

MOLAR CONDUCTIVITY OF AQUEOUS HF, HCl, HBr, AND HI

The molar conductivity Λ of an electrolyte solution is defined as the conductivity divided by amount-of-substance concentration. The customary unit is $S\text{ cm}^2\text{mol}^{-1}$ (i.e., $\Omega^{-1}\text{ cm}^2\text{mol}^{-1}$). The first part of this table gives the molar conductivity of the hydrohalogen acids at 25°C as a function of the concentration in mol/L. The second part gives the temperature dependence of Λ for HCl and HBr. More extensive tables and mathematical representations may be found in the reference.

Reference

Hamer, W. J., and DeWane, H. J., *Electrolytic Conductance and the Conductances of the Hydrohalogen Acids in Water*, Natl. Stand. Ref. Data Sys.- Natl. Bur. Standards (U.S.), No. 33, 1970.

$c/\text{mol L}^{-1}$	HF	HCl	HBr	HI	$c/\text{mol L}^{-1}$	HF	HCl	HBr	HI
Inf. dil.	405.1	426.1	427.7	426.4	3.5		218.3	217.5	215.4
0.0001		424.5	425.9	424.6	4.0		200.0	199.4	195.1
0.0005		422.6	424.3	423.0	4.5		183.1	182.4	176.8
0.001		421.2	422.9	421.7	5.0		167.4	166.5	160.4
0.005	128.1	415.7	417.6	416.4	5.5		152.9	151.8	145.5
0.01	96.1	411.9	413.7	412.8	6.0		139.7	138.2	131.7
0.05	50.1	398.9	400.4	400.8	6.5		127.7	125.7	118.6
0.10	39.1	391.1	391.9	394.0	7.0		116.9	114.2	105.7
0.5	26.3	360.7	361.9	369.8	7.5		107.0	103.8	
1.0	24.3	332.2	334.5	343.9	8.0		98.2	94.4	
1.5		305.8	307.6	316.4	8.5		90.3	85.8	
2.0		281.4	281.7	288.9	9.0		83.1		
2.5		258.9	257.8	262.5	9.5		76.6		
3.0		237.6	236.8	237.9	10.0		70.7		

$c/\text{mol L}^{-1}$	HCl								$c/\text{mol L}^{-1}$	HBr							
	-20°C	-10°C	0°C	10°C	20°C	30°C	40°C	50°C		-20°C	-10°C	0°C	10°C	20°C	30°C	40°C	50°C
0.5			228.7	283.0	336.4	386.8	436.9	482.4	0.5			240.9	295.9	347.0	398.9	453.6	496.8
1.0			211.7	261.6	312.2	359.0	402.9	445.3	1.0			229.6	276.0	329.0	380.4	418.6	465.2
1.5			196.2	241.5	287.5	331.1	371.6	410.8	1.5			209.5	254.9	298.9	340.6	381.8	421.4
2.0			182.0	222.7	262.9	303.3	342.4	378.2	2.0		150.8	188.6	231.3	271.8	314.1	350.5	387.4
2.5		131.7	168.5	205.1	239.8	277.0	315.2	347.6	2.5		136.8	171.7	208.3	244.8	281.7	316.0	349.1
3.0		120.8	154.6	188.5	219.3	253.3	289.3	319.0	3.0		125.7	157.2	189.5	222.2	255.0	287.8	318.6
3.5	85.5	111.3	139.6	172.2	201.6	232.9	263.9	292.1	3.5		116.1	144.1	174.6	203.2	234.4	263.7	291.9
4.0	79.3	102.7	129.2	158.1	185.6	214.2	242.2	268.2	4.0	84.0	107.5	132.3	160.2	186.8	214.2	239.7	266.9
4.5	73.7	94.9	119.5	145.4	170.6	196.6	222.5	246.7	4.5	78.0	99.0	123.0	146.4	171.2	195.1	218.8	242.6
5.0	68.5	87.8	110.3	133.5	156.6	180.2	204.1	226.5	5.0	72.3	91.4	112.6	134.0	155.7	178.2	199.6	221.3
5.5	63.6	81.1	101.7	122.5	143.6	165.0	187.1	207.7	5.5	67.0	84.2	103.1	122.7	142.1	162.8	181.4	201.8
6.0	58.9	74.9	93.7	112.3	131.5	151.0	171.3	190.3	6.0	61.8	77.2	94.3	112.0	129.6	148.0	165.4	183.4
6.5	54.4	69.1	86.2	103.0	120.4	138.2	156.9	174.3	6.5	56.8	70.7	86.0	102.0	118.0	134.1	150.5	166.3
7.0	50.2	63.7	79.3	94.4	110.2	126.4	143.3	159.7	7.0	51.9	64.6	78.4	92.6	107.1	121.4	136.3	150.8
7.5	46.3	58.6	73.0	86.5	100.9	115.7	131.6	146.2									
8.0	42.7	54.0	67.1	79.4	92.4	106.1	120.6	134.0									
8.5	39.4	49.8	61.7	72.9	84.7	97.3	110.7	123.0									
9.0	36.4	45.9	56.8	67.1	77.8	89.4	101.7	112.9									
9.5	33.6	42.3	52.3	61.8	71.5	82.3	93.6	103.9									
10.0	31.2	39.1	48.2	57.0	65.8	75.9	86.3	95.7									
10.5	28.9	36.1	44.5	52.7	60.7	70.1	79.6	88.4									
11.0	26.8	33.4	41.1	48.8	56.1	64.9	73.6	81.7									
11.5	24.9	31.0	38.0	45.3	51.9	60.1	68.0	75.6									
12.0	23.1	28.7	35.3	42.0	48.0	55.6	62.8	70.0									
12.5	21.4	26.7	32.7	39.0	44.4	51.4	57.9	64.8									

