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Thermodynamic Functions of Transfer of Single Ions from Water to Non-aqueous and Mixed Solvents (Based on an Extrathermodynamic Assumption): Part 5

# GIBBS ENERGIES OF TRANSFER INTO AQUEOUS ALCOHOLS

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# Thermodynamic functions of transfer of single ions from water to non-aqueous and mixed solvents (based on an extrathermodynamic assumption): part 5 – Gibbs energies of transfer into aqueous alcohols

**Abstract** - Literature data on the standard molar Gibbs energies of transfer of ions X from water W into aqueous alcohol mixtures W+S, $\Delta_t G^o$(X, W $\longrightarrow$ W+S)/kJ on the mol L$^{-1}$ scale at 25°C, are compiled to the end of 1986 and evaluated according to the criteria established in previous parts. The data are presented at evenly spaced mass fractions $\underline{w}$ of the alcohol in the mixture, interpolated where necessary. In the cases of a few ions transferring into aqueous methanol or ethanol 'selected' values are suggested. Smoothing equations relating $\Delta_t G^o$(X, W $\longrightarrow$ W+S) to the mass fraction $\underline{w}$ of S in the mixture are then presented.

## INTRODUCTION

Previous parts of this series dealt with literature data that directly or indirectly reported on the transfer of single ions from the reference solvent, water, into nonaqueous solvents. The standard molar Gibbs energy of transfer of ions was dealt with in Part 1,[1] the standard molar enthalpy and entropy of transfer in Part 2,[2] and the standard electrode potentials of some selected electrodes in Part 3.[3] The division of the standard thermodynamic functions of transfer of electrolytes into the single ion contributions[1,2] was reported on the basis of the extrathermodynamic assumptions employed by the original authors. These were summarized in Part 4,[4] where it was shown that the TATB assumption,i.e., that the Gibbs energy, enthalpy, and entropy of transfer of tetraphenylarsonium cations equal those of tetraphenylborate anions for transfers into all solvents, is among all the assumptions hitherto suggested the least objectionable.

Several criteria were applied in the evaluation of the literature data. These included[1] the reliability of the experimental data, their being correctly reduced to standard thermodynamic values, and the adherence to ionic additivity of the standard quantities. The standard entropy also must conform to the difference between the standard enthalpy and the Gibbs energy, divided by the absolute temperature. The data were all converted to a common concentration scale, mol L$^{-1}$ for the Gibbs energy and entropy, and to SI units.

Values for single ions based on less reliable extrathermodynamic assumptions were adjusted,[1,2] where possible, by the addition (subtraction) of a constant quantity to (from) the cation (anion) data reported by an author, to bring the data into the range of the TATB scale. The adjustment represents the transfer quantity for the reference ion or ion/molecule pair for this particular set of data. The values for the transfer of a given ion to a given non-aqueous solvent were then weighted by estimates of their relative reliabilities. The weighted average of these values was taken to yield a 'selected' value. Its reliability was indicated by the number of significant digits accorded to it in the tables. In many cases no 'selected' value could be derived from the reported data.

Many practical chemical operations on ionic substances are carried out in mixed solvents, and in particular in mixtures of water and organic solvents. The solvation of ions in such aqueous solvents is of importance, since it determines the equilibria and kinetics of reactions involving the ions. Standard thermodynamic functions of transfer of ions from the reference solvent, water, into these aqueous solvent mixtures provide information on this solvation. The present report deals with a part of this wide area, namely with the Gibbs energies of transfer (at 298.15K) of ions, X, from water, W, into mixtures of alcohols, S, with water, $\Delta_t G^o$(X, W $\longrightarrow$ W+S).

In order to report these data, three variables: the ion X, the solvent S, and the composition of the aqueous solvent mixture W+S, in addition to the source of the data, had to be presented. Hence, a four-dimensional representation was required. The previous parts [1,2] listed the data for each solvent S separately, and doing so in the present case reduced the set to three dimensions. The choice was made to report here on each ion separately (under each solvent S). A two-dimensional display, of the reported values from each literature source against the composition of the aqueous-solvent W+S, thus resulted.

Most of the data in the literature have been reported as a function of the mass fraction, or the mass %, $w$, of the solvent S in the aqueous mixture. This has the merit of being readily reproducible. When mole fractions are employed in the original source, they are easily converted to mass fractions by means of the molar masses. When volume fractions are employed, conversion depends on the availability of density data for the aqueous solvent mixtures. Otherwise, a small error is introduced when it is assumed that mixing takes place without a change in volume and the densities of water and the pure solvent S are used for the conversion. The error is reduced somewhat in the interpolation procedure, used in order to report all the data at evenly spaced decadic increments in $w$. Power series in $w$ up to third or fourth power, forced to pass through the origin, have been used to interpolate the $\Delta_t G^O(X, W \longrightarrow W+S)$ values. (For interpolations at high $w$, $(100-w)$ has been used as the independent variable and $\Delta_t G^O(X, W \longrightarrow S) - \Delta_t G^O(X, W \longrightarrow W+S)$ as the dependent one).

In parts 1 and 2[1,2] it was the practice to include only data for individual ions but not data for complete electrolytes. Following this practice in the present case would have reduced the amount of information this report could convey inappropriately. There is an appreciable amount of information on the standard Gibbs energy of transfer of hydrochloric acid from water to aqueous alcohols. This quantity, in particular for the higher alcohols, cannot at present be reliably split into the ionic contributions, since no values for the hydrogen or the chloride ions are available on the TATB or an equivalent reliable scale. However, in order to compare the effects of alcohols with varying chain length or branching, data for aqueous-alcoholic hydrochloric acid are valuable even if they cannot be split into appropriate ionic contributions. Similar decisions for inclusion have been made for a few other electrolytes too, where otherwise information on the transfer of ions, even in combination, would not have been available at all. It is hoped that the comparative presentation in this compilation will encourage the future use of the data in conjunction with reliable data on some single ions (e.g., the chloride ion, obtained according to the TATB assumption).

In few cases indeed were data of high accuracy confirmed from at least one independent source. Such cases were practically limited to the two lower alcohols, methanol and ethanol. In such cases 'selected' values were proposed, based as before [1,2] on a weighted average of the data traceable to the TATB or an equivalent reliable extrathermodynamic assumption.[4] Such selected values of $\Delta_t G^O(X, W \longrightarrow W+S)$ were fitted with a smoothing equation, a fourth degree power series in $w$, forced through the origin. The standard deviation, $\sigma$, of these fits were also reported.

Data were collected from the primary sources and Chemical Abstracts till the end of 1986. Table 1 presents a summary of the alcoholic solvents and the ions for which $\Delta_t G^O(X, W \longrightarrow W+S)$ data could be found and presented in the following detailed tables. Data for transfer into pure alcohols, rather than into their aqueous mixtures, are also included for those alcohols where there are also data for transfer into mixtures. For 2-butanol, 2-methyl-1-propanol, and hexanol there are some data[5] for the transfer of hydrogen, picrate, potassium, butyl(tri-3-methylbutyl)ammonium,[†] chloride, bromide, and tetraphenylborate into the neat alcohols only, and these are not included here (but see ref. 1).

## REFERENCES

1. Y. Marcus, <u>Pure Appl. Chem.</u>, <u>55</u>, 977-1021 (1983).
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4. Y. Marcus, <u>Pure Appl. Chem.</u>, <u>58</u>, 1721-1736 (1986).
5. I.M. Kolthoff and M.K. Chantooni, Jr., <u>J. Phys. Chem.</u>, <u>82</u>, 994-1003 (1978), <u>83</u>, 468-474 (1979).

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† Denoted elsewhere in this document as $iPe_3BuN^+$($iPe$ = isopentyl, a trivial designation for 3-methylbutyl).

Table 1.  Summary of alcohols S and ions (or electrolytes) X for which standard molar Gibbs energies of transfer of the ions from water W into the aqueous solvents $\Delta_t \underline{G}^o(X, W \longrightarrow W+S)/kJ\ mol^{-1}$, at 298.15 K on the mol $L^{-1}$ scale, are tabulated as a function of the composition (in mass %, $\underline{w}$) of the mixed solvent W+S.

| Table No. | Solvent | Ions |
|---|---|---|
| 2 | Methanol | $H^+$, $Li^+$, $Na^+$, $K^+$, $Rb^+$, $Cs^+$, $(CH_3)_4N^+$, $(C_2H_5)_4N^+$, $(C_3H_7)_4N^+$, $(C_4H_9)_4N^+$, $(C_6H_5)_4P^+$, $(C_6H_5)_4As^+$, $Tl^+$, $Ca^{2+}$, $Sr^{2+}$, $Ba^{2+}$, $Cu^{2+}$, $Zn^{2+}$, $Cd^{2+}$, $Hg^{2+}$, $Pb^{2+}$, $La^{3+}$, $OH^-$, $CH_3O^-$, $F^-$, $Cl^-$, $Br^-$, $I^-$, $CN^-$, $SCN^-$, $N_3^-$, $BrO_3^-$, $IO_3^-$, $ClO_4^-$, $ReO_4^-$, $C_6H_2(NO_2)_3O^-$ (picrate), $SO_4^{2-}$, $S_2O_8^{2-}$, $Fe(CN)_6^{3-}$, $B(C_6H_5)_4^-$. |
| 3 | Ethanol | HCl, $H^+$, $K^+$, $Rb^+$, $Cs^+$, $(CH_3)_4N^+$, $(C_2H_5)_4N^+$, $(C_3H_7)_4N^+$, $(C_4H_9)_4N^+$, $(\underline{i}C_5H_{11})_3C_4H_9N^+$, $(C_6H_5)_4P^+$, $(C_6H_5)_4As^+$, $Ag^+$, $Cu^{2+}$, $Hg^{2+}$, $UO_2^{2+}$, $U^{4+}$, $Cl^-$, $Br^-$, $I^-$, $CN^-$, $SCN^-$, $ClO_4^-$, $Ag(CN)_2^-$, $Au(CN)_2^-$, $C_6H_2(NO_2)_3O^-$ (picrate), $B(C_6H_5)_4^-$. |
| 4 | 1-Propanol | HCl, $H^+$, $Li^+$, $Na^+$, $K^+$, RbCl, $Rb^+$, $Cs^+$, $Ag^+$, AgSCN, $NH_4^+$, $(CH_3)_4N^+$, $(C_2H_5)_4N^+$, $(C_3H_7)_4N^+$, $(C_4H_9)_4N^+$, $(\underline{i}C_5H_{11})_3C_4H_9N^+$, $(C_6H_5)_4As^+$, $Cu^{2+}$, $Hg^{2+}$, $Hg_2^{2+}$, $Cl^-$, $Br^-$, $I^-$, $ClO_4^-$, $C_6H_2(NO_2)_3O^-$ (picrate), $B(C_6H_5)_4^-$. |
| 5 | 2-Propanol | HCl, HBr, $H^+$, $K^+$, RbCl, $NH_4I$, $Ag^+$, AgSCN, $(iC_5H_{11})_3C_4H_9N^+$, $Cu^{2+}$, $Zn^{2+}$, $Cl^-$, $Br^-$, $I^-$, $C_6H_2(NO_2)_3O^-$ (picrate), $B(C_6H_5)_4^-$. |
| 6 | 1-Butanol | $H^+$, $Na^+$, $K^+$, $Rb^+$, $Cs^+$, $NH_4^+$, $(CH_3)_4N^+$, $(C_2H_5)N^+$, $(C_3H_7)_4N^+$, $(C_4H_9)_4N^+$, $(C_6H_5)_4As^+$, $Cl^-$, $Br^-$, $I^-$, $ClO_4^-$, $C_6H_2(NO_2)_3O^-$ (picrate), $B(C_6H_5)_4^-$. |
| 7 | 2-Methyl-2-propanol | HCl, HBr, $H^+$, LiCl, $Li^+$, $Na^+$, $K^+$, RbCl, $Rb^+$, $CsB(C_6H_5)_4$, $Cs^+$, $NH_4^+$, AgCl, $(C_6H_5)_4As^+$, $Mg^{2+}$, $Ca^{2+}$, $Sr^{2+}$, $Ba^{2+}$, $Hg[B(C_6H_5)_4]_2$, $F^-$, $Cl^-$, $Br^-$, $I^-$, $OH^-$, $C_6H_2(NO_2)_3O^-$ (picrate), $B(C_6H_5)_4^-$. |

Table 1. (cont.)

| Table No. | Solvent | Ions |
|---|---|---|
| 8 | 1,2-Ethane-diol | HCl, HBr, $H^+$, $Li^+$, $Na^+$, $K^+$, $CsB(C_6H_5)_4$, $(C_6H_5)_4As^+$, $CuSO_4$, $Cu^{2+}$, $Cd^{2+}$, $Cl^-$, $Br^-$, $I^-$, $C_6H_2(NO_2)_3O^-$ (picrate), $B(C_6H_5)_4^-$. |
| 9 | 1,2-Propane-diol | HCl, $H^+$, $Cl^-$, $Br^-$, $I^-$. |
| 10 | 1,2,3-Propa-netriol | HCl, HBr, HI, $H^+$, $Li^+$, $Na^+$, $K^+$, $Rb^+$, $Cs^+$, AgCl, AgBr, AgI, AgSCN, $AgN_3$, $(C_6H_5)_4As^+$, $Cl^-$, $Br^-$, $I^-$, $C_6H_2(NO_2)_3O^-$ (picrate), $B(C_6H_5)_4^-$. |
| 11 | 2-Methoxy-ethanol | HCl, $H^+$, $Li^+$, $Na^+$, $K^+$, RbCl, $Rb^+$, $Cs^+$, $(C_6H_5)_4As^+$, $OH^-$, $Cl^-$, $Br^-$, $I^-$, $C_6H_2(NO_2)_3O^-$ (picrate), $B(C_6H_5)_4^-$. |
| 12 | 3-Oxa-1,5-pentanediol | $H^+$, $Cl^-$, $Br^-$, $I^-$. |

Table 2. Standard molar Gibbs energies of transfer of ions from water into mixtures of methanol (S) and water (W) at 25°C

Selected values

| Mass% S | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| $H^+$ | 0.5 | 0.8 | 0.7 | 0.4 | -0.2 | -0.6 | -0.8 | -0.5 | 2.3 | 10.4 |
| $Li^+$ | 1.1 | 1.8 | 2.4 | 2.9 | 3.3 | 33.4 | 3.6 | 3.6 | 3.8 | 4.4 |
| $Na^+$ | 1.7 | 2.8 | 4.1 | 5.0 | 5.9 | 6.6 | 7.6 | 8.0 | 8.4 | 8.2 |
| $K^+$ | 1.4 | 2.8 | 4.1 | 5.1 | 5.8 | 7.0 | 8.1 | 9.1 | 9.8 | 9.6 |
| $Rb^+$ | 1.6 | 3.0 | 3.9 | 5.0 | 6.0 | 7.1 | 8.2 | 9.4 | 9.7 | 9.6 |
| $Cs^+$ | 1.6 | 2.7 | 3.6 | 4.6 | 5.5 | 6.2 | 7.5 | 8.5 | 9.0 | 8.9 |
| $Ag^+$ | 1.0 | 1.6 | 2.5 | 3.5 | 4.3 | 5.4 | 5.7 | 6.4 | 6.9 | 6.6 |
| $Ph_4As^+$ | -2.3 | -4.7 | -7.6 | -10.8 | -13.9 | -16.2 | -18.5 | -20.1 | -21.8 | -22.8 |
| $Cl^-$ | 0.2 | 0.8 | 1.5 | 2.5 | 3.6 | 5.0 | 6.5 | 8.4 | 10.7 | 13.2 |
| $Br^-$ | -0.1 | 0.1 | 0.7 | 1.4 | 2.4 | 3.6 | 4.9 | 6.8 | 8.8 | 11.1 |

Table 2. Standard molar Gibbs energies of transfer of ions from water into mixtures of methanol (S) and water (W) at 25°C (cont.)

