdot\ln(K_{eq})$:

$[H_2O]=996/18=55.33333$ M;

$K_{eq1}=[H_3O^+]*[OH^-]/[H_2O]^2=10^{\wedge(-7.00035)}*10^{\wedge(-7.00035)}/55.33333^{\wedge2}=3.261*10^{-18}$;

$K_{eq2}=[H_2O]^2/[H_3O^+]*[OH^-]=55.33333^{\wedge2}/10^{\wedge(-7.00035)}/10^{\wedge(-7.00035)}=3.067*10^{17}$;

At equilibrium the values of the constants are reciprocally inverse:

$K_{eq1}=[H_3O^+]*[OH^-]/[H_2O]^2=3.261\cdot10^{\wedge(-18)}=1/K_{eq2}=1/(3.067*10^{\wedge17})=$ or

$K_{eq2}=[H_2O]^2/[H_3O^+]*[OH^-]=3.067\cdot10^{\wedge17}=1/K_{eq1}=1/(3.261*10^{\wedge(-18)})=$

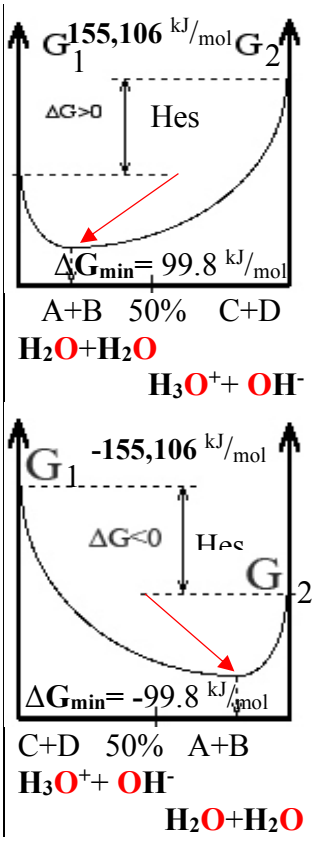
$\Delta G_{eq1}=-R\cdot T\cdot\ln(K_{eq1})=-8.3144*298.15*\ln(3.261*10^{\wedge(-18)})=99.8$ $^{kJ}/_{mol}$,

$\Delta G_{eq2}=-R\cdot T\cdot\ln(K_{eq2})=-8.3144*298.15*\ln(3.067*10^{\wedge17})=-99.8$ $^{kJ}/_{mol}$,

The change in free energy ΔG_{Hess} in Hess's law for pure substances is larger in absolute value, but in equilibrium the change in free energy tends towards the attractor: $99.8\ ^{kJ}/_{mol}=|\Delta G_{eq}|<|\Delta G_{Hess}|=\mathbf{155,106}\ ^{kJ}/_{mol}$. All reactions by Le Chatelier's principle tend to a minimum of the Prigogine attractors $|\Delta G_{eq}|=99.8\ ^{kJ}/_{mol}$ in an equilibrium mixture of substances.

Each reaction proceeds in both forward and reverse directions.

With inverse equilibrium constants in the forward reaction, such as protolysis K_{eq1}, and in the reverse reaction, such as neutralization, $1/K_{eq2}$, which is the opposite of protolysis K_{eq1}.



$$3.261\cdot10^{\wedge(-18)}=\frac{[OH^-]\cdot[H_3O^+]}{[H_2O]\cdot[H_2O]}=K_{H3O++OH-}=\frac{1}{K_{eq2}}=\frac{1}{\frac{[H_2O]\cdot[H_2O]}{[OH^-]\cdot[H_3O^+]}}=\frac{1}{3,068*10^{17}}=3.261\cdot10^{\wedge(-18)}.....$$

The attractor, declared by Ilya Prigogine in 1977., mathematically accurately shows how the equilibrium state tend to minimize the change in energy works.

High-speed protolysis maintains self-organizing attractors pH=7.36, C_{osm}=0.305 M, ionic strength I=0.25 M. The equilibrium state is an attractor for all non-equilibrium states. The homeostasis of complex metabolic reactions irreversibly tends to maintain self-organizing attractors: osmolar concentration 0.305 M, ionic strength 0.25 M, carbonic anhydrase CA synthesis, biosphere pH=7.36. This is how irreversible processes self-organize into perfect homeostasis order for survival and evolution.

Deviation from attractors: osmolar concentration of 0.305 M, ionic strength of 0.25 M, carbonic anhydrase deficiency and physiological pH=7.36 disrupts the order of perfect homeostasis, creates chaos and the destruction of the biosphere.

$G_{H3O++OH-}=G_{H3O+}+G_{OH-}=22.44+77.36=G_{H3O+}+G_{OH-}-G_{2H2O}=-R\cdot T\cdot\ln(K_{H3O++OH-})-2*0=99.8$ $^{kJ}/_{mol}$. [1,4,8]

The protolysis of water activates in the products $H_3O^++OH^-$ and accumulates free energy from zero 0 $^{kJ}/_{mol}$ for water $2H_2O$ to 99.8 $^{kJ}/_{mol}$ per mole (19 $^{g}/_{mol}$ H_3O^+ and 17 $^{g}/_{mol}$ OH^-) of the products. The accumulated energy produces heat Q and drives processes in homeostasis

$$\mathbf{\Delta G_{eq2}=-R\cdot T\cdot\ln(K_{eq2})}=2*G_{H2O}-(G_{H3O+}+G_{OH-})=2*0-(22.44+77.36)=-99.8\ ^{kJ}/_{mol}.$$

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