STANDARD KCl SOLUTIONS FOR CALIBRATING CONDUCTIVITY CELLS

This table presents recommended electrolytic conductivity (κ) values for aqueous potassium chloride solutions with molalities of 0.01 mol/kg, 0.1 mol/kg and 1.0 mol/kg at temperatures from 0°C to 50°C. The values, which are based on measurements at the National Institute of Standards and Technology, provide primary standards for the calibration of conductivity cells. The measurements at 0.01 and 0.1 molal are described in Reference 1, while those at 1.0 molal are in Reference 2. Temperatures are given on the ITS-90 scale. The uncertainty in the conductivity is about 0.03% for the 0.01 molal values and about 0.04% for the 0.1 and 1.0 molal values. The conductivity of water saturated with atmospheric CO₂ is given in the last column. These values were subtracted from the original measurements to give the values in the second, third, and fourth columns. All κ values are given in units of 10⁻⁴ S/m (numerically equal to μ S/cm).

The assistance of Kenneth W. Pratt is appreciated.

$t/^\circ\text{C}$	$10^4 \kappa/\text{S m}^{-1}$			
	0.01 m KCl	0.1 m KCl	1.0 m KCl	H ₂ O (CO ₂ sat.)
0	772.92	7 116.85	63 488	0.58
5	890.96	8 183.70	72 030	0.68
10	1 013.95	9 291.72	80 844	0.79
15	1 141.45	10 437.1	89 900	0.89
18	1 219.93	11 140.6	—	0.95
20	1 273.03	11 615.9	99 170	0.99
25	1 408.23	12 824.6	108 620	1.10
30	1 546.63	14 059.2	118 240	1.20
35	1 687.79	15 316.0	127 970	1.30
40	1 831.27	16 591.0	137 810	1.40
45	1 976.62	17 880.6	147 720	1.51
50	2 123.43	19 180.9	157 670	1.61

References

1. Wu, Y. C., Koch, W. F., and Pratt, K. W., *J. Res. Natl. Inst. Stand. Technol.* 96, 191, 1991.
2. Wu, Y. C., Koch, W. F., Feng, D., Holland, L. A., Juhasz, E., Arvay, E., and Tomek, A., *J. Res. Natl. Inst. Stand. Technol.* 99, 241, 1994.
3. Pratt, K. W., Koch, W. F., Wu, Y. C., and Berezansky, P. A., *Pure Appl. Chem.* 73, 1783, 2001.