Selected values

| Mass% S | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| $I^-$ | -0.3 | -0.4 | -0.1 | 0.0 | 0.9 | 1.4 | 2.2 | 3.5 | 5.4 | 7.3 |
| $BPh_4^-$ | -2.3 | -4.7 | -7.6 | -10.8 | -13.9 | -16.2 | -18.5 | -20.1 | -21.8 | -22.8 |

$\Delta_t G^\circ$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, into methanol (S) + water (W)

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $H^+$ | | | | | | | | | | | |
| | -19.4 | -27.0 | -30.2 | -32.2 | -35.0 | -35.6 | -35.5 | -34.7 | -34.1 | -23.9 | 2[a] |
| | -2.1 | -3.8 | -6.9 | | -13.5 | | -19.8 | | -22.3 | -12.3 | 3[h] |
| | 0.6 | 0.8 | | 0.3 | | -0.7 | | -0.6 | | 10.4 | 6[b] |
| | -0.8 | -1.9 | | -4.7 | -6.8 | | | | | | 10[c] |
| | 0.6 | 0.7 | 0.7 | 0.3 | -0.2 | -0.7 | -1.0 | -0.8 | | | 14[d] |
| | 0.0 | | -2.5 | | -8.1 | | -10.4 | -11.7 | -7.0 | | 16[e] |
| | 0.3 | 0.4 | 0.5 | 0.2 | -0.3 | -0.6 | -0.8 | -0.5 | 0.8 | 10.3 | 31[f] |
| | 0.6 | 1.1 | 0.7 | 0.5 | -0.2 | -0.5 | -0.6 | -0.4 | 3.0 | 10.2 | 32[g] |
| | | 0.1 | -0.6 | -1.3 | -2.3 | -3.1 | -3.9 | -4.7 | -5.2 | -2.2 | 34[j] |
| | | 1.2 | | 0.5 | | -0.6 | | -0.5 | 0.9 | 3.7 | 35[b] |
| | -1.1 | | | -6.4 | | | | | -13.2 | -7.7 | 36[h] |
| | -0.8 | | | -2.8 | | | | | -4.3 | 3.1 | 37[h] |
| | -0.5 | -0.7 | -1.4 | -1.7 | -2.3 | -2.6 | -2.2 | -2.2 | -1.8 | 1.4 | 38[i] |
| | -1.2 | -2.6 | -4.1 | -5.2 | -6.3 | -7.2 | -7.7 | -7.3 | -5.3 | 4.6 | 39[k] |
| | 0.0 | -0.1 | -0.1 | -0.4 | -0.4 | | 0.2 | | 4.4 | 15.1 | 41[l] |
| Selected | 0.5 | 0.8 | 0.7 | 0.4 | -0.2 | -0.6 | -0.8 | -0.5 | 2.3 | 10.4 | |

Equation $\Delta_t G^\circ$ /kJ mol$^{-1}$ = $0.0379 \cdot w + 0.001742 \cdot w^2 - 93.09 \cdot 10^{-6} \cdot w^3 + 81.62 \cdot 10^{-8} \cdot w^4$

$$\sigma(\Delta_t G^\circ \text{ /kJ mol}^{-1}) = 0.32$$

[a] From "real" potentials, weight = 0 . [b] Calculated with the Cl⁻ value from ref. 32 based on the TATB assumption, weight = 1. [c] From assumptions concerning electrostatic $\Delta_t G^\circ$ and activity coefficients of indicators, weight = 0; data also for $w$ = 33.4: -3.7, and $w$ = 43.1: -5.3 kJ mol$^{-1}$. [d] See comment [b]; data also for $w$ = 15, 25, 35, 45, 55, 65, 75, and 85: 0.7, 0.8, 0.4, 0.3, -0.4, -0.9, -1.0, and -0.4 kJ mol$^{-1}$, respectively. [e] From ferrocene/ferrocinium assumption, weight = 0. [f] From TPTB assumption, weight = 1 . [g] From TATB assumption, weight = 1. [h] From extrapolation of data for HX to infinite value of the radius of X⁻, weight = 0. [i] From $H_0$ data with Hammett indicators and assumptions concerning the activity coefficients, weight = 0. [j] See comment [b] but with weight = 0. [k] Composition is given in "concentration %", assumed from subsequent papers of the authors to be w; data for single ions were obtained from "real" potentials and assumptions concerning the "stabilization" of the surface potential on addition of heptanol, weight = 0. [l] From "Owen extrapolation," neglecting the liquid junction potential.

$\Delta_t\underline{G}^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, into methanol (S) + water (W)

| Mass% S($\underline{w}$) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Li$^+$** | | | | | | | | | | | |
| | 1.2 | 1.9 | | 3.0 | | 3.4 | | 3.5 | | | 1[a] |
| | -18.7 | -25.6 | -28.0 | -29.2 | -29.4 | -30.2 | -30.1 | -29.7 | -29.1 | -27.5 | 2[b] |
| | -1.4 | -2.4 | -4.7 | | -9.5 | | -20.3 | | -22.3 | -12.3 | 3[f] |
| | 1.2 | 1.9 | | 2.9 | | 3.2 | | 3.3 | | 3.4 | 6[a] |
| | | | 2.7 | 3.0 | 3.2 | 3.4 | 3.7 | 3.9 | 4.2 | 4.5 | 13[c] |
| | | 0.9 | | 2.6 | | 3.8 | | 4.2 | | 3.8 | 20[d] |
| | 1.2 | 1.9 | | 2.9 | | 3.2 | | 3.2 | | 3.4 | 25[a] |
| | 0.9 | 1.6 | 2.2 | 2.7 | 3.1 | 3.3 | 3.4 | 3.5 | 3.5 | 3.4 | 31[e] |
| | 1.1 | 2.3 | 2.6 | 3.0 | 3.4 | 3.3 | 3.7 | 3.6 | 4.1 | 4.8 | 32[d] |
| | -0.6 | | | -3.8 | | | | | -11.9 | | 36[f] |
| | -0.3 | | | - 0.1 | | | | | -0.8 | 2.3 | 37[f] |
| Selected | 1.1 | 1.8 | 2.4 | 2.9 | 3.3 | 3.4 | 3.6 | 3.6 | 3.8 | 4.4 | |

Equation $\Delta_t\underline{G}^o$ /kJ mol$^{-1}$ = 0.1231.$\underline{w}$ - 0.001670.$\underline{w}^2$ + 10.26.10$^{-6}$.$\underline{w}^3$ - 1.65.10$^{-8}$.$\underline{w}^4$

$$\sigma(\Delta_t\underline{G}^o \text{ /kJ mol}^{-1}) = 0.13$$

[a] Calculated with the Cl$^-$ value from ref. 32 based on the TATB assumption, weight = 1 . [b] From "real" potentials, weight = 0. [c] Interpolated from data at $\underline{w}$ = 30.8, 57.9, 73.9, 88.1, and 100, see comment [a]. [d] Using TATB assumption, weight = 1. [d] Using TPTB assumption, weight = 1. [e] Using TPTB assumption, weight = 1. [f] Interpolated from data at $\underline{w}$ = 10.0, 20.2, 33.4, 50.0, 68.3, 90.0 and 100 (ref. 3), and 10.0 43.2, 87.7, and 100 (ref. 36, 37), using extrapolation to infinite radius of X$^-$ in MX series of data, weight = 0.

| Mass% S($\underline{w}$) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Na$^+$** | | | | | | | | | | | |
| | 1.7 | 3.0 | | 5.1 | | 6.8 | | 7.7 | | 9.4 | 1[a] |
| | -18.2 | -24.6 | -26.4 | -27.1 | -27.1 | -26.8 | -26.2 | -24.8 | -23.4 | -23.9 | 2[b] |
| | -1.0 | -1.4 | -3.3 | | -6.9 | | -10.3 | | -11.5 | -12.1 | 3[g] |
| | 1.7 | 3.0 | 4.1 | 5.1 | 5.9 | 6.6 | | 7.9 | 8.4 | 8.6 | 6[a] |
| | 1.7 | 3.0 | 4.1 | 5.1 | 5.9 | 6.6 | | 7.9 | 8.4 | 8.6 | 9[a] |
| | | | | 0.9 | | 1.2 | 1.3 | 1.4 | | 1.5 | 12[c] |
| | | | 4.2 | 5.3 | 6.3 | 7.1 | 7.7 | 8.3 | 8.6 | 8.9 | 13[d] |
| | | 1.7 | | 4.0 | | 6.1 | | 8.1 | 8.7 | 9.6 | 20[a] |
| | 1.7 | 3.0 | | 5.1 | | 6.5 | | 8.3 | | 8.6 | 25[a] |
| | 1.4 | 2.6 | 3.9 | 4.9 | 5.8 | 6.6 | 7.4 | 7.9 | 8.2 | 8.4 | 31[f] |
| | 1.7 | 3.4 | 4.2 | 5.2 | 5.8 | 6.7 | 7.8 | 8.3 | 8.6 | 8.9 | 32[e] |
| | 0.2 | | | -1.7 | | | | | -6.5 | -7.1 | 36[g] |
| | -0.3 | | | 1.7 | | | | | 4.1 | 3.1 | 37[g] |
| Selected | 1.7 | 2.8 | 4.1 | 5.0 | 5.9 | 6.6 | 7.6 | 8.0 | 8.4 | 8.2 | |

Equation $\Delta_t\underline{G}^o$ /kJ mol$^{-1}$ = 0.1935.$\underline{w}$ - 0.003056.$\underline{w}^2$ + 41.70.10$^{-6}$.$\underline{w}^3$ - 22.36.10$^{-8}$.$\underline{w}^4$

$$\sigma(\Delta_t\underline{G}^o \text{ /kJ mol}^{-1}) = 0.18$$

[a] Calculated with the Cl⁻ value from ref. 32 based on the TATB assumption, weight = 1. [b] From "real" potentials, weight = 0. [c] From vapor pressures of S + W mixtures, weight = 0. [d] Interpolated from data at $\underline{w}$ = 30.8, 54.2, 71.9, 88.1, and 100, see comment [a]. [e] Using TATB assumption, weight = 1. [f] Using TPTB assumption, weight = 1. [g] Interpolated from data at $\underline{w}$ = 10.0, 20.2, 33.4, 50, 68.3, 90, and 100 (ref. 3), and 10, 43.2, 87.7 and 100 (ref. 36, 37), using an extrapolation to infinite radius of X⁻ in MX series of data, weight = 0.

$\Delta_t G^\circ$ /kJ mol⁻¹, mol dm⁻³ scale, 25 °C, into methanol (S) + water (W)

| Mass% S($\underline{w}$) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| K⁺ | | | | | | | | | | | |
| | 1.7 | 3.0 | | 5.2 | | 7.0 | | 8.8 | | | 1[a] |
| | -18.1 | -24.4 | -26.0 | -26.4 | -26.4 | -25.2 | -23.6 | -21.4 | -18.3 | -19.9 | 2[b] |
| | -0.8 | -1.1 | -2.8 | | -5.9 | | -7.6 | | -6.5 | -8.4 | 3[f] |
| | 1.7 | 3.0 | | 5.1 | | 6.9 | | 8.8 | | 9.8 | 6[a] |
| | 1.7 | 3.0 | | 5.1 | | | | | | | 8[a] |
| | | | 4.1 | 5.2 | 6.2 | 7.2 | 8.2 | 9.3 | 10.3 | 11.3 | 13[c] |
| | 1.0 | 2.2 | | 5.3 | | 7.3 | | 9.6 | 10.5 | 11.2 | 17[d] |
| | 1.0 | 2.1 | | 4.6 | | 6.9 | | 9.1 | 9.9 | 9.6 | 20[d] |
| | 1.2 | 2.9 | 4.0 | 5.0 | 5.6 | 7.1 | 7.9 | 9.1 | 9.6 | 9.6 | 21[d] |
| | 1.7 | 3.0 | | 5.1 | | 6.9 | | 9.1 | | 9.8 | 25 |
| | 1.4 | 2.6 | 4.0 | 5.0 | 5.8 | 6.9 | 8.0 | 9.0 | 9.4 | 9.8 | 31 |
| | 1.2 | 2.8 | 4.1 | 5.1 | 5.8 | 7.1 | 8.0 | 9.1 | 9.7 | 9.8 | 32[d] |
| | 0.2 | | | -1.5 | | | | | -5.4 | -4.5 | 36[f] |
| | -0.3 | | | 2.1 | | | | | 5.2 | 6.0 | 37[f] |
| Selected | 1.4 | 2.8 | 4.1 | 5.1 | 5.8 | 7.0 | 8.1 | 9.1 | 9.8 | 9.6 | |

Equation $\Delta_t G^\circ$ /kJ mol⁻¹ = $0.1503 \cdot \underline{w} - 0.000777 \cdot \underline{w}^2 + 0.689.10^{-6} \cdot \underline{w}^3 - 4.29.10^{-8} \cdot \underline{w}^4$

$$\sigma \, (\Delta_t G^\circ \text{ /kJ mol}^{-1}) = 0.23$$

[a] Calculated with the Cl⁻ value from ref. 32 based on the TATB assumption, weight = 1. [b] From "real" potentials, weight = 0. [c] Interpolated from data at $\underline{w}$ = 30.8, 43.8, 62.4, 76.8, and 94.1, see comment [a]. [d] Using TATB assumption, weight = 1. [e] Using the TPTB assumption, weight = 1. [f] Interpolated from data at $\underline{w}$ = 10, 20.2, 33.4, 50.0, 68.8, 90, and 100 (ref. 3), and 10.0, 43.2, 87.7, and 100 (ref. 36, 37), using extrapolation to infinite radius of X⁻ in MX series of data, weight = 0.

$\Delta_t G^\circ$ /kJ mol⁻¹, mol dm⁻³ scale, 25 °C, into methanol (S) + water (W) (cont.)

| Mass% S($\underline{w}$) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Rb⁺ | | | | | | | | | | | |
| | | | | -24.9 | -27.6 | | | -27.4 | -24.6 | -22.4 | 2[a] |
| | | 2.9 | | | 5.9 | | | | | | 3[b] |
| | | -1.7 | | | -7.5 | | | | | | 3[g] |
| | 1.5 | | | 5.3 | 6.5 | | | 9.3 | 10.1 | 10.9 | 4[c] |
| | 1.7 | 2.9 | | 4.9 | 5.9 | 6.7 | | 8.8 | | 10.3 | 6[b] |

$\Delta_t\underline{G}^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, into methanol (S) + water (W) (cont.)

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Rb^{+}** (cont.) | | | | | | | | | | | |
| | | | 3.9 | 4.6 | 5.4 | 6.4 | 7.4 | 8.6 | 10.0 | 8.8 | 13[d] |
| | 1.7 | 3.0 | 4.1 | 5.1 | 6.2 | 7.2 | 8.5 | 10.0 | | | 14[b] |
| | | 2.2 | | 5.0 | | 7.8 | | 9.3 | 9.5 | 9.3 | 20[d] |
| | 1.7 | 2.9 | | 4.9 | | 6.7 | | 9.1 | | 10.2 | 25[b] |
| | 1.4 | 2.6 | 3.7 | 4.7 | 5.7 | 6.7 | 7.9 | 9.0 | 9.8 | 10.1 | 31[f] |
| | 2.0 | 4.2 | 6.0 | 7.3 | 7.4 | 8.9 | 8.9 | 9.8 | 11.2 | | 32[e] |
| | | | | -1.7 | | | | | -5.1 | -4.5 | 36[g] |
| | -0.3 | | | 2.1 | | | | | 5.6 | 6.9 | 37[g] |
| | 1.0 | 2.1 | | 4.3 | 5.6 | 7.1 | | 11.0 | 12.9 | 14.6 | 41[h] |
| Selected | 1.6 | 3.0 | 3.9 | 5.0 | 6.0 | 7.1 | 8.2 | 9.4 | 9.7 | 9.6 | 9.6 |

Equation $\Delta_t\underline{G}^o$ /kJ mol$^{-1}$ = 0.1885$\cdot\underline{w}$ − 0.003027$\cdot\underline{w}^2$ + 46.12.10$^{-6}\cdot\underline{w}^3$ − 25.04.10$^{-8}\cdot\underline{w}^4$

$$\sigma\,(\Delta_t\underline{G}^o\,/\text{kJ mol}^{-1}) = 0.14$$

[a] From "real" potentials, interpolated from data at $\underline{w}$ = 43.1, 87.7, and 100, weight = 0. [b] Calculated with the Cl⁻ value from ref. 32 based on the TATB assumption, weight = 1. [c] Interpolated from data at $\underline{w}$ = 10, 43.1, 87.8, and 100, and calculated with the value for K⁺ from ref. 32, based on the TATB assumption, weight = 1. [d] Interpolated from data at $\underline{w}$ = 30.8, 54.2, 73.9, 86.8, and 100, see comment [b]. [e] Using the TATB assumption, weight = 1. [f] Using the TPTB assumption, weight = 1. [g] From interpolation of data at $\underline{w}$ = 10.0, 43.2, 87.7 and 100, using extrapolation to infinite radius of X⁻ in series of MX of data, weight = 0. [h] From "Owen extrapolation", neglecting liquid junction potential, weight = 0.

| Cs^{+} | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | -24.9 | -27.6 | | | -27.5 | -24.7 | -22.4 | 2[a] |
| | 1.8 | 3.2 | | | 5.8 | | | 8.7 | | | 3[b] |
| | -1.0 | -1.5 | | | -7.6 | | | | | | 3[h] |
| | 1.2 | | | 4.2 | 5.2 | | | 8.1 | 9.1 | 10.8 | 4[c] |
| | 1.5 | 2.7 | | 4.5 | 5.3 | 6.1 | | 8.2 | | | 6[b] |
| | | | | 4.5 | 5.6 | 6.6 | 7.7 | 8.7 | 9.7 | 10.6 | 13[d] |
| | | 2.3 | | 5.0 | | 6.4 | | 8.0 | 8.6 | 8.7 | 20[e] |
| | 1.3 | 3.1 | 5.4 | 8.0 | | | | | | | 23[f] |
| | 1.6 | 2.6 | | 4.5 | | 6.1 | | 8.6 | | | 25[a] |
| | 1.2 | 2.3 | 3.4 | 4.3 | 5.2 | 6.1 | 7.3 | 8.5 | 9.1 | 9.5 | 31[g] |
| | 1.9 | 4.0 | 4.6 | 5.4 | 6.5 | 6.5 | 8.1 | 8.7 | 9.8 | 10.3 | 32[e] |
| | | | | -1.6 | | | | | -5.0 | -4.8 | 36[h] |
| | -0.3 | | | 1.7 | | | | | 3.9 | 6.4 | 37[h] |
| Selected | 1.6 | 2.7 | 3.6 | 4.6 | 5.5 | 6.2 | 7.5 | 8.5 | 9.0 | 8.9 | |

Equation $\Delta_t\underline{G}^o$ /kJ mol$^{-1}$ = 0.1932$\cdot\underline{w}$ − 0.003984$\cdot\underline{w}^2$ + 62.79.10$^{-6}\cdot\underline{w}^3$ − 33.37.10$^{-8}\cdot\underline{w}^4$

$$\sigma\,(\Delta_t\underline{G}^o\,/\text{kJ mol}^{-1}) = 0.06$$

$\Delta_t\underline{G}^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, into methanol (S) + water (W) (cont.)

| Mass% S($\underline{w}$) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $NH_4^+$ | | | | | | | | | | | |
| | 1.5 | 1.8 | 2.2 | 2.7 | 3.2 | 3.8 | 4.5 | 5.3 | 6.1 | 11.3 | 15[a] |
| | | | | | | | | | | 5 | 40[b] |

[a] Interpolated from values for $NH_4I$ at $\underline{w}$ = 16.5, 30.5, 43.1, 51.3, 61.7, 66.5, 74.7, 80.4, 87.7, 94.1, and 100, using the interpolated $\Delta_t\underline{G}^o$ ($I^-$) data from ref. 9 based on the TATB assumption.  [b] Tentative value.

| $(CH_3)_4N^+$ | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.9 | | | 2.1 | 2.8 | | | 5.5 | 6.6 | 8.3 | 4[a] |
| | 0.9 | 0.9 | 1.2 | 1.8 | 2.1 | 2.7 | 3.6 | 4.8 | 5.7 | 7.0 | 31[b] |
| | 0.1 | | | 1.0 | | | | | 2.2 | 4.3 | 37[c] |
| | | | | | | | | | | 6 | 40[d] |

[a] Interpolated from values for $(CH_3)_4NClO_4$ at $\underline{w}$ = 10, 43.1, 87.7, and 100, using the interpolated $\Delta_t\underline{G}^o$ ($K^+$) data from ref. 32 based on the TATB assumption. [b] Using the TPTB assumption. [c] From interpolation in data at $\underline{w}$ = 10.0, 43.2, 87.7, and 100, using extrapolation to infinite radius of $X^-$ in series of MX data. [d] Selected value.

| $(C_2H_5)_4N^+$ | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -1.2 | | | -2.2 | | | | | -4.0 | -5.3 | 37[a] |
| | | | | | | | | | | 1 | 40[b] |

[a] Interpolated from values at $\underline{w}$ = 10, 43.1, 87.7, and 100 for the ferricinium ion, which has the same radius as the $(CH_2H_5)_4N^+$ ion, using extrapolation to infinite radius of $X^-$ in a series of MX data, weight = 0.  [d] Selected value.

| $(C_3H_7)_4N^+$ | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -0.9 | | | -3.7 | -4.6 | | | -7.0 | -7.8 | -7.9 | 4[a] |
| | -0.9 | -2.9 | -3.3 | -3.9 | -4.9 | -5.9 | -6.6 | -7.5 | -9.1 | -8.7 | 31[b] |
| | -1.6 | | | -5.1 | | | | | -12.8 | -12.0 | 37[c] |

[a] Interpolated from values for $(CH_3H_7)_4NClO_4$ at $\underline{w}$ = 10, 43.1, 87.7, and 100, using the interpolated $\Delta_t\underline{G}^o$ ($K^+$) data from ref. 32 based on the TATB assumption. [b] Using the TPTB assumption. [c] From interpolation in data at $\underline{w}$ = 10.0, 43.2, 87.7, and 100, using extrapolation to infinite radius of $X^-$ in a series of MX data, weight = 0.

| $(C_4H_9)_4N^+$ | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -1.4 | | | -6.2 | -8.1 | | | | | | 4[a] |
| | -1.4 | -3.1 | -4.8 | -6.6 | -8.8 | -11.1 | -13.2 | -15.6 | -18.9 | -21.9 | 31[b] |
| | -2.4 | | | -7.6 | | | | | | -21 | 40[d] |

[a] Interpolated from values for $(C_4H_9)_4NClO_4$ at $\underline{w}$ = 10, and 43.1, using the interpolated $\Delta_t G^o$ ($K^+$) data from ref. 32 based on the TATB assumption. [b] Using the TPTB assumption. [c] From interpolation in data at $\underline{w}$ = 10, 43.1, 87.7, and 100, using extrapolation to infinite radius of $X^-$ in a series of MX data, weight = 0. [d] Selected value.

$\Delta_t G^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, into methanol (S) + water (W) (cont.)

| Mass% S($\underline{w}$) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $(C_6H_5)_4P^+$ | | | | | | | | | | | |
| | -2.0 | -5.9 | -9.5 | -12.6 | -15.2 | -17.5 | -19.3 | -20.7 | -21.7 | -22.3 | 21[a] |
| | -2.5 | -4.9 | -7.8 | -11.2 | -13.9 | -16.5 | -18.6 | -20.5 | -21.6 | -22.6 | 31[a] |

[a] Using the TPTB assumption.

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $(C_6H_5)_4As^+$ | | | | | | | | | | | |
| | | -11.2 | | -18.5 | | -23.3 | -24.7 | -25.5 | | -25.9 | 12[a] |
| | -2.0 | -4.6 | | -9.6 | | -14.2 | | -18.8 | -20.7 | -22.0 | 17[b] |
| | -2.3 | -4.7 | -7.6 | -10.8 | -13.9 | -16.3 | -18.6 | -20.2 | -22.0 | -23.1 | 32[c] |
| Selected | -2.3 | -4.7 | -7.6 | -10.8 | -13.9 | -16.2 | -18.5 | -20.1 | -21.8 | -22.8 | |

Equation $\Delta_t G^o$ /kJ mol$^{-1}$ = $-.1946.\underline{w} - 0.003285.\underline{w}^2 + 42.57.10^{-6}.\underline{w}^3 - 13.91.10^{-8}.\underline{w}^4$

$$\sigma\,(\Delta_t G^o \text{ /kJ mol}^{-1}) = 0.34$$

[a] Interpolated from vapor pressure data at $\underline{w}$ = 19.5, 39.7, 64.0, 70.7, 79.8, and 100, using the TATB assumption, weight = 0. [b] Using the TATB assumption, weight = 0.1. [c] Using the TATB assumption, weight = 1.

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $Ag^+$ | | | | | | | | | | | |
| | 1.1 | 1.8 | 2.7 | 3.5 | 4.5 | 5.4 | | | | | 5[a] |
| | 1.3 | 2.3 | | 3.6 | | | | | | | 8[b] |
| | 0.8 | 1.4 | 2.3 | 3.3 | 4.1 | 4.9 | 5.7 | 6.4 | 6.9 | 7.4 | 31[c] |
| | 0.9 | 1.4 | 2.2 | 3.2 | 4.5 | | | | | | 33[c] |
| | | | 1.6 | 2.1 | 2.9 | | 5.7 | | | 10.8 | 41[d] |
| Selected | 1.0 | 1.6 | 2.5 | 3.5 | 4.3 | 5.1 | 5.7 | 6.4 | 6.9 | 6.6 | |

Equation $\Delta_t G^o$ /kJ mol$^{-1}$ = $0.1086.\underline{w} - 0.001592.\underline{w}^2 + 32.05.10^{-6}.\underline{w}^3 - 20.44.10^{-8}.\underline{w}^4$

$$\sigma\,(\Delta_t G^o \text{ /kJ mol}^{-1}) = 0.22$$

[a] Interpolated from data for AgCl at $\underline{w}$ = 9.5, 19.8, 34.4, 42.1, and 54.2, using the $\Delta_t G^o$ ($Cl^-$) data from ref. 32 based on the TATB assumption, weight = 0.5. [b] Using the $\Delta_t G^o_{tr}$ ($Cl^-$) data from ref. 32, based on the TATB assumption, Weight = 0.5. [c] Using the TPTB assumption. [d] From "Owen extrapolation", neglecting liquid junction potential.

$\Delta_t G^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, into methanol (S) + water (W) (cont.)

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tl$^+$** | | | | | | | | | | | |
| | 2.3 | 3.3 | 4.0 | 4.6 | 5.0 | 5.2 | 5.3 | 5.1 | 4.8 | 4.2 | 33[a] |
| | | | | | | | | | | 4.1 | 40[b] |
| | | | 3.2 | | | | | 9.3 | 10.2 | 11.2 | 41[c] |

[a] Using the TPTB assumption. [b] Selected value. [c] From "Owen extrapolation", neglecting liquid junction potential.

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ca$^{2+}$** | | | | | | | | | | | |
| | 2.3 | 4.0 | | | | | | | | | 33[a] |

[a] Interpolated from data w = 4.7, 9.5, and 14.5, using the TPTB assumption.

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sr$^{2+}$** | | | | | | | | | | | |
| | | 1.9 | | | | | | | | | 8[a] |
| | 2.3 | 4.4 | 6.1 | | | | | | | | 31[b] |
| | | 5.7 | 7.7 | | | | | | | | 33[c] |

[a] Using the $\Delta_t G^o$ (Cl$^-$) data from ref. 32, based on the TATB assumption. [b] Using the TPTB assumption. [c] Interpolated from data at w = 16.5 and 34.4, using the TPTB assumption.

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ba$^{2+}$** | | | | | | | | | | | |
| | 1.4 | 1.9 | 1.8 | | | | | | | | 8[a] |
| | 2.4 | 4.5 | 6.3 | 8.2 | | | | | 18.4 | | 31[b] |
| | 2.7 | 5.5 | | | | | | | | | 33[c] |

[a] Using the $\Delta_t G^o$ (Cl$^-$) data from ref. 32, based on the TATB assumption. [b] Using the TPTB assumption. [c] Interpolated from data at w = 16.5 and 34.4, using the TPTB assumption.

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cu$^{2+}$** | | | | | | | | | | | |
| | 0.5 | 0.8 | 1.5 | 2.6 | 4.1 | 6.1 | 8.4 | 11.1 | 14.3 | 25.9 | 24[a] |
| | 1.6 | 2.3 | 3.2 | 4.8 | 6.5 | 8.6 | 10.9 | 14.1 | 19.0 | 30.9 | 30[a] |
| | | | 1.4 | 3.0 | | | | | | | 33[b] |
| | | | | | | | | | | 26 | 40[c] |

[a] Using the negligible liquid junction potential assumption. [b] Interpolated from data at w = 16.5 and 34..4, using the TPTB assumption. [c] Tentative value.

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Zn$^{2+}$** | | | | | | | | | | | |
| | 1.0 | 1.3 | | | | | | | | | 8[a] |
| | 2.0 | 3.7 | 5.5 | | 8.2 | | 10.7 | | | | 18[b] |
| | 1.7 | 3.5 | 5.9 | 7.8 | 9.5 | 11.2 | 13.4 | | 27.6 | | 31[b] |

[a] Using the $\Delta_t G^o$ (Cl$^-$) data from ref. 32, based on the TATB assumption. [b] Using the TPTB assumption.

$\Delta_t G^\circ$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, into methanol (S) + water (W) (cont.)

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cd$^{2+}$** | | | | | | | | | | | |
| | | 1.0 | 1.3 | 0.7 | | | | | | | 8[a] |
| | | 1.7 | 3.2 | 4.6 | 5.9 | | | | | 32.6 | 31[b] |

[a] Using the $\Delta_t G^\circ$ (Cl$^-$) data from ref. 32, based on the TATB assumption. [b] Using the TPTB assumption.

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Hg$^{2+}$** | | | | | | | | | | | |
| | | 7.9 | 15.0 | 21.2 | 26.7 | | | | | | 23[a] |

[a] Interpolated from data at $\underline{w}$ = 8.1, 16.5, 25.3, and 34.4, using the TATB assumption with $\Delta_t G^\circ$ (C$_6$H$_5$)$_4$B$^-$) from ref. 32.

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pb$^{2+}$** | | | | | | | | | | | |
| | | 2.8 | 4.8 | 6.3 | 7.2 | 7.5 | | | | | 33[a] |

[a] Interpolated from data at $\underline{w}$ =16.5, 34.4, and 54.2, using the TATB assumption.

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **La$^{3+}$** | | | | | | | | | | | |
| | | 4.0 | 7.3 | | | | | | | | 33[a] |

[a] Interpolated from data at $\underline{w}$ = 4.7, 9.5, and 14.5, using the TPTB assumption.

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **OH$^-$** | | | | | | | | | | | |
| | 2.7 | 5.5 | 8.2 | 11.0 | 13.7 | 16.4 | 19.2 | 21.9 | 24.6 | 27.4 | 7[a] |
| | | | | 7.9 | | 10.0 | 10.7 | 11.2 | | 12.6 | 12[b] |
| | -0.1 | -0.2 | -0.1 | 0.2 | 1.1 | 2.7 | 4.8 | 7.5 | 9.8 | 12.5 | 31[c] |

[a] Assuming proportionality of $\Delta_t G^\circ$ (OH$^-$) with the mole fraction of S. [b] Interpolated from vapor pressure data at $\underline{w}$ = 39.7, 64.0, 70.7, 79.8, and 100, using the TATB assumption. [c] Using the TPTB assumption.

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CH$_3$O$^-$** | | | | | | | | | | | |
| | 2.4 | 4.8 | 7.2 | 9.6 | 12.0 | 14.5 | 16.9 | 19.3 | 21.7 | 24.1 | 7[a] |
| | 0.0 | -0.1 | 0.0 | 0.4 | 1.0 | 1.5 | 2.4 | 2.4 | 4.9 | 6.4 | 31[b] |

[a] Assuming proportionality of $\Delta_t G^\circ$ (CH$_3$O$^-$) with the mole fraction of S. [b] Using the TPTB assumption.