EQUIVALENT CONDUCTIVITY OF ELECTROLYTES IN AQUEOUS SOLUTION

Petr Vanýsek

This table gives the equivalent (molar) conductivity Λ at 25°C for some common electrolytes in aqueous solution at concentrations up to 0.1 mol/L. The units of Λ are $10^{-4} \text{ m}^2 \text{ S mol}^{-1}$.

For very dilute solutions, the equivalent conductivity for any electrolyte of concentration c can be approximately calculated using the Debye-Hückel-Onsager equation, which can be written for a symmetrical (equal charge on cation and anion) electrolyte as

$$\Lambda = \Lambda^\circ - (A + B\Lambda^\circ)c^{1/2}$$

For a solution at 25°C and both cation and anion with charge $|1|$, the constants are $A = 60.20$ and $B = 0.229$. Λ° can be found from the next table, "Ionic Conductivity and Diffusion at Infinite Dilution". The equation is reliable for $c < 0.001 \text{ mol/L}$; with higher concentration the error increases.

Compound	Infinite dilution Λ°	Concentration (mol/L)						
		0.0005	0.001	0.005	0.01	0.02	0.05	0.1
AgNO ₃	133.29	131.29	130.45	127.14	124.70	121.35	115.18	109.09
1/2BaCl ₂	139.91	135.89	134.27	127.96	123.88	119.03	111.42	105.14
1/2CaCl ₂	135.77	131.86	130.30	124.19	120.30	115.59	108.42	102.41
1/2Ca(OH) ₂	258	—	—	233	226	214	—	—
1/2CuSO ₄	133.6	121.6	115.20	94.02	83.08	72.16	59.02	50.55
HCl	425.95	422.53	421.15	415.59	411.80	407.04	398.89	391.13
KBr	151.9	149.8	148.9	146.02	143.36	140.41	135.61	131.32
KCl	149.79	147.74	146.88	143.48	141.20	138.27	133.30	128.90
KClO ₄	139.97	138.69	137.80	134.09	131.39	127.86	121.56	115.14
1/3K ₃ Fe(CN) ₆	174.5	166.4	163.1	150.7	—	—	—	—
1/4K ₄ Fe(CN) ₆	184	—	167.16	146.02	134.76	122.76	107.65	97.82
KHCO ₃	117.94	116.04	115.28	112.18	110.03	107.17	—	—
KI	150.31	148.2	143.32	144.30	142.11	139.38	134.90	131.05
KIO ₄	127.86	125.74	124.88	121.18	118.45	114.08	106.67	98.2
KNO ₃	144.89	142.70	141.77	138.41	132.75	132.34	126.25	120.34
KMnO ₄	134.8	132.7	131.9	—	126.5	—	—	113
KOH	271.5	—	234	230	228	—	219	213
KReO ₄	128.20	126.03	125.12	121.31	118.49	114.49	106.40	97.40
1/3LaCl ₃	145.9	139.6	137.0	127.5	121.8	115.3	106.2	99.1
LiCl	114.97	113.09	112.34	109.35	107.27	104.60	100.06	95.81
LiClO ₄	105.93	104.13	103.39	100.52	98.56	96.13	92.15	88.52
1/2MgCl ₂	129.34	125.55	124.15	118.25	114.49	109.99	103.03	97.05
NH ₄ Cl	149.6	147.5	146.7	134.4	141.21	138.25	133.22	128.69
NaCl	126.39	124.44	123.68	120.59	118.45	115.70	111.01	106.69
NaClO ₄	117.42	115.58	114.82	111.70	109.54	106.91	102.35	98.38
NaI	126.88	125.30	124.19	121.19	119.18	116.64	112.73	108.73
NaOOCCH ₃	91.0	89.2	88.5	85.68	83.72	81.20	76.88	72.76
NaOH	247.7	245.5	244.6	240.7	237.9	—	—	—
Na picrate	80.45	78.7	78.6	75.7	73.7	—	66.3	61.8
1/2Na ₂ SO ₄	129.8	125.68	124.09	117.09	112.38	106.73	97.70	89.94
1/2SrCl ₂	135.73	131.84	130.27	124.18	120.23	115.48	108.20	102.14
1/2ZnSO ₄	132.7	121.3	114.47	95.44	84.87	74.20	61.17	52.61