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **F$^-$** | | | | | | | | | | | |
| | | | 6.1 | 8.9 | 12.0 | 15.4 | | | | | 10[a] |
| | | | 2.8 | 4.4 | 6.1 | 8.0 | 10.1 | 12.4 | 14.8 | 17.5 | 13[b] |
| | 0.8 | 2.0 | 3.1 | 4.6 | 6.3 | 8.3 | 10.2 | 12.7 | 15.9 | 20.8 | 31[c] |
| | | | | | | | | | | 16 | 40[d] |

[a] Interpolated from data at $\underline{w}$ = 33.4, 40.0, 43.1, and 50.0, using an assumption concerning the electrostatic $\Delta_t G^\circ$ and activity coefficients of indicators. [b] Interpolated from data at $\underline{w}$ = 30.8, 54.2, 73.9, 86.8, and 100, differences between $\Delta_t G^\circ$ of alkali metal fluorides and chlorides, and $\Delta_t G^\circ$ (Cl$^-$) from ref. 32, based on the TATB assumption. [c] Using the TPTB assumption. [d] Selected value.

$\Delta_t G^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, into methanol (S) + water (W) (cont.)

**Cl⁻**

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 20.1 | 28.6 | 32.4 | 35.2 | 37.5 | 39.7 | 41.6 | 43.6 | 45.6 | 47.4 | 2[a] |
| | -2.8 | 5.3 | 9.0 | | 17.0 | | 25.1 | | 33.8 | 35.9 | 3[h] |
| | 24.0 | 27.8 | 31.4 | 34.5 | 37.3 | 39.8 | 41.9 | 43.7 | 45.1 | 47.1 | 11[a] |
| | | 4.9 | | 8.4 | | 11.0 | 11.8 | 12.4 | | 12.9 | 12[b] |
| | 0.2 | 0.5 | 1.5 | 2.5 | 3.8 | 5.1 | 6.6 | 8.4 | 8.6 | | 19[c] |
| | 0.8 | 1.6 | | 3.0 | | 5.0 | | 8.2 | | 12.3 | 20[d] |
| | -0.8 | -0.6 | 0.7 | | | | | | | | 22[e] |
| | -0.2 | 0.4 | 1.4 | 2.1 | 3.2 | 4.7 | 6.0 | 8.3 | 10.5 | 12.8 | 28[e] |
| | 0.4 | 1.1 | 1.7 | 2.6 | 3.8 | 5.1 | 6.6 | 8.4 | 10.8 | 13.4 | 31[f] |
| | 0.2 | 0.4 | 1.5 | 2.5 | 3.9 | 5.2 | 6.6 | 8.4 | 10.7 | 13.4 | 32[g] |
| | 0.6 | 1.0 | 1.6 | 2.5 | 3.6 | 5.1 | 6.7 | 8.6 | 10.8 | 13.3 | 33[f] |
| | 2.0 | | | 9.4 | | | | | 27.5 | 33.1 | 36[h] |
| | 1.7 | | | 5.7 | | | | | 16.2 | 20.7 | 37[h] |
| | | | | | | | | | | 13.2 | 40[i] |
| | 0.8 | 1.5 | 2.2 | 3.0 | 3.4 | | | 6.2 | 7.1 | 8.2 | 41[j] |
| Selected | 0.2 | 0.8 | 1.5 | 2.5 | 3.6 | 5.0 | 6.5 | 8.4 | 10.7 | 13.2 | |

Equation $\Delta_t G^o$ /kJ mol$^{-1}$ = $0.0019 \cdot w + 0.002131 \cdot w^2 - 20.08 \cdot 10^{-6} \cdot w^3 + 11.87 \cdot 10^{-8} \cdot w^4$

$$\sigma(\Delta_t G^o \text{ /kJ mol}^{-1}) = 0.07$$

[a] From "real" potentials, weight = 0.   [b] From vapor pressure data at w = 19.5, 30.9, 64.0, 70.7, 79.8, and 100, using the TATB assumption, weight = 0.   [c] From data for HCl and the value of $\Delta_t G^o$ (H⁺) from ref. 32, based on the TATB assumption.   [d] Using the TATB assumption, weight = 1.   [e] Using the value of $\Delta_t G^o$ (K⁺) from ref. 32 based on the TATB assumption, weight = 0.   [f] Using the TPTB assumption, weight = 1.   [g] Using the TATB assumption, weight = 1.   [h] Interpolation of data at w = 10, 20.2, 33.4, 50, 68.3, 90, and 100 (ref. 3) or 10, 43.1, 87.7, and 100 (ref. 36, 37), based on extrapolation of series of data for MX to infinite radius of M⁺, weight = 0.   [i] Selected value.   [j] From "Owen extrapolation", neglecting the liquid junction potential, weight = 0.

**Br⁻**

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 19.9 | | | 33.3 | 36.6 | | | 43.0 | 44.0 | 44.9 | 2[a] |
| | -1.6 | 4.8 | 8.3 | | 15.6 | | 23.4 | | 31.8 | 37.9 | 3[f] |
| | -0.5 | -0.3 | 0.1 | 0.8 | 1.7 | 2.9 | | | | | 5[b] |
| | -0.1 | 0.1 | | 1.4 | | 3.6 | | 6.7 | | 11.0 | 6[c] |
| | -0.1 | 0.2 | 0.7 | 1.4 | 2.3 | 3.6 | | 6.7 | 8.8 | 10.7 | 9[c] |
| | -0.2 | -0.1 | 0.7 | 1.5 | 2.6 | 3.7 | 5.0 | 7.0 | 6.6 | | 19[d] |
| | -0.1 | 0.2 | | 1.4 | | 3.6 | | 6.7 | | 10.8 | 25[c] |

$\Delta_t G°$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, into methanol (S) + water (W) (cont.)

| Mass% S($\underline{w}$) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Br⁻** (cont.) | | | | | | | | | | | |
| | 0.1 | 0.5 | 0.9 | 1.6 | 2.6 | 3.6 | 4.9 | 7.0 | 8.9 | 11.2 | 31[e] |
| | 1.7 | | | 8.4 | | | | | 25.3 | 30.9 | 36[f] |
| | 1.3 | | | 8.4 | | | | | 14.1 | 18.2 | 37[f] |
| | | 1.3 | 2.0 | | | 4.0 | | 5.2 | 6.0 | 6.7 | 41[g] |
| Selected | -0.1 | 0.1 | 0.7 | 1.4 | 2.4 | 3.6 | 4.9 | 6.8 | 8.8 | 11.1 | |

Equation $\Delta_t\underline{G}°$ /kJ mol$^{-1}$ = $-.0297.\underline{w} + .002056.\underline{w}^2 - 13.84.10^{-6}.\underline{w}^3 + 7.40.10^{-8}.\underline{w}^4$

$$\sigma\,(\Delta_t\underline{G}° \text{ /kJ mol}^{-1}) = 0.06$$

[a] Interpolated from "real" potential data at $\underline{w}$ = 10.0, 43.1, 87.7, and 100, weight = 0. [b] From data for AgBr and AgCl and the value of $\Delta_t\underline{G}°$ (Cl⁻) from ref. 32, based on the TATB assumption. [d] Using the TATB assumption, weight = 1. [e] Using the value of $\Delta_t\underline{G}°$ (K⁺) from ref. 32 based on the TATB assumption, weight = 1. [c] From data for HX and NaX (X = Cl or Br) and the value of $\Delta_t\underline{G}°_{tr}$ (Cl⁻) from ref. 32, based on the TATB assumption, weight = 1. [d] From data for HBr and HCl and the value of $\Delta_t\underline{G}°$ (Cl⁻) from ref. 32, based on the TATB assumption, weight = 1. [e] Using the TPTB assumption, weight = 1. [f] Interpolated from data at $\underline{w}$ = 10, 20.2, 33.4, 50, 68.8, 90, and 100 (ref. 3) or 10, 43.1, 87.7, and 100 (ref. 36, 37), based on extrapolation of series of data for MX to infinite radius of M⁺, weight = 0. [g] From "Owen extrapolation" of emf data, neglecting the liquid junction potential, weight = 0.

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **I⁻** | | | | | | | | | | | |
| | 19.6 | | | 31.5 | 34.3 | | | 39.5 | 40.1 | 41.0 | 2[a] |
| | -1.8 | 4.4 | 7.3 | | 13.7 | | 20.6 | | 39.9 | 29.4 | 3[f] |
| | 0.2 | | | 1.2 | | | | | | | 5[b] |
| | -0.3 | -0.4 | | -0.3 | | 1.2 | | 3.4 | | 6.7 | 6[c] |
| | -0.4 | -0.4 | -0.3 | -0.2 | 0.3 | 1.2 | | 3.4 | 5.0 | 7.1 | 9[c] |
| | -0.4 | -0.7 | -0.1 | 0.3 | 1.2 | 1.7 | 2.2 | 3.6 | 3.6 | | 19[d] |
| | -0.1 | -0.4 | | -0.2 | | 1.2 | | 3.4 | | 7.1 | 25[b] |
| | -0.2 | -0.1 | 0.0 | 0.4 | 1.0 | 1.6 | 2.2 | 3.9 | 5.7 | 6.9 | 31[e] |
| | 1.5 | | | 6.7 | | | | | 21.2 | 26.6 | 36[f] |
| | 0.9 | | | 3.0 | | | | | 9.9 | 14.0 | 37[f] |
| | | | | | | | | | | 7.3 | 40[g] |
| | | | 0.7 | | 1.5 | | | 3.0 | | | 41[h] |
| Selected | -0.3 | -0.4 | -0.1 | 0.0 | 0.9 | 1.4 | 2.2 | 3.5 | 5.4 | 7.3 | |

Equation $\Delta_t\underline{G}°$ /kJ mol$^{-1}$ = $-.0467.\underline{w} + .001735.\underline{w}^2 - 15.79.10^{-6}.\underline{w}^3 + 10.49.10^{-8}.\underline{w}^4$

$$\sigma\,(\Delta_t\underline{G}° \text{ /kJ mol}^{-1}) = 0.15$$

[a] Interpolated from "real" potential data at $\underline{w}$ = 10.0, 43.1, 87.7, and 100, weight = 0. [b] With $\Delta_t\underline{G}°$ (Cl⁻) from ref. 32, using the TATB assumption, weight = 1. [c] Using data for HI and NaI, in refs. 6 and 9, respectively, see comment [b]. [d] With

$\Delta_t G^o$ (H+) from ref. 32, using the TATB assumption, weight = 1. [e] Using the TPTB assumption, weight = 1. [f] Interpolation of data at w = 10, 20.2, 33.4, 50, 68.3, 90, and 100 (ref. 3) or 10, 43.1, 87.7, and 100 (ref. 36, 37), based on extrapolation of series of data for MX to infinite radius of M+, weight = 0. [g] Selected value. [h] From "Owen extrapolation", neglecting the liquid junction potential, weight = 0.

$\Delta_t G^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, into methanol (S) + water (W) (cont.)

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CN$^-$** | | | | | | | | | | | |
| | | -1.1 | -2.0 | -2.7 | -3.0 | | | | | | 22[a] |
| | -1.1 | -1.8 | -2.6 | -2.6 | -2.0 | -1.1 | 0.2 | 1.8 | 4.7 | 8.7 | 31[b] |
| | -0.8 | -2.0 | -2.5 | -2.9 | -1.9 | -1.1 | 0.4 | 2.3 | 5.0 | 9.0 | 42[a] |

[a] Using the value of $\Delta_t G^o$ (K+) from ref. 32, based on the TATB assumption. [b] Using the TPTB assumption.

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SCN$^-$** | | | | | | | | | | | |
| | 0.6 | 0.9 | 0.2 | 1.0 | | | | | 4.4 | | 26[a] |
| | -1.4 | -1.8 | -1.8 | -2.2 | | | | | | | 27[b] |
| | -1.4 | -1.8 | | | | | | | | | 29[a] |
| | -0.5 | -0.7 | -1.1 | -1.1 | | | | | 5.6 | | 31[c] |
| | -0.6 | -0.9 | -1.0 | -0.7 | 0.0 | 1.0 | 2.3 | 4.0 | | | 33[c] |

[a] Using the selected values of $\Delta_t G^o$ (Ag+) from the present work, based on the TATB assumption. [b] Using the values of $\Delta_t G^o$ (H+) from ref. 32, based on the TATB assumption. [c] Using the TPTB assumption.

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **N$_3^-$** | | | | | | | | | | | |
| | | 3.5 | | 6.7 | | 9.8 | 11.8 | | 13.0 | 16.5 | 12[a] |

[a] Interpolated from data at w = 19.5, 39.7, 70.7, 79.8 and 100, using the TATB assumption.

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **BrO$_3^-$** | | | | | | | | | | | |
| | | 1.1 | 2.2 | 3.1 | 4.0 | 4.7 | | | | | 33[a] |

[a] Interpolated from data at w = 8.1, 16.5, 25.3, 34.4 and 44.1 using the TPTB assumption.

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **IO$_3^-$** | | | | | | | | | | | |
| | | 1.2 | 2.6 | 4.3 | 6.1 | 8.2 | | | | | 33[a] |

[a] Interpolated from data at w = 8.1, 16.5, 25.3, 34.4 and 44.1 using the TPTB assumption.

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **ClO$_4^-$** | | | | | | | | | | | |
| | | -0.1 | | | -0.2 | | | | 4.8 | 7.0 | 4[a] |
| | 0.0 | 0.1 | 0.0 | -0.2 | 0.1 | 0.6 | 1.3 | 2.3 | 4.4 | 6.3 | 31[b] |
| | -0.2 | -0.4 | -0.4 | -0.2 | 0.2 | 0.9 | 1.7 | 2.8 | 4.1 | 5.7 | 33[b] |

$\Delta_t G^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, into methanol (S) + water (W) (cont.)

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ClO$_4$$^-$ (cont.) | | | | | | | | | | | |
| | 0.9 | | | 2.6 | | | | | 8.1 | 9.8 | 37[c] |
| | | | | | | | | | | 6.1 | 40[d] |

[a] Interpolated from data at w = 10.0, 42.1, 87.7, and 100 using the value of $\Delta_t G^o$ (K$^+$) from ref. 32, based on the TATB assumption. [b] Using the TPTB assumption. [c] Interpolated from data at w= 10, 43.1, 87.7, and 100, based on extrapolation of a series of data on MX to infinite radius of M$^+$. [d] Selected value.

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ReO$_4$$^-$ | -0.4 | -0.8 | -1.3 | -1.7 | | | | | | | 31[a] |
| | | | | | | | | | | 9.4 | 37[b] |

[a] Using the TPTB assumption. [b] Based on extrapolation of data for a series of MX to infinite radius of M$^+$.

| C$_6$H$_3$(NO$_2$)$_3$OH$^-$ (picrate) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.0 | -0.5 | | -2.8 | | -4.0 | | -5.2 | -5.2 | -5.2 | 17[a] |
| | 0.0 | -1.1 | -2.1 | -2.9 | -3.4 | -3.8 | -3.9 | -3.8 | -3.5 | -3.0 | 21[a] |
| | -0.2 | -0.8 | -1.8 | -2.6 | -3.2 | -3.6 | -3.8 | -3.6 | -3.6 | -3.1 | 31[b] |
| | 0.0 | -0.8 | -1.7 | -2.5 | -3.0 | -3.5 | -3.7 | -4.0 | -3.6 | -3.2 | 32[a] |
| Selected | 0.0 | -0.8 | -1.9 | -2.7 | -3.2 | -3.7 | -3.8 | -4.2 | -4.0 | -3.6 | |

[a] Using the TATB assumption. [b] Using the TPTB assumption.

| SO$_4$$^{2-}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3.7 | 7.1 | 10.0 | 12.5 | | | | | | | 22[a] |

[a] Using $\Delta_t G^o$ (K$^+$) from ref. 32, based on the TATB assumption.

| S$_2$O$_8$$^{2-}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.4 | 1.0 | 2.0 | 3.3 | | | | | | | 22[a] |

[a] Using $\Delta_t G^o$ (K$^+$) from ref. 32, based on the TATB assumption.

| Fe(CN)$_6$$^{3-}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -2.5 | -3.8 | -4.6 | 0.0 | 0.0 | 2.9 | 8.4 | 15.9 | 27.6 | 44.4 | 31[a] |

[a] Using the TPTB assumption.

| B(C$_6$H$_5$)$_4$$^-$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -11.2 | | -18.5 | | -23.3 | -24.7 | -25.5 | | -25.9 | 12[a] |
| | -2.0 | -4.6 | | -9.6 | | -14.2 | | -18.8 | -20.7 | -22.0 | 17[b] |
| | -2.3 | -4.7 | -7.6 | -10.8 | -13.9 | -16.3 | -18.6 | -20.2 | -22.2 | -23.1 | 32[c] |
| Selected | -2.3 | -4.7 | -7.6 | -10.8 | -13.9 | -16.2 | -18.5 | -20.1 | -21.8 | -22.8 | |

Equation $\Delta_t G^o$ /kJ mol$^{-1}$ = $-.1946 w - .003285 w^2 + 42.57 \cdot 10^{-6} w^3 - 13.91 \cdot 10^{-8} w^4$

$$\sigma\,(\Delta_t G^o \text{ /kJ mol}^{-1}) = 0.34$$

[a] Interpolated from vapor pressure data at $\overline{w}$= 19.5, 39.7, 64.0, 70.7, 79.8, and 100, using the TATB assumption, weight = 0.  [b] Using the TPTB assumption, weight = 0.1.  [c] Using the TATB assumption, weight = 1.

Table 2

## TRANSFER INTO METHANOL + WATER MIXTURES – REFERENCES

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Table 3. Standard molar Gibbs energies of transfer of ions from water into mixtures of ethanol (S) and water (W) at 25°C

**Selected values**

| Mass% S | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| HCl | 0.9 | 1.7 | 2.3 | 3.2 | 5.1 | 5.4 | 7.3 | 9.9 | 14.1 | 30.3 |
| $H^+$ | 0.3 | 0.1 | -1.1 | -1.6 | -4.0 | -4.7 | -4.7 | -3.5 | -2.3 | 10.5 |
| $K^+$ | 1.3 | 2.6 | 3.1 | 4.2 | 4.2 | 4.6 | 5.4 | 8.3 | 12.7 | 16.4 |
| $Ph_4As^{+a}$ | -2.4 | -5.6 | -9.8 | -13.9 | -16.3 | -18.5 | -19.0 | -19.8 | -20.8 | -21.2 |
| $Cl^-$ | 0.4 | 1.2 | 2.6 | 4.8 | 7.4 | 9.4 | 11.7 | 13.3 | 15.8 | 20.2 |
| $Br^-$ | 0 | 0.5 | 2 | 3 | 5 | 7 | 9 | 9 | 10 | 18 |
| $BPh_4^-$ | -2.4 | -5.6 | -9.8 | -13.9 | -16.3 | -18.5 | -19.0 | -19.8 | -20.8 | -21.2 |

[a] Assumed to be the same as for $Ph_4P^+$

$\Delta_t G^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, into ethanol (S) • water (W) (cont.)

| Mass% S($\underline{w}$) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HCl | | | | | 5.3 | | 7.8 | 8.4 | 12.6 | 27.4 | 1 |
| | | 2.43 | 3.97 | | 7.11 | | 10.94 | 13.79 | 17.87 | 29.78 | 2 |
| | 0.80 | 1.61 | | | | | | | | | 3 |
| | 0.89 | 1.70 | | | | | 7.2 | | | 29.77 | 6 |
| | | 1.41 | 2.20 | 3.13 | 4.26 | 5.64 | 7.34 | | | | 5 |
| | 0.89 | 1.71 | | | | | 8.54 | 12.26 | | | 7 |
| | | 1.65 | | 3.17 | | 5.28 | 7.49 | | 13.59 | | 8 |
| | 0.81 | | | | 4.00 | 5.27 | 7.44 | 9.93 | 14.03 | | 9 |
| | 0.9 | 1.7 | 2.5 | 3.2 | 4.2 | 5.2 | 7.3 | 9.9 | 13.7 | 30.5 | 14 |
| | 0.80 | 1.60 | 2.23 | 2.97 | 3.88 | 5.20 | 6.96 | 9.42 | | | 21 |
| | 0.89 | 1.67 | | 3.19 | | | | | | | 24 |
| | 0.88 | 1.67 | 2.39 | 3.17 | 4.13 | 5.65 | 7.61 | 10.44 | 15.00 | 21.32 | 29 |
| | 1.7 | | | 5.7 | | | | | | 31.3 | 31 |
| Selected | 0.9 | 1.7 | 2.3 | 3.2 | 4.1 | 5.4 | 7.3 | 9.9 | 14.1 | 30.3 | |

Equation $\Delta_t \underline{G}^o$ /kJ mol$^{-1}$ = $0.0538.\underline{w} + 0.003882.\underline{w}^2 - 121.7.10^{-6}.\underline{w}^3 + 105.9.10^{-8}.\underline{w}^4$

$\sigma (\Delta_t \underline{G}^o$ /kJ mol$^{-1}$) = 0.85

$\Delta_t G^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, into ethanol (S) + water (W) (cont.)

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| H⁺ | | | | | | | | | | | |
| | | | | | | | | | 2 | 14.3 | 1[a] |
| | | 1.2 | 1.4 | | -0.3 | | -0.8 | -1.0 | -0.4 | 9.5 | 2[b] |
| | 0.4 | 0.4 | | | | | | | | | 3[b] |
| | | | 0.0 | 0.0 | 0.5 | 1.4 | 2.8 | 4.4 | 6.6 | 26.9 | 4[c] |
| | 0.5 | 0.5 | | -1.5 | | -4.2 | | -3.6 | -2.9 | 10.2 | 11[d] |
| | -0.3 | -1.3 | -2.7 | -4.4 | -5.5 | -6.2 | -5.2 | -3.8 | -2.4 | 11.2 | 14[e] |
| | | -0.6 | | | -2.2 | | -4.0 | | | 8.5 | 15[f] |
| | 0.5 | 0.5 | -0.2 | -1.6 | -3.2 | -4.2 | -4.5 | -3.3 | -2.1 | 10.2 | 16[g] |
| | -0.8 | -2.6 | -3.6 | -5.4 | -6.3 | -6.7 | -7.6 | -8.4 | -8.1 | 1.0 | 17[h] |
| | -2.9 | -4.8 | -6.3 | -7.1 | -7.6 | -7.6 | -7.5 | -6.8 | -3.9 | 10.1 | 18[i] |
| | -3.6 | -6.6 | -12.3 | | -20.3 | | | | | | 23[j] |
| | -14.6 | | | -0.7 | | -0.9 | | 0.7 | 3.4 | 18.5 | 25[k] |
| | -1.9 | -4.7 | -7.5 | -8.7 | -8.8 | -8.3 | | | | | 35[m] |
| | 0.5 | 0.5 | -0.3 | -1.6 | -3.3 | -4.0 | -4.3 | -3.4 | -1.7 | 10.0 | [n] |
| Selected | 0.3 | 0.1 | -1.1 | -1.6 | -4.0 | -4.7 | -4.7 | -3.5 | -2.3 | 10.5 | |

Equation $\Delta_t G^o$ /kJ mol$^{-1}$ = $0.050 \cdot w - 0.000072 \cdot w^2 - 97.3 \cdot 10^{-6} \cdot w^3 + 102.41 \cdot 10^{-8} \cdot w^4$

$$\sigma\,(\Delta_t G^o\ /\text{kJ mol}^{-1}) = 1.05$$

[a] From data at w between 93.2 and 100, based on the assumption of a negligible liquid junction between a 3.5 mol dm$^{-3}$ aqueous KCl salt bridge and the alcoholic solutions, weight = 0. [b] From data for HCl and $\Delta_t G^o$ (Cl⁻) from ref. 16, based on the mean of the TATB and TPTB assumptions, weight = 0. [c] Interpolated from data at w = 20, 35, 50, 65, 80, and 100, based on the change of the dissociation constant of carboxylic acids and anilinium salts, weight = 0. [d] Interpolated from data at w = 15.0, 20.3, 40, 60.2, 80.3, 92.3, and 100, based on $\Delta_t G^o$ (K⁺) from ref. 16, based on the mean of the TATB and TPTB assumptions, weight = 1. [e] From assumption that $\Delta_t G^o$ [(iC$_5$H$_{11}$)$_3$C$_4$H$_9$N⁺] = $\Delta_t G^o$ [C$_6$H$_5$)$_4$B⁻], weight = 1. [f] Interpolated from data at w = 30, 50, 71.9, and 100, based on extrapolation of series of data for HX to infinite radius of X⁻, weight = 0. [g] Based on the mean of the TATB and TPTB assumptions, weight = 1. [h] Based on the Hammett acidity function H$_0$ and assumptions concerning activity coefficients, weight = 0. [i] From "real" potentials of solutions modified by the presence of heptanol, weight = 0. [j] Based on extrapolation of series of data for HX to infinite radius of X⁻, weight = 0. [k] From an "Owen extrapolation" of emf data, neglecting the liquid junction potential, weight = 0. [l] Selected value. [m] Using an assumption concerning the electrostatic term of the transfer of the tetrasolvated proton and assumptions concerning activity coefficients, weight = 0. [n] From the selected values for HCl, this work, and $\Delta_t G^o$ (Cl⁻) from ref. 16, based on the mean of the TATB and TPTB assumptions, weight = 1.

$\Delta_t G^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, into ethanol (S) + water (W) (cont.)

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **K⁺** | | | | | | | | | | | |
| | 1.3 | 3.0 | | 4.5 | | 6.3 | | 10.1 | 15.4 | 18.0 | 11[a] |
| | 1.3 | 2.3 | 3.3 | 4.4 | 4.0 | 4.3 | 4.3 | 6.5 | 11.2 | 17.0 | 13[b] |
| | 0.5 | 0.6 | 0.8 | 0.8 | 1.5 | 2.9 | 5.2 | 8.0 | 12.0 | 16.8 | 14[c] |
| | | | 2.7 | | 4.9 | | 6.1 | | | 14.0 | 15[d] |
| | 1.3 | 2.5 | 3.3 | 3.7 | 3.8 | 4.8 | 6.0 | 8.4 | 12.2 | 15.8 | 16[e] |
| | | | | | | | | | | 16.4 | 31[f] |
| Selected | 1.3 | 2.6 | 3.1 | 4.2 | 4.2 | 4.6 | 5.4 | 8.3 | 12.7 | 16.4 | |

Equation $\Delta_t G^o$ /kJ mol$^{-1}$ = 0.1408·w − 0.000369·w$^2$ − 35.79·10$^{-6}$·w$^3$ + 42.56·10$^{-8}$·w$^4$

$$\sigma\,(\Delta_t G^o \text{ /kJ mol}^{-1}) = 0.44$$

[a] Interpolated from data at w = 15.0, 20.3, 40, 60.2, 80.3, 92.3, and 100, using $\Delta_t G^o$ ($Cl^-$) from ref. 16, based on the mean of the TATB and TPTB assumptions, weight = 1. [b] Interpolated from data at w = 10, 20, 30, 37.3, 51.0, 58.8, 68.3, 84.8, 92.3, and 100, using $\Delta_t G^o$ ($Cl^-$) from ref. 16, based on the mean of the TATB and TPTB assumptions, weight = 1. [c] Based on the assumption that $\Delta_t G^o$ [$(C_6H_5)_4B^-$] $\Delta_t G^o$[$(iC_5H_{11})_3C_4H_9N^+$], weight = 1. [d] Interpolated from data at w = 30, 50, 71.9, and 100, based on an extrapolation of series of KX data to infinite radius of X⁻, weight = 0. [e] Based on the mean of the TATB and TPTB assumptions, weight = 1. [f] Selected value.

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Rb⁺** | | | | | | | | | | | |
| | | | 1.2 | | 2.3 | | 6.4 | | | 16.3 | 12[a] |
| | | | 2.7 | | 4.5 | | 6.3 | | | 14.4 | 15[b] |
| | 1.7 | 3.0 | 3.7 | 3.8 | 3.7 | 4.5 | 5.8 | 9.1 | | | 21[c] |
| | | | | | | | | | | 16 | 31[d] |

[a] Interpolated from data at w = 30, 50, 71.9, and 100, using $\Delta_t G^o$ (K⁺) from ref. 16, based on the mean of the TATB and TPTB assumptions. [b] Interpolated from data at w = 30, 50, 71.9, and 100, based on an extrapolation of series of Rb data to infinite radius of X⁻. [c] Data for RbCl, using $\Delta_t G^o$ ($Cl^-$) from ref. 16, based on the mean of the TATB and TPTB assumptions. [d] Selected value.

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cs⁺** | | | | | | | | | | | |
| | | | 0.6 | | 1.5 | | 5.8 | | | 16.3 | 12[a] |
| | | | 2.3 | | 4.1 | | 5.8 | | | 14.8 | 15[b] |
| | -3.0 | -3.7 | -3.7 | -4.4 | | | | | | | 26[c] |
| | | | | | | | | | | 15 | 31[d] |

[a] Interpolated from data at w = 30, 50, 71.9, and 100, using $\Delta_t G^o$ (K⁺) from ref. 16, based on the mean of the TATB and TPTB assumptions. [b] Interpolated from data at w = 30, 50, 71.9, and 100, based on an extrapolation of series of Cs data to infinite radius of X⁻. [c] Data for CsBPh4 using $\Delta_t G^o$ (BPh4⁻) from ref. 16, based on the mean of the TATB and TPTB assumptions. [d] Selected value.

$\Delta_t G^O$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, into ethanol (S) + water (W) (cont.)

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $(CH_3)_4N^+$ | | | | | | | | | | | |
| | | | -1.4 | | -0.9 | | 3.0 | | | 14.0 | 12[a] |
| | | | 0.2 | | 1.6 | | 3.0 | | | 12.3 | 15[b] |
| | | | | | | | | | | 10.9 | 31[c] |

[a] Interpolated from data at w = 30, 50, 71.9, and 100, using $\Delta_t G^O$ (K$^+$) from ref. 16, based on the mean of the TATB and TPTB assumptions. [b] Interpolated as in [a], using extrapolation of a series of MX salts to infinite radius of X$^-$. [c] Selected value.

| $(C_2H_5)_4N^+$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -1.1 | | -3.5 | | -2.0 | | | -0.3 | 15[a] |
| | | | | | | | | | | 6 | 31[b] |

[a] Interpolated from data at w = 30, 50, 71.9, and 100, using extrapolation of a series of MX salts to infinite radius of X$^-$. [c] Selected value.

| $(C_3H_7)_4N^+$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -4.7 | | -7.3 | | -6.6 | | | -2.9 | 12[a] |
| | | | -3.2 | | -4.7 | | -6.7 | | | -8.9 | 15[b] |
| | | | | | | | | | | -6 | 31[c] |

[a] Interpolated from data at w = 30, 50, 71.9, and 100, using $\Delta_t G^O$ (K$^+$) from ref. 16, based on the mean of the TATB and TPTB assumptions. [b] Interpolated as in [a], using extrapolation of a series of MX salts to infinite radius of X$^-$. [c] Selected value.

| $(C_4H_9)_4N^+$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -4.7 | | -7.3 | | -6.6 | | | -2.9 | 12[a] |
| | | | -3.2 | | -4.7 | | -6.7 | | | -8.9 | 15[b] |
| | | | | | | | | | | -6 | 31[c] |

[a] Interpolated from data at w = 30, 50, 71.9, and 100, using $\Delta_t G^O$ (K$^+$) from ref. 16, based on the mean of the TATB and TPTB assumptions. [b] Interpolated as in [a], using extrapolation of a series of MX salts to infinite radius of X$^-$. [c] Selected value.

| $(iC_5H_{11})_3(C_4H_9)_4N^+$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -1.1 | -2.2 | -4.7 | -7.8 | -11.0 | -14.9 | -17.3 | -19.6 | -20.9 | -21.9 | 13[a] |
| | -1.6 | -3.8 | -7.2 | -11.1 | -14.0 | -16.5 | -18.2 | -19.4 | -20.5 | -21.1 | 14[b] |
| | | | -5.2 | | -10.6 | | -16.8 | | | -23.7 | 15[c] |

[a] Using the TATB assumption and $\Delta_t G^O$ [$(C_6H_5)_4B^-$] from ref. 14. [b] Using the assumption that $\Delta_t G^O$ [$(iC_5H_{11})_3(C_4H_9)N^+$] = $\Delta_t G^O_{tr}$ [$(C_6H_5)_4B^-$]. [c] Interpolated from data at w = 30, 50, 71.9, and 100, using extrapolation of a series of MX salts to infinite radius of X$^-$.