IONIC CONDUCTIVITY AND DIFFUSION AT INFINITE DILUTION

Petr Vanýsek

This table gives the molar (equivalent) conductivity λ for common ions at infinite dilution. All values refer to aqueous solutions at 25°C. It also lists the diffusion coefficient D of the ion in dilute aqueous solution, which is related to λ through the equation

$$D = (RT / F^2)(\lambda / |z|)$$

where R is the molar gas constant, T the temperature, F the Faraday constant, and z the charge on the ion. The variation with temperature is fairly sharp; for typical ions, λ and D increase by 2 to 3% per degree as the temperature increases from 25°C.

The diffusion coefficient for a salt, D_{salt} , may be calculated from the D_+ and D_- values of the constituent ions by the relation

$$D_{\text{salt}} = \frac{(z_+ + |z_-|)D_+D_-}{z_+D_+ + |z_-|D_-}$$

For solutions of simple, pure electrolytes (one positive and one negative ionic species), such as NaCl, equivalent ionic conductivity Λ° , which is the molar conductivity per unit concentration of charge, is defined as

$$\Lambda^\circ = \Lambda_+ + \Lambda_-$$

where Λ_+ and Λ_- are equivalent ionic conductivities of the cation and anion. The more general formula is

$$\Lambda^\circ = \nu_+\Lambda_+ + \nu_-\Lambda_-$$

where ν_+ and ν_- refer to the number of moles of cations and anions to which one mole of the electrolyte gives a rise in the solution.

References

1. Gray, D. E., Ed., *American Institute of Physics Handbook*, McGraw-Hill, New York, 1972, 2-226.
2. Robinson, R. A., and Stokes, R. H., *Electrolyte Solutions*, Butterworths, London, 1959.
3. Lobo, V. M. M., and Quaresma, J. L., *Handbook of Electrolyte Solutions*, Physical Science Data Series 41, Elsevier, Amsterdam, 1989.
4. Conway, B. E., *Electrochemical Data*, Elsevier, Amsterdam, 1952.
5. Milazzo, G., *Electrochemistry: Theoretical Principles and Practical Applications*, Elsevier, Amsterdam, 1963.

Ion	Λ_+ $10^{-4} \text{ m}^2 \text{ S mol}^{-1}$	D $10^{-5} \text{ cm}^2 \text{ s}^{-1}$
<i>Inorganic Cations</i>		
Ag ⁺	61.9	1.648
1/3Al ³⁺	61	0.541
1/2Ba ²⁺	63.6	0.847
1/2Be ²⁺	45	0.599
1/2Ca ²⁺	59.47	0.792
1/2Cd ²⁺	54	0.719
1/3Ce ³⁺	69.8	0.620
1/2Co ²⁺	55	0.732
1/3[Co(NH ₃) ₆] ³⁺	101.9	0.904
1/3[Co(en) ₃] ³⁺	74.7	0.663
1/6[Co ₂ (trien) ₃] ⁶⁺	69	0.306
1/3Cr ³⁺	67	0.595
Cs ⁺	77.2	2.056
1/2Cu ²⁺	53.6	0.714
D ⁺	249.9	6.655
1/3Dy ³⁺	65.6	0.582
1/3Er ³⁺	65.9	0.585
1/3Eu ³⁺	67.8	0.602
1/2Fe ²⁺	54	0.719
1/3Fe ³⁺	68	0.604
1/3Gd ³⁺	67.3	0.597
H ⁺	349.65	9.311
1/2Hg ²⁺	68.6	0.913
1/2Hg ²⁺	63.6	0.847
1/3Ho ³⁺	66.3	0.589
K ⁺	73.48	1.957
1/3La ³⁺	69.7	0.619
Li ⁺	38.66	1.029
1/2Mg ²⁺	53.0	0.706
1/2Mn ²⁺	53.5	0.712
NH ₄ ⁺	73.5	1.957
N ₂ H ₅ ⁺	59	1.571

Ion	Λ_+ $10^{-4} \text{ m}^2 \text{ S mol}^{-1}$	D $10^{-5} \text{ cm}^2 \text{ s}^{-1}$
Na ⁺	50.08	1.334
1/3Nd ³⁺	69.4	0.616
1/2Ni ²⁺	49.6	0.661
1/4[Ni ₂ (trien) ₃] ⁴⁺	52	0.346
1/2Pb ²⁺	71	0.945
1/3Pr ³⁺	69.5	0.617
1/2Ra ²⁺	66.8	0.889
Rb ⁺	77.8	2.072
1/3Sc ³⁺	64.7	0.574
1/3Sm ³⁺	68.5	0.608
1/2Sr ²⁺	59.4	0.791
Tl ⁺	74.7	1.989
1/3Tm ³⁺	65.4	0.581
1/2UO ₂ ²⁺	32	0.426
1/3Y ³⁺	62	0.550
1/3Yb ³⁺	65.6	0.582
1/2Zn ²⁺	52.8	0.703
<i>Inorganic Anions</i>		
Au(CN) ₂ ⁻	50	1.331
Au(CN) ₄ ⁻	36	0.959
B(C ₆ H ₅) ₄ ⁻	21	0.559
Br ⁻	78.1	2.080
Br ₃ ⁻	43	1.145
BrO ₃ ⁻	55.7	1.483
CN ⁻	78	2.077
CNO ⁻	64.6	1.720
1/2CO ₃ ²⁻	69.3	0.923
Cl ⁻	76.31	2.032
ClO ₂ ⁻	52	1.385
ClO ₃ ⁻	64.6	1.720
ClO ₄ ⁻	67.3	1.792
1/3[Co(CN) ₆] ³⁻	98.9	0.878
1/2CrO ₄ ²⁻	85	1.132