$\Delta_t \underline{G}^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, into ethanol (S) + water (W) (cont.)

| Mass% S($\underline{w}$) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $(C_6H_5)_4As^+$ and $(C_6H_5)_4P^+$ | | | | | | | | | | | |
| | -2.4 | -5.6 | -9.8 | -13.9 | -16.3 | -18.5 | -19.0 | -19.8 | -20.8 | -20.1 | 16[a] |
| | | | | | | | | | | -21.2 | 31[b] |

Selected -2.4  -5.6  -9.8  -13.9  -16.3  -18.5  -19.0  -19.8  -20.8  -20.1

Equation $\Delta_t\underline{G}^o$ /kJ mol$^{-1}$ = $-0.1363.\underline{w} - 0.01160.\underline{w}^2 - 203.09.10^{-6}.\underline{w}^3 - 94.75510^{-8}.\underline{w}^4$

$\sigma\ (\Delta_t\underline{G}^o$ /kJ mol$^{-1})$ = 0.42

[a] Using the mean of the TPTB and TATB assumptions.   [b] Selected value.

$Ag^+$

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.1 | 1.5 | 1.4 | 0.6 | -0.5 | 0.1 | 0.3 | 3.4 | 4.2 | 4.3 | 22[a] |
| | | 1.1 | | | 1.7 | | | 4.8 | 7.2 | 10.6 | 25[b] |
| | | | | | | | | | | 4.6 | 31[c] |
| | -0.3 | | -1.5 | | -2.1 | -1.9 | | 2.0 | 3.7 | 4.6 | 32[d] |

[a] From data for AgCl and value of $\Delta_t\underline{G}^o$ (Cl$^-$) from ref. 16, based on the mean of the TPTB and TATB assumptions.   [b] Interpolated from data at $\underline{w}$ = 33.5, 50, 80, 85.6, and 100, using an "Owen extrapolation", neglecting the liquid junction potential.   [c] Selected value.   [d] Interpolated from data at $\underline{w}$ = 8.0, 30.0, 47.5, 64.7, 87.1, and 97.6, based on the TATB assumption.

$Zn^{2+}$

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -3.6 | -8.7 | -13.3 | -14.1 | | | | | | | 35[a] |

[a] Using an assumption about the electrostatic term for the tetrasolvated proton and concerning activity coefficients.

$Cu^{2+}$

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.7 | 3.3 | 5.0 | 7.5 | 10.0 | 13.4 | 17.2 | 21.8 | 32.6 | 46.0 | 27[a] |
| | | | | | | | | | | 46 | 31[b] |

[a] Using the negligible liquid junction potential assumption.   [b] Selected value.

$Hg^{2+}$

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2.3 | 4.1 | 4.8 | 3.4 | | | | | | | 26[a] |

[a] Using the TATB assumption.

$UO_2^{2+}$

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -3.7 | -6.0 | -4.4 | -1.1 | 2.7 | 7.6 | 13.2 | | | | 20[a] |

[a] Using the assumption that $\Delta_t\underline{G}^o_{tr}$ [$iC_5H_{11})_3(C_4H_9)N^+$] = $\Delta_t\underline{G}^o$ [$(C_6H_5)_4B^-$].

$\Delta_t G^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, into ethanol (S) + water (W) (cont.)

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **U$^{4+}$** | | | | | | | | | | | |
| | 0.4 | 2.9 | 7.3 | 14.0 | 20.9 | 29.0 | 36.7 | | | | 20[a] |

[a] Using the assumption that $\Delta_t G^o{}_{tr}$ [iC$_5$H$_{11}$)$_3$(C$_4$H$_9$)N$^+$] = $\Delta_t G^o$ [(C$_6$H$_5$)$_4$B$^-$].

| **Cl$^-$** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.4 | 1.7 | | 5.6 | | 10.9 | | 15.0 | 19.0 | 22.5 | 11[a] |
| | 1.2 | 3.0 | 5.2 | 7.6 | 9.7 | 11.4 | 12.5 | 13.7 | 16.1 | 19.3 | 14[b] |
| | | | 3.1 | | 6.2 | | 11.4 | | | 21.9 | 15[c] |
| | 0.4 | 1.2 | 2.6 | 4.8 | 7.4 | 9.4 | 11.7 | 13.3 | 15.8 | 20.3 | 16[d] |
| | 21.3 | 33.4 | 38.8 | 40.0 | 39.7 | 41.7 | 43.8 | 45.8 | 48.2 | 51.4 | 19[e] |
| | 4.0 | 7.4 | 13.4 | | 21.9 | | | | | | 23[f] |
| | | 1.5 | | 2.9 | | 4.6 | | 6.5 | 7.4 | 11.3 | 25[g] |
| | -1.9 | 1.0 | | | | | | | | | 30[h] |
| | | | | | | | | | | 20.2 | 31[i] |
| | -0.5 | -0.5 | 0.5 | 2.7 | | | | | | | 33[j] |

Selected[k]   0.4    1.2    2.6    4.8    7.4    9.4    11.7    13.3    15.8    20.2

Equation $\Delta_t G^o$ /kJ mol$^{-1}$ = -0.0083.$w$ + 0.004459.$w^2$ - 38.14.10$^{-6}$.$w^3$ + 13.79.10$^{-8}$.$w^4$

$\sigma$ ($\Delta_t G^o$ /kJ mol$^{-1}$) = 0.47

[a] Interpolated from data for KCl at $w$ = 15.0, 20.3, 40, 60.2, 80.3, 92.3, and 100, using $\Delta_t G^o$ (K$^+$) from ref. 16, based on the mean of the TPTB and TATB assumptions. [b] Based on the $\Delta_t G^o$ [iC$_5$H$_{11}$)$_3$(C$_4$H$_9$)N$^+$] = $\Delta_t G^o$ [B(C$_6$H$_5$)$_4$$^-$] assumption. [c] Interpolated from data at $w$ = 30, 50, 71.9, and 100, based on extrapolation of series of MX data to infinite radius of M$^+$. [d] Based on the mean of the TPTB and TATB assumptions. [e] Interpolated from data at $w$ = 22.1, 39.0, 52.3, 63.0, 71.9, 79.3, 85.6, 91.1, 95.8, and 100, from "real" potentials. [f] Based on extrapolation of series of MX data to infinite radius of M$^+$. [g] Based on "Owen extrapolation", neglecting the liquid junction potential. [h] Based on extrapolation of series of MX data to infinite radius of M$^+$. [i] Selected value. [j] From HBr data and the selected values of $\Delta_t G^o$ (H$^+$) of this work. [k] The selected values taken as taken as equal to those from ref. 16, based on the mean of the TPTB and TATB assumptions.

| **Br$^-$** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0.9 | | 3.4 | | 7.8 | 9.1 | | 10.5 | | 10[a] |
| | | | 2.3 | | 4.9 | | 9.0 | | | 19.0 | 15[b] |
| | 3.5 | 6.6 | 12.3 | | 20.2 | | | | | | 23[c] |
| | | | | | | | | | | 7.7 | 25[d] |
| | -0.2 | 0.1 | 1.5 | 2.0 | 4.8 | 6.2 | 7.7 | 8.8 | 11.5 | 4.3 | 29[e] |
| | -2.2 | 0.3 | | | | | | | | | 30[f] |
| | | | | | | | | | | 18.2 | 31[g] |

Selected   0    0.5    2    3    5    7    9    9    10    18

Equation $\Delta_t G^o$ /kJ mol$^{-1}$ = -0.0070.$w$ + 0.0072.$w^2$ - 106.10.10$^{-6}$.$w^3$ + 57.3.10$^{-8}$.$w^4$

$\sigma$ ($\Delta_t G^o$ /kJ mol$^{-1}$) = 0.8

[a] Interpolated from HBr data at $\underline{w}$ = 20, 40, 65, 90, and 95, based on the selected values of $\Delta_t\underline{G}^o$ ($H^+$) from this work. [b] Interpolated from data at $\underline{w}$ = 30, 50, 71.9, and 100, based on extrapolation of series of MX data to infinite radius of $M^+$. [c] Based on extrapolation of series of MX data to infinite radius of $M^+$. [d] Based on an "Owen extrapolation", neglecting the liquid junction potential. [e] Based on HBr data and the selected values of $\Delta_t\underline{G}^o$ ($H^+$) from this work. [f] Based on extrapolation of series of MX data to infinite radius of $M^+$. [g] Selected value.

$\Delta_t\underline{G}^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, into ethanol (S) + water (W) (cont.)

| Mass% S($\underline{w}$) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $I^-$ | | | | | | | | | | | |
| | | | 0.6 | | 2.4 | | 6.0 | | | 14.0 | 15[a] |
| | 3.3 | 6.2 | 11.2 | | 18.2 | | | | | | 23[b] |
| | | | | | | | | | | 12.9 | 31[c] |

[a] Interpolated from data at $\underline{w}$ = 30, 50, 71.9, and 100, based on an extrapolation of a series of MX values to infinite radius of ($M^+$). [b] Based on the same extrapolation as in [a]. [c] Selected value.

$OH^-$

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2.8 | 5.9 | 9.0 | 10.7 | 11.1 | | | | | | 35[a] |

[a] Using an assumption about the electrostatic term for the tetrasolvated proton and concerning activity coefficients.

$CN^-$

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.8 | 1.4 | | | 2.7 | | 4.3 | 5.2 | 6.2 | 7.3 | 32[a] |
| | -0.3 | -1.4 | -1.6 | | | -0.5 | | 1.4 | 2.9 | 3.9 | 7.1 | 34[b] |

[a] Interpolated from data at $\underline{w}$ = 12.4, 22.1, 39.0, 55.9, 63.0, 74.8, 79.3, 88.5, 92.0, and 96, based on $\Delta_t G^o$ ($Ag^+$) from ref. 22. [b] Interpolated from KCN data at $\underline{w}$ = 12.4, 24.1, 35.2, 55.9, 74.8, 83.6, 92.0, and 100, using the $\Delta_t\underline{G}^o$ ($K^+$) values from ref. 16, based on the mean of the TPTB and TATB assumptions.

$SCN^-$

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -0.2 | 2.1 | | | 0.8 | 2.8 | | | | -32 | 28[a] |
| | -2.4 | -0.4 | | | | | | | | | 30[b] |
| | 1.3 | 3.6 | | | | | | | | | 35[c] |

[a] Interpolated from AgSCN data at $\underline{w}$ = 9.7, 19.9, 34.5, 42.2, 54.2, and 100, based on the selected $\Delta_t\underline{G}^o$ ($Ag^+$) values from this work. [b] Based on an extrapolation of a series of MX values to infinite radius of $M^+$. [c] Using an assumption about the electrostatic term for the tetrasolvated proton and concerning activity coefficients.

$\Delta_t \underline{G}^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, into ethanol (S) + water (W) (cont.)

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ClO$_4^-$ | | | | | | | | | | | |
| | | | 2.8 | | 4.2 | | 5.0 | | | 9.9 | 12[a] |
| | | | 1.4 | | 2.0 | | 5.5 | | | 11.5 | 15[b] |
| | | | | | | | | | | 10 | 31[c] |
| | | | 6.1 | | 4.8 | | | | | | 35[d] |

[a] Interpolated from data at $\underline{w}$ = 30, 50, 71.9, and 100, using the value of $\Delta_t \underline{G}^o$ (K$^+$) from ref. 16, based on the mean of the TPTB and TATB assumptions. [b] Based on an extrapolation of a series of MX values to infinite radius of M$^+$. [c] Selected value. [d] Using an assumption about the electrostatic term for the tetrasolvated proton and concerning activity coefficients.

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ag(CN)$_2^-$ | | | | | | | | | | | |
| | 0.4 | | | 1.2 | | 2.0 | 2.9 | 3.9 | 5.1 | | 32[a] |

[a] Interpolated from data at $\underline{w}$ = 12.4, 40.6, 55.9, 74.8, 92.0, and 96, based on $\Delta_t \underline{G}^o$ (Ag$^+$) from ref. 22.

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Au(CN)$_2^-$ | | | | | | | | | | | |
| | | | -1.0 | -4.1 | | -3.2 | -1.2 | 1.7 | 6.3 | | 32[a] |

[a] Interpolated from data at $\underline{w}$ = 22.1, 39.0, 63.0, 79.3, 88.5, and 96, based on $\Delta_t \underline{G}^o$ (Ag$^+$) from ref. 22.

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C$_6$H$_2$(NO$_2$)$_3$O$^-$ (picrate) | | | | | | | | | | | |
| | | -0.8 | | -1.6 | -1.2 | -1.4 | -1.1 | -1.0 | -1.2 | 0.6 | 13[a] |
| | 0.6 | 1.1 | 0.8 | 0.3 | -0.7 | -0.9 | -1.1 | -1.2 | -0.8 | -0.3 | 14[b] |
| | 0.0 | -0.6 | -1.9 | -2.5 | -3.2 | -2.8 | -3.2 | -2.6 | -1.3 | 0.5 | 16[c] |
| | | | | | | | | | | 0.5 | 31[d] |
| | 1.6 | 3.1 | 3.6 | 1.8 | -1.2 | -3.1 | | | | | 35[e] |

[a] Interpolated from data at $\underline{w}$ = 20, 37.3, 51.0, 58.8, 68.3, 84.8, 92.3 and 100, using $\Delta_t \underline{G}^o$ (K$^+$) from ref. 16, based on the mean of the TPTB and TATB assumptions. [b] Based on the assumption that $\Delta_t \underline{G}^o$ [(iC$_5$H$_{11}$)$_3$(C$_4$H$_9$N$^+$] = $\Delta_t \underline{G}^o$ [B(C$_6$H$_5$)$_4^-$]. [c] Based on the mean of the TPTB and TATB assumptions. [d] Selected value. [e] Using an assumption about the electrostatic term for the tetrasolvated proton and concerning activity coefficients.

| Mass% S(w) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| B(C$_6$H$_5$)$_4^-$ | | | | | | | | | | | |
| | -2.4 | -5.6 | -9.8 | -13.2 | -16.1 | -19.0 | -20.7 | -21.7 | -21.8 | -18.8 | 13[a] |
| | -1.6 | -3.8 | -7.2 | -11.1 | -14.0 | -16.5 | -18.2 | -19.4 | -20.5 | -21.1 | 14[b] |
| | | | -9.4 | | -17.3 | | -19.0 | | | -18.7 | 15[c] |
| | -2.4 | -5.6 | -9.8 | -13.9 | -16.3 | -18.5 | -19.0 | -19.8 | -20.8 | -20.1 | 16[d] |
| | | | | | | | | | | -21.2 | 31[e] |
| Selected | -2.4 | -5.6 | -9.8 | -13.9 | -16.3 | -18.5 | -19.0 | -19.8 | -20.8 | -21.2 | |

Equation $\Delta_t \underline{G}^o$ /kJ mol$^{-1}$ = $-0.1363 \cdot \underline{w} - 0.01160 \cdot \underline{w}^2 + 203.09 \cdot 10^{-6} \cdot \underline{w}^3 - 94.755 \cdot 10^{-8} \cdot \underline{w}^4$.

$$\sigma \,(\Delta_t \underline{G}^o \text{ /kJ mol}^{-1}) = 0.42$$

[a] Interpolated from KBPh$_4$ data at $\underline{w}$ = 10, 20, 30, 38.4, 60.6, 78.1, and 100, using $\Delta_t\underline{G}^o{}_{tr}$ (K$^+$) from ref. 16, based on the mean of the TPTB and TATB assumptions. [b] Based on the assumption that $\Delta_t\underline{G}^o$ [(iC$_5$H$_{11}$)$_3$(C$_4$H$_9$N$^+$]$ = \Delta_t\underline{G}^o$ [B(C$_6$H$_5$)$_4^-$]. [c] Interpolated from data at $\underline{w}$ = 30, 50, 71.9, and 100, using an extrapolation of a series of MX data to infinite radius of M$^+$. [d] Based on the mean of the TPTB and TATB assumptions. [e] Selected value.

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Table 4. Standard molar Gibbs energies of transfer of ions from water into 1-propanol (S) - water (W) mixtures, $\Delta_t G^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, as a function of $\underline{w}$, the mass % of S.

| $\underline{w}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **HCl** | | | | | | | | | | | |
| | 0.4 | 0.8 | | | | | | | | 19.7[a] | 1 |
| | | 1.7 | | 3.7 | | 6.7 | | 11.2 | | | 2 |
| | 0.8 | 1.6 | 2.3 | 3.4 | 4.7 | 6.2 | 8.3 | 11.2 | | | 3 |

[a] at $\underline{w}$ = 95.

| $\underline{w}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **H$^+$** | | | | | | | | | | | |
| | -1.8 | -3.4 | -4.7 | -6.1 | -6.3 | 7.1 | -7.4 | -7.9 | -7.1 | -2.8 | 4 |
| | -0.7 | -1.5 | -2.3 | -2.6 | -2.8 | -3.1 | -3.2 | -3.2 | -0.9 | -0.8 | 5 |
| | -3.3 | -6.2 | -7.1 | -7.4 | -7.7 | -7.1 | -5.5 | -3.9 | -0.7 | 4.3 | 6 |
| | | | | | | | | | | 9 | 10 |
| | | | | | | | | | | 8.7 | 12 |
| **Li$^+$** | | | | | | | | | | | |
| | | | | | | | | | | 11 | 10 |
| **Na$^+$** | | | | | | | | | | | |
| | | | | | | | | | | 17 | 10 |
| **K$^+$** | | | | | | | | | | | |
| | | | | | | | | | | 18 | 10 |
| **RbCl** | | | | | | | | | | | |
| | 2.0 | 3.9 | 5.6 | 7.4 | 9.7 | 12.5 | 16.2 | 21.7 | | | 3 |
| **Rb$^+$** | | | | | | | | | | | |
| | | | | | | | | | | 19 | 10 |
| **Cs$^+$** | | | | | | | | | | | |
| | | | | | | | | | | 17 | 10 |
| **Ag$^+$** | | | | | | | | | | | |
| | 0.4 | 0.4 | | | | | | | | | 7 |
| **AgSCN** | | | | | | | | | | | |
| | -0.6 | -1.0 | | | | | | | | | 7 |
| | -2.9 | | | | | | | | | | 8 |
| **NH$_4^+$** | | | | | | | | | | | |
| | | | | | | | | | | 7 | 11 |
| **Me$_4$N$^+$** | | | | | | | | | | | |
| | | | | | | | | | | 11 | 10 |
| **Et$_4$N$^+$** | | | | | | | | | | | |
| | | | | | | | | | | 5 | 11 |

Table 4. Standard molar Gibbs energies of transfer of ions from water into 1-propanol (S) - water (W) mixtures, $\Delta_t \underline{G}^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, as a function of $\underline{w}$, the mass % of S. (cont.)

| $\underline{w}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $Pr_4N^+$ | | | | | | | | | | -6 | 11 |
| $Bu_4N^+$ | | | | | | | | | | -17 | 11 |
| $iPe_3BuN^+$ | | | | | | | | | | -18 | 13 |
| $Ph_4As^+$ | | | | | | | | | | -25 | 10 |
| $Cu^{2+}$ | 0.4 | 0.8 | 1.7 | 2.9 | 4.6 | 7.1 | 10.5 | 15.9 | 25.1 | 43.1 | 9 |
| $Hg^{2+}$ | | | | | | | | | | 18 | 12 |
| $Hg_2^{2+}$ | | | | | | | | | | 27 | 12 |
| $Cl^-$ | | | | | | | | | | 26 | 10 |
| $Br^-$ | | | | | | | | | | 22 | 10 |
| $I^-$ | | | | | | | | | | 19 | 10 |
| $ClO_4^-$ | | | | | | | | | | 17 | 10 |
| $Pic^-$ | | | | | | | | | | 1.2 | 12 |
| $BPh_4^-$ | | | | | | | | | | -25 | 10 |
| | | | | | | | | | | -18 | 13 |

## TRANSFER INTO 1-PROPANOL + WATER MIXTURES – REFERENCES AND COMMENTS

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Table 5.  Standard molar Gibbs energies of transfer of ions from water into 2-propanol (S) - water (W) mixtures, $\Delta_t \underline{G}^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, as a function of $\underline{w}$, the mass % of S.

| $\underline{w}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **HCl** | | | | | | | | | | | |
| | 0.9 | 1.7 | | | | | | | | | 1 |
| | | 1.8 | | | | | | | | | 2 |
| | 0.5 | 0.8 | | | | | | | | | 3 |
| | 1.8 | 2.6 | | 4.2 | 5.4 | | 9.2 | 16.0 | 24.8[a] | | 4 |
| | 0.9 | 1.7 | 2.4 | 3.4 | 4.6 | 6.3 | 8.6 | 11.9 | | | 5 |
| | 0.4 | 0.8 | 1.3 | 1.9 | 2.6 | 3.4 | 4.5 | 6.0 | 7.7 | | 6 |
| | 0.7 | 1.4 | 2.3 | 3.3 | 4.2 | 5.3 | 6.6 | 8.1 | 9.2 | | 7 |

[a] at $\underline{w}$ = 95.

| $\underline{w}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **HBr** | | | | | | | | | | | |
| | | 0.5 | | 1.0 | | 2.3 | | | 6.9 | 11.7[a] | 8 |
| | 0.4 | 0.7 | 1.0 | 1.4 | 2.1 | 2.9 | 4.0 | 5.7 | 8.2 | | 7 |

[a] at $\underline{w}$ = 95.

| $\underline{w}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **HI** | | | | | | | | | | | |
| | 1.2 | 1.9 | 2.2 | 3.2 | | | | | | | 19 |
| **H$^+$** | | | | | | | | | | | |
| | -0.6 | -1.3 | -2.1 | -2.5 | -2.6 | -3.2 | -3.4 | -3.3 | -3.3 | 1.0 | 9 |
| | -0.8 | -3.1 | -4.4 | -5.5 | -6.1 | -7.3 | -7.7 | -7.8 | -7.7 | 1.2 | 10 |
| | -2.6 | -6.6 | | -8.3 | | | | | | | 11 |
| | -3.2 | -7.1 | -14.0 | | -20.3 | | | | | | 12 |
| | -0.7 | | -2.4 | | -4.2 | | | | | | 13 |
| | | | | | | | | | | 2.4 | 20 |
| **K$^+$** | | | | | | | | | | | |
| | 0.3 | | 1.0 | | 0.7 | | | | | | 13 |
| | | | | | | | | | | 22.4 | 20 |

Table 5. Standard molar Gibbs energies of transfer of ions from water into 2-propanol (S) - water (W) mixtures, $\Delta_t G^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, as a function of $\underline{w}$, the mass % of S (cont).

| $\underline{w}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RbCl | 2.2 | 4.4 | 6.5 | 8.6 | 11.1 | 14.3 | 18.3 | 24.2 | | | 5 |
| NH$_4$I | 1.0 | 2.2 | 3.5 | 4.9 | 6.4 | 8.1 | 9.9 | 11.8 | | | 14 |
| Ag$^+$ | 0.3 | 0.2 | | | | | | | | | 15 |
| AgSCN | 0.1 | -0.2 | | | | | | | | | 15 |
| | 1.4 | 1.2 | | | | | | | | | 16 |
| iPe$_3$BuN$^+$ | | | | | | | | | | -14.5 | 20 |
| Cu$^{2+}$ | 0.3 | 1.0 | 2.0 | 3.5 | 5.5 | 7.8 | 10.5 | 16.0 | 24.9 | 66.5 | 17 |
| Zn$^{2+}$ | -4.5 | -22.5 | -13.1 | | | | | | | | 18 |
| Cl$^-$ | 4.1 | 8.9 | 17.0 | | 25.5 | | | | | | 12 |
| | 1.2 | | 3.2 | | 6.8 | | | | | | 13 |
| | 4.2 | | 17.0 | | 25.5 | | | | | | 18 |
| | | | | | | | | | | 29.2 | 20 |
| Br$^-$ | 3.8 | 8.3 | 15.6 | 23.9 | | | | | | | 12 |
| | | | | | | | | | | 28.8 | 20 |
| I$^-$ | 3.4 | 7.5 | 14.3 | 21.5 | | | | | | | 12 |
| Pic$^-$ | 0.4 | | -2.8 | -3.4 | | | | | | | 13 |
| | | | | | | | | | | 5.9 | 20 |
| Ph$_4$B$^-$ | -3.4 | | -13.5 | -17.8 | | | | | | | 13 |
| | | | | | | | | | | -14.5 | 20 |

## TRANSFER INTO 2-PROPANOL + WATER MIXTURES – REFERENCES AND COMMENTS

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Table 6. Standard molar Gibbs energies of transfer of ions from water into 1-butanol (S) – water (W) mixtures, $\Delta_t G^{\circ}$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, as a function of $w$, the mass % of S.

| $w$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| H$^+$ | 0.0 | | | | | | | 1.7 | 4.5 | 18.1 | 1 |
| Na$^+$ | | | | | | | | | | 19 | 2 |
| K$^+$ | | | | | | | | | | 20 | 2 |
| Rb$^+$ | | | | | | | | | | 23 | 2 |
| Cs$^+$ | | | | | | | | | | 19 | 2 |

Table 6. Standard molar Gibbs energies of transfer of ions from water into 1-butanol (S) - water (W) mixtures, $\Delta_t \underline{G}^O$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, as a function of $\underline{w}$, the mass % of S (cont).

| $\underline{w}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $NH_4^+$ | | | | | | | | | | 12 | 2 |
| $Me_4N^+$ | | | | | | | | | | 12 | 2 |
| $Et_4N^+$ | | | | | | | | | | 7 | 2 |
| $Pr_4N^+$ | | | | | | | | | | -7 | 2 |
| $Bu_4N^+$ | | | | | | | | | | -12 | 2 |
| $Ph_4As^+$ | | | | | | | | | | -20 | 2 |
| $Cl^-$ | 0.8 | | | | | | | 10.9 | 13.2 | 15.3<br>29 | 1<br>2 |
| $Br^-$ | | | | | | | | | | 24 | 2 |
| $I^-$ | | | | | | | | | | 22 | 2 |
| $ClO_4^-$ | | | | | | | | | | 22 | 2 |
| $BPh_4^-$ | | | | | | | | | | -20 | 2 |

## TRANSFER INTO 1-BUTANOL + WATER MIXTURES – REFERENCES AND COMMENTS

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Table 7. Standard molar Gibbs energies of transfer of ions from water into 2-methyl-2-propanol (S) – water (W) mixtures, $\Delta_t G^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, as a function of $\underline{w}$, the mass % of S.

| $\underline{w}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **HCl** | | | | | | | | | | | |
| | 1.8 | 3.0 | | 4.5 | | | 11.2 | | | | 1 |
| | 1.0 | 1.8 | 2.8 | 3.9 | 5.6 | 7.8 | | | | | 2 |
| | 1.8 | 4.8 | 5.9 | 5.0 | | | | | | | 5 |
| | 0.9 | 1.7 | 2.6 | 3.8 | 5.3 | 7.3 | 10.3 | 14.6 | | | 4 |
| | 0.9 | 1.7 | 2.6 | 3.7 | 5.1 | 6.9 | 9.4 | 12.4 | 15.9 | | 5 |
| **HBr** | | | | | | | | | | | |
| | 0.8 | 1.3 | 2.1 | 3.2 | 4.9 | | 12.9 | | | | 6 |
| | 0.6 | 1.3 | 2.1 | 3.2 | 4.8 | 7.3 | 10.7 | 15.0 | 19.6 | | 15 |
| **HI** | | | | | | | | | | | |
| | 1.6 | 2.4 | 3.1 | | 5.1 | | | | | | 16 |
| **H$^+$** | | | | | | | | | | | |
| | -2.7 | -7.1 | -9.1 | -8.2 | -6.8 | | | | | | 7 |
| | -7.0 | -13.1 | -13.8 | | -16.6 | | | | | | 7 |
| | 0.7 | -0.7 | -2.3 | -2.8 | | | | | | | 9 |
| | 0.0 | -1.6 | -3.2 | | -4.8 | | | | | | 10 |
| | 0.9 | -0.9 | -2.8 | -3.2 | | | | | | | 11 |
| | | | | | | | | | 5.8 | | 17 |
| **LiCl** | | | | | | | | | | | |
| | 2.6 | 3.4 | 0.7 | -2.0 | | | | | | | 3 |
| **Li$^+$** | | | | | | | | | | | |
| | 1.7 | 1.2 | 0.1 | 0.5 | | | | | | | 11 |
| | 1.2 | 2.1 | 0.2 | 0.5 | | | | | | | 12 |
| **Na$^+$** | | | | | | | | | | | |
| | 2.2 | 1.8 | 1.1 | 1.5 | | | | | | | 11 |
| | 2.2 | 1.9 | 1.2 | 1.4 | | | | | | | 12 |
| **K$^+$** | | | | | | | | | | | |
| | 2.1 | 1.8 | 1.0 | 1.4 | | | | | | | 9 |
| | 0.2 | -0.4 | -0.2 | 0.4 | | | | | | | 10 |
| | 2.2 | 1.9 | 1.2 | 1.6 | | | | | | | 11 |
| **RbCl** | | | | | | | | | | | |
| | 2.1 | 4.3 | 6.2 | 8.3 | 10.9 | 14.3 | 18.9 | 25.6 | | | 4 |
| **Rb$^+$** | | | | | | | | | | | |
| | 2.0 | 1.6 | 0.8 | 1.1 | | | | | | | 12 |
| **CsBPh$_4$** | | | | | | | | | | | |
| | -1.9 | -5.2 | -8.5 | | | | | | | | 13,14 |

Table 7. Standard molar Gibbs energies of transfer of ions from water into 2-methyl-2-propanol (S) - water (W) mixtures, $\Delta_t G^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, as a function of $\underline{w}$, the mass % of S (cont).

| $\underline{w}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cs$^+$ | | | | | | | | | | | |
| | 2.0 | 1.5 | 0.7 | 0.9 | | | | | | | 12 |
| AgCl | | | | | | | | | | | |
| | 1.6 | 3.2 | 4.6 | 6.3 | 8.5 | 11.6 | | | | | 2 |
| NH$_4{}^+$ | | | | | | | | | | | |
| | 1.6 | 0.8 | -0.2 | 0.0 | | | | | | | 9 |
| iPe$_3$BuN$^+$ | | | | | | | | | | | |
| | | | | | | | | | | -8.7 | 17 |
| Ph$_4$As$^+$ | | | | | | | | | | | |
| | -2.7 | -8.5 | -13.2 | -15.4 | | | | | | | 9 |
| | -3.6 | -10.1 | -14.4 | | -17.0 | | | | | | 10 |
| Mg$^{2+}$ | | | | | | | | | | | |
| | 3.0 | 0.3 | -2.9 | -2.9 | | | | | | | 11 |
| Ca$^{2+}$ | | | | | | | | | | | |
| | 3.3 | 1.1 | -0.6 | 0.5 | | | | | | | 11 |
| Sr$^{2+}$ | | | | | | | | | | | |
| | 4.3 | 3.8 | 1.6 | 2.2 | | | | | | | 11 |
| Ba$^{2+}$ | | | | | | | | | | | |
| | 4.3 | 3.8 | 1.6 | 2.2 | | | | | | | 11 |
| Hg(BPh$_4$)$_2$ | | | | | | | | | | | |
| | -1.9 | -5.2 | -8.5 | | | | | | | | 13 |
| | -0.7 | -3.7 | -6.6 | | | | | | | | 14 |
| OH$^-$ | | | | | | | | | | | |
| | 1.4 | 5.8 | 8.5 | | | | | | | | 9 |
| F$^-$ | | | | | | | | | | | |
| | 0.7 | 3.6 | 6.7 | 8.7 | | | | | | | 11 |
| ·Cl$^-$ | | | | | | | | | | | |
| | 8.2 | 14.8 | 15.4 | 19.2 | | | | | | | 8 |
| | 1.2 | 3.3 | 4.8 | 7.4 | | | | | | | 10 |
| | 0.0 | 2.5 | 5.1 | 6.7 | | | | | | | 12 |