Ion	Λ_{\pm} $10^{-4} \text{ m}^2 \text{ S mol}^{-1}$	D $10^{-5} \text{ cm}^2 \text{ s}^{-1}$	Ion	Λ_{\pm} $10^{-4} \text{ m}^2 \text{ S mol}^{-1}$	D $10^{-5} \text{ cm}^2 \text{ s}^{-1}$
F ⁻	55.4	1.475	Histidyl ⁺	23.0	0.612
1/4[Fe(CN) ₆] ⁴⁻	110.4	0.735	Hydroxyethyltrimethylarsonium ⁺	39.4	1.049
1/3[Fe(CN) ₆] ³⁻	100.9	0.896	Methylammonium ⁺	58.7	1.563
H ₂ AsO ₄ ⁻	34	0.905	Octadecylpyridinium ⁺	20	0.533
HCO ₃ ⁻	44.5	1.185	Octadecyltributylammonium ⁺	16.6	0.442
HF ₂ ⁻	75	1.997	Octadecyltriethylammonium ⁺	17.9	0.477
1/2HPO ₄ ²⁻	57	0.759	Octadecyltrimethylammonium ⁺	19.9	0.530
H ₂ PO ₄ ⁻	36	0.959	Octadecyltripropylammonium ⁺	17.2	0.458
H ₂ PO ₂ ⁻	46	1.225	Octyltrimethylammonium ⁺	26.5	0.706
HS ⁻	65	1.731	Pentylammonium ⁺	37	0.985
HSO ₃ ⁻	58	1.545	Piperidinium ⁺	37.2	0.991
HSO ₄ ⁻	52	1.385	Propylammonium ⁺	40.8	1.086
H ₂ SbO ₄ ⁻	31	0.825	Pyridylammonium ⁺	24.3	0.647
I ⁻	76.8	2.045	Tetrabutylammonium ⁺	19.5	0.519
IO ₃ ⁻	40.5	1.078	Tetradecyltrimethylammonium ⁺	21.5	0.573
IO ₄ ⁻	54.5	1.451	Tetraethylammonium ⁺	32.6	0.868
MnO ₄ ⁻	61.3	1.632	Tetramethylammonium ⁺	44.9	1.196
1/2MoO ₄ ²⁻	74.5	1.984	Tetraoisopentylammonium ⁺	17.9	0.477
N(CN) ₂ ⁻	54.5	1.451	Tetrapentylammonium ⁺	17.5	0.466
NO ₂ ⁻	71.8	1.912	Tetrapropylammonium ⁺	23.4	0.623
NO ₃ ⁻	71.42	1.902	Triethylammonium ⁺	34.3	0.913
NH ₂ SO ₃ ⁻	48.3	1.286	Triethylsulfonium ⁺	36.1	0.961
N ₃ ⁻	69	1.837	Trimethylammonium ⁺	47.23	1.258
OCN ⁻	64.6	1.720	Trimethylhexylammonium ⁺	34.6	0.921
OD ⁻	119	3.169	Trimethylsulfonium ⁺	51.4	1.369
OH ⁻	198	5.273	Tripentylammonium ⁺	26.1	0.695
PF ₆ ⁻	56.9	1.515			
1/2PO ₃ F ₂ ⁻	63.3	0.843	Organic Anions		
1/3PO ₄ ³⁻	92.8	0.824	Acetate ⁻	40.9	1.089
1/4P ₂ O ₇ ⁴⁻	96	0.639	<i>p</i> -Anisate ⁻	29.0	0.772
1/3P ₃ O ₉ ³⁻	83.6	0.742	1/2Azelate ²⁻	40.6	0.541
1/5P ₃ O ₁₀ ⁵⁻	109	0.581	Benzoate ⁻	32.4	0.863
ReO ₄ ⁻	54.9	1.462	Bromoacetate ⁻	39.2	1.044
SCN ⁻	66	1.758	Bromobenzoate ⁻	30	0.799
1/2SO ₃ ²⁻	72	0.959	Butyrate ⁻	32.6	0.868
1/2SO ₄ ²⁻	80.0	1.065	Chloroacetate ⁻	39.8	1.060
1/2S ₂ O ₃ ²⁻	85.0	1.132	<i>m</i> -Chlorobenzoate ⁻	31	0.825
1/2S ₂ O ₄ ²⁻	66.5	0.885	<i>o</i> -Chlorobenzoate ⁻	30.2	0.804
1/2S ₂ O ₆ ²⁻	93	1.238	1/3Citrate ³⁻	70.2	0.623
1/2S ₂ O ₈ ²⁻	86	1.145	Crotonate ⁻	33.2	0.884
Sb(OH) ₆ ⁻	31.9	0.849	Cyanoacetate ⁻	43.4	1.156
SeCN ⁻	64.7	1.723	Cyclohexane carboxylate ⁻	28.7	0.764
1/2SeO ₄ ²⁻	75.7	1.008	1/2 1,1-Cyclopropanedicarboxylate ²⁻	53.4	0.711
1/2WO ₄ ²⁻	69	0.919	Decylsulfate ⁻	26	0.692
			Dichloroacetate ⁻	38.3	1.020
Organic Cations			1/2Diethylbarbiturate ²⁻	26.3	0.350
Benzyltrimethylammonium ⁺	34.6	0.921	Dihydrogencitrate ⁻	30	0.799
Isobutylammonium ⁺	38	1.012	1/2Dimethylmalonate ²⁻	49.4	0.658
Butyltrimethylammonium ⁺	33.6	0.895	3,5-Dinitrobenzoate ⁻	28.3	0.754
Decylpyridinium ⁺	29.5	0.786	Dodecylsulfate ⁻	24	0.639
Decyltrimethylammonium ⁺	24.4	0.650	Ethylmalonate ⁻	49.3	1.313
Diethylammonium ⁺	42.0	1.118	Ethylsulfate ⁻	39.6	1.055
Dimethylammonium ⁺	51.8	1.379	Fluoroacetate ⁻	44.4	1.182
Dipropylammonium ⁺	30.1	0.802	Fluorobenzoate ⁻	33	0.879
Dodecylammonium ⁺	23.8	0.634	Formate ⁻	54.6	1.454
Dodecyltrimethylammonium ⁺	22.6	0.602	1/2Fumarate ²⁻	61.8	0.823
Ethanolammonium ⁺	42.2	1.124	1/2Glutarate ²⁻	52.6	0.700
Ethylammonium ⁺	47.2	1.257	Hydrogenoxalate ⁻	40.2	1.070
Ethyltrimethylammonium ⁺	40.5	1.078	Isovalerate ⁻	32.7	0.871
Hexadecyltrimethylammonium ⁺	20.9	0.557	Iodoacetate ⁻	40.6	1.081
Hexyltrimethylammonium ⁺	29.6	0.788	Lactate ⁻	38.8	1.033