Table 7.  Standard molar Gibbs energies of transfer of ions from water into 2-methyl-2-propanol (S) - water (W) mixtures, $\Delta_t G^\circ$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, as a function of $\underline{w}$, the mass % of S (cont).

| w | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Br$^-$** | | | | | | | | | | | |
| | 7.5 | 13.3 | 14.2 | 18.2 | | | | | | | 8 |
| | -0.3 | 1.9 | 4.4 | 5.8 | | | | | | | 9 |
| **I$^-$** | | | | | | | | | | | |
| | 6.9 | 12.3 | 12.8 | 16.0 | | | | | | | 8 |
| | -0.6 | 1.1 | 3.1 | 4.2 | | | | | | | 9 |
| **Pic$^-$** | | | | | | | | | | | |
| | -1.0 | -1.7 | -2.7 | -3.4 | | | | | | | 9 |
| | 0.5 | -0.6 | -2.7 | -3.5 | | | | | | | 10 |
| | | | | | | | | | | 13.3 | 17 |
| **BPh$_4$$^-$** | | | | | | | | | | | |
| | -2.7 | -8.5 | -13.2 | -15.4 | | | | | | | 9 |
| | -3.6 | -10.1 | -14.4 | | -17.0 | | | | | | 10 |
| | | | | | | | | | | -8.7 | 17 |

## TRANSFER INTO 2-METHYL-2-PROPANOL + WATER MIXTURES – REFERENCES AND COMMENTS

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16. K. Das, K. Bose, A.K. Das, and K.K. Kundu, **Electrochim. Acta**, **23**, 159 (1978).
17. I.M. Kolthoff and M.K. Chantooni, Jr., **J. Phys. Chem.**, **82**, 994 (1978), **83**, 468 (1979), triisopentylbutylammonium tetraphenylborate assumption.

Table 8. Standard molar Gibbs energies of transfer of ions from water into 1,2-ethanediol (ethylene glycol, S) - water (W) mixtures, $\Delta_t G^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, as a function of $\underline{w}$, the mass % of S.

| $\underline{w}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HCl | | | | | | | | | | | |
| | 0.6 | 1.2 | 1.7 | 2.3 | | 3.8 | | | | | 1 |
| | 0.8 | 1.2 | | 2.3 | | 3.8 | | | | | 2 |
| | 0.7 | 1.4 | | | | | | | | | 3 |
| | 0.2 | 0.4 | 0.6 | 0.8 | | | | | | | 4 |
| | 0.3 | | 1.1 | | 2.0 | | 3.3 | | 7.5 | 15.8 | 5 |
| | 0.7 | | | | | 4.3 | | 6.7 | 10.0 | 19.2 | 6 |
| HBr | | | | | | | | | | | |
| | 0.3 | 0.6 | 1.0 | 1.5 | 2.0 | 2.7 | 3.7 | 5.0 | 7.7 | 16.0 | 7 |
| H$^+$ | | | | | | | | | | | |
| | -0.2 | -0.2 | -0.3 | -0.3 | -0.4 | -0.5 | -0.6 | -0.6 | -0.4 | 1.8 | 8 |
| | -0.2 | -0.5 | -1.0 | -1.5 | -1.5 | -1.9 | -2.0 | | | | 9 |
| | | | -1.2 | | -1.0 | | -2.2 | | -0.7 | 5.1 | 10 |
| | -0.3 | -0.4 | -0.8 | -0.9 | -1.3 | -1.7 | -2.1 | -1.8 | -0.8 | 4.1 | 11 |
| Li$^+$ | | | | | | | | | | | |
| | | | -0.4 | | 0.7 | | 0.8 | | 1.2 | -0.1 | 10 |
| Na$^+$ | | | | | | | | | | | |
| | | | -0.6 | | 0.4 | | -0.3 | | -1.0 | -2.1 | 10 |
| K$^+$ | | | | | | | | | | | |
| | | | -0.4 | | 0.5 | | 0.1 | | -0.8 | -2.1 | 10 |
| CsBPh$_4$ | | | | | | | | | | | |
| | -0.3 | -1.1 | -2.2 | -3.7 | | | | | | | 12 |
| Ph$_4$As$^+$ | | | | | | | | | | | |
| | | | -5.0 | | -9.1 | | -13.3 | | -19.4 | -21.2 | 10 |
| CuSO$_4$ | | | | | | | | | | | |
| | 11.2 | | | | 15.3 | | | 22.8 | | 30.4 | 13 |
| Cu$^{2+}$ | | | | | | | | | | | |
| | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.9 | 4.2 | 14 |
| Cd$^{2+}$ | | | | | | | | | | | |
| | | | -2.0 | -3.5 | -5.5 | -7.9 | -10.8 | -14.0 | -18.3 | | 15 |
| Cl$^-$ | | | | | | | | | | | |
| | | | 1.9 | | 2.1 | | 3.9 | | 5.7 | 8.1 | 10 |
| | | 17.3 | 20.0 | 22.7 | 25.3 | 28.0 | 30.7 | | | | 16 |

Table 8.  Standard molar Gibbs energies of transfer of ions from water into 1,2-ethanediol (ethylene glycol, S) - water (W) mixtures, $\Delta_t G^\circ$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, as a function of $\underline{w}$, the mass % of S (cont.).

| $\underline{w}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Br$^-$ | | | 1.2 | | 1.1 | | 2.5 | | 3.6 | 6.4 | 10 |
| I$^-$ | | | 0.5 | | -0.1 | | 0.4 | | 0.3 | 3.3 | 10 |
| Pic$^-$ | | | -0.2 | | -2.2 | | -3.6 | | -5.6 | -6.8 | 10 |
| BPh$_4^-$ | | | -5.0 | | -9.1 | | -13.3 | | -19.4 | -21.7 | 10 |

## TRANSFER INTO 1,2-ETHANEDIOL + WATER MIXTURES – REFERENCES AND COMMENTS

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Table 9.  Standard molar Gibbs energies of transfer of ions from water into 1,2-propanediol (propylene glycol, S) - water (W) mixtures, $\Delta_t G^\circ$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, as a function of $\underline{w}$, the mass % of S.

| $\underline{w}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HCl | 0.7 | 1.5 | | | | | | | | | 1 |
| H$^+$ | | -2.5 | | -3.3 | | -7.7 | | -11.0 | -10.0 | | 2 |

Table 9. Standard molar Gibbs energies of transfer of ions from water into 1,2-propanediol (propylene glycol, S) - water (W) mixtures, $\Delta_t G^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, as a function of $\underline{w}$, the mass % of S (cont.).

| $\underline{w}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cl$^-$ | | 4.0 | | 6.2 | | | 13.5 | | 23.0 | 34.4 | 2 |
| Br$^-$ | | 3.7 | | 5.4 | | | 12.5 | | 21.1 | 32.5 | 2 |
| I$^-$ | | 7.7 | | 4.3 | | | 10.5 | | 14.6 | 28.6 | 2 |

## TRANSFER INTO 1,2-PROPANEDIOL + WATER MIXTURES – REFERENCES AND COMMENTS

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Table 10. Standard molar Gibbs energies of transfer of ions from water into 1,2,3 - propanetriol (glycerol, S) - water (W) mixtures, $\Delta_t G^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, as a function of $\underline{w}$, the mass % of S.

| $\underline{w}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HCl | 0.8 | 1.7 | | | 3.2 | | | | | | 1 |
| | 0.8 | | 2.7 | | | | | | | | 2 |
| | 0.1 | 0.4 | 0.6 | | 1.1 | | | | | | 3 |
| | | 1.1 | | 2.6 | | | 6.3 | | 11.3 | 18.3 | 4 |
| | 0.5 | 1.0 | 1.7 | 2.3 | 3.1 | | 5.7 | | | | 5 |
| | 0.5 | 1.0 | 1.6 | 2.3 | 3.1 | 4.2 | 5.7 | 8.1 | 11.7 | | 6 |
| | 0.5 | | 1.6 | | 3.2 | | 5.7 | | | | 7 |
| HBr | 0.4 | 0.8 | 1.3 | 1.9 | 2.5 | | 4.7 | | | | 5 |
| | 0.5 | | 1.4 | | 2.5 | | 4.8 | | | | 7 |
| HI | 0.1 | 0.4 | 0.6 | 0.7 | 1.0 | | | | | | 5 |
| | 0.2 | | 0.8 | | 1.4 | | 2.8 | | | | 7 |
| H$^+$ | -2.0 | -3.0 | -4.9 | -7.1 | -9.6 | | | | | | 5 |
| | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 5.6 | | | | 9 |
| Li$^+$ | 0.6 | | 1.4 | | 2.5 | | 4.6 | | | | 9 |
| Na$^+$ | 0.7 | | 1.9 | | 2.9 | | 4.1 | | | | 9 |

Table 10. Standard molar Gibbs energies of transfer of ions from water into 1,2,3 - propanetriol (glycerol, S) - water (W) mixtures, $\Delta_t G^\circ$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, as a function of $\underline{w}$, the mass % of S (cont.)

| $\underline{w}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| K$^+$ | 0.7 | | 1.7 | | 2.6 | | 3.9 | | | | 9 |
| Rb$^+$ | 0.7 | | 1.6 | | 2.4 | | 3.8 | | | | 9 |
| Cs$^+$ | 0.7 | | 1.6 | | 2.4 | | 3.5 | | | | 9 |
| AgCl | 2.2 | 2.2 | 2.0 | | 1.8 | | | | | | 10 |
| AgBr | 2.2 | 2.4 | 2.3 | | 2.4 | | | | | | 10 |
| AgI | 2.4 | 2.8 | 2.9 | | 3.8 | | | | | | 10 |
| AgSCN | 3.0 | 3.0 | 3.0 | | 4.2 | | | | | | 10 |
| AgN$_3$ | 2.0 | 1.9 | 1.8 | | | | | | | | 10 |
| Ph$_4$As$^+$ | -0.8 | | -1.7 | | -2.9 | | -4.3 | | | | 9 |
| Cl$^-$ | 2.5 | 4.1 | 6.6 | 9.6 | 12.7 | | | | | | 5 |
| | -0.2 | | -0.3 | | -0.1 | | 0.1 | | | | 9 |
| Br$^-$ | 2.4 | 3.8 | 6.2 | 9.0 | 12.1 | | | | | | 5 |
| | -0.3 | | -0.5 | | -0.8 | | -0.8 | | | | 9 |
| I$^-$ | 2.1 | 3.4 | 5.5 | 7.9 | 10.6 | | | | | | 5 |
| | -0.6 | | -1.1 | | -1.9 | | -2.7 | | | | 9 |
| Pic$^-$ | -0.7 | | -1.2 | | -2.0 | | -3.1 | | | | 9 |
| Ph$_4$B$^-$ | -0.8 | | -1.7 | | -2.9 | | -4.3 | | | | 9 |

## TRANSFER INTO 1,2,3-PROPANETRIOL + WATER MIXTURES – REFERENCES AND COMMENTS

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Table 11. Standard molar Gibbs energies of transfer of ions from water into 2-methoxyethanol (S) - water (W) mixtures, $\Delta_t G^\circ$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, as a function of $\underset{\sim}{w}$, the mass % of S.

| $\underset{\sim}{w}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **HCl** | | | | | | | | | | | |
| | 0.7 | 1.3 | 2.1 | 2.9 | 4.0 | 5.5 | | 12.7 | | | 1 |
| | 0.7 | 1.4 | 2.0 | 2.7 | 3.8 | 5.3 | 7.5 | 11.1 | | | 2 |
| **H$^+$** | | | | | | | | | | | |
| | 0.0 | | -0.3 | | -3.2 | | -3.3 | | | | 3 |
| | 0.0 | | -1.6 | | -3.2 | | -3.3 | | | | 4 |
| | -0.1 | | -2.0 | | -4.4 | | -6.0 | | | | 5 |
| **Li$^+$** | | | | | | | | | | | |
| | 0.6 | | -0.3 | | -0.9 | | -1.3 | | | | 4 |
| **Na$^+$** | | | | | | | | | | | |
| | 0.9 | | 0.5 | | 0.2 | | -0.5 | | | | 4 |
| **K$^+$** | | | | | | | | | | | |
| | 0.8 | | 0.4 | | -0.1 | | -0.8 | | | | 3 |
| | 0.8 | | 0.4 | | -0.1 | | -0.8 | | | | 4 |
| **RbCl** | | | | | | | | | | | |
| | 1.4 | 2.9 | 4.4 | 6.2 | 8.2 | 10.7 | 13.6 | 17.1 | | | 2 |
| **Rb$^+$** | | | | | | | | | | | |
| | 0.6 | | -0.1 | | -0.2 | | -1.0 | | | | 4 |
| **Cs$^+$** | | | | | | | | | | | |
| | 0.6 | | 0.0 | | -0.5 | | -1.1 | | | | 4 |

Table 11.  Standard molar Gibbs energies of transfer of ions from water into 2-methoxy-ethanol (S) - water (W) mixtures, $\Delta_t G^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, as a function of $\underline{w}$, the mass % of S (cont.)

| $\underline{w}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ph$_4$As$^+$ | -3.8 | | -8.0 | | -13.6 | | -20.7 | | | | 4 |
| OH$^-$ | 1.2 | | 5.3 | | 8.4 | | 11.6 | | | | 3 |
| Cl$^-$ | 0.7 | | 3.8 | | 7.3 | | 11.6 | | | | 4 |
|  | 0.8 | | 4.2 | | 8.6 | | 14.6 | | | | 5 |
| Br$^-$ | 0.2 | | 2.7 | | 5.6 | | 9.2 | | | | 4 |
|  | 0.3 | | 3.0 | | 7.1 | | 12.1 | | | | 5 |
| I$^-$ | 0.0 | | 1.3 | | 2.4 | | 4.5 | | | | 4 |
|  | -0.2 | | 1.2 | | 3.3 | | 7.0 | | | | 5 |
| Pic$^-$ | 0.0 | | 0.2 | | -0.8 | | -1.6 | | | | 4 |
| BPh$_4^-$ | -3.8 | | -8.0 | | -13.6 | | -20.7 | | | | 4 |

## TRANSFER INTO 2-METHOXYETHANOL + WATER MIXTURES – REFERENCES AND COMMENTS

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Table 12.  Standard molar Gibbs energies of transfer of ions from water into 3-oxa-1,5-pentanediol (S) - water (W) mixtures, $\Delta_t G^o$ /kJ mol$^{-1}$, mol dm$^{-3}$ scale, 25 °C, as a function of $\underline{w}$, the mass % of S.

| $\underline{w}$ | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| H$^+$ | | -9.9 | | 16.0 | | -24.5 | | -28.7 | | | 1 |
| Cl$^-$ | | 11.4 | | 18.4 | | 29.1 | | 37.8 | | | 1 |
| Br$^-$ | | 10.4 | | 17.0 | | 26.3 | | 33.7 | | | 1 |
| I$^-$ | | 9.3 | | 15.0 | | 23.0 | | 28.4 | | | 1 |

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