Ion	Λ_{\pm}	D	Ion	Λ_{\pm}	D
	$10^{-4} \text{ m}^2 \text{ S mol}^{-1}$	$10^{-5} \text{ cm}^2 \text{ s}^{-1}$		$10^{-4} \text{ m}^2 \text{ S mol}^{-1}$	$10^{-5} \text{ cm}^2 \text{ s}^{-1}$
1/2Malate ²⁻	58.8	0.783	Picrate ⁻	30.37	0.809
1/2Maleate ²⁻	61.9	0.824	Pivalate ⁻	31.9	0.849
1/2Malonate ²⁻	63.5	0.845	Propionate ⁻	35.8	0.953
Methylsulfate ⁻	48.8	1.299	Propylsulfate ⁻	37.1	0.988
Naphthylacetate ⁻	28.4	0.756	Salicylate ⁻	36	0.959
1/2Oxalate ²⁻	74.11	0.987	1/2Suberate ²⁻	36	0.479
Octylsulfate ⁻	29	0.772	1/2Succinate ²⁻	58.8	0.783
Phenylacetate ⁻	30.6	0.815	<i>p</i> -Sulfonate	29.3	0.780
1/2 <i>o</i> -Phthalate ²⁻	52.3	0.696	1/2Tartarate ²⁻	59.6	0.794
1/2 <i>m</i> -Phthalate ²⁻	54.7	0.728	Trichloroacetate ⁻	35	0.932

ACTIVITY COEFFICIENTS OF ACIDS, BASES, AND SALTS

Petr Vanýsek

This table gives mean activity coefficients at 25°C for molalities in the range 0.1 to 1.0. See the following table for definitions, refer-

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
AgNO ₃	0.734	0.657	0.606	0.567	0.536	0.509	0.485	0.464	0.446	0.429
AlCl ₃	0.337	0.305	0.302	0.313	0.331	0.356	0.388	0.429	0.479	0.539
Al ₂ (SO ₄) ₃	0.035	0.0225	0.0176	0.0153	0.0143	0.014	0.0142	0.0149	0.0159	0.0175
BaCl ₂	0.500	0.444	0.419	0.405	0.397	0.391	0.391	0.391	0.392	0.395
BeSO ₄	0.150	0.109	0.0885	0.0769	0.0692	0.0639	0.0600	0.0570	0.0546	0.0530
CaCl ₂	0.518	0.472	0.455	0.448	0.448	0.453	0.460	0.470	0.484	0.500
CdCl ₂	0.2280	0.1638	0.1329	0.1139	0.1006	0.0905	0.0827	0.0765	0.0713	0.0669
Cd(NO ₃) ₂	0.513	0.464	0.442	0.430	0.425	0.423	0.423	0.425	0.428	0.433
CdSO ₄	0.150	0.103	0.0822	0.0699	0.0615	0.0553	0.0505	0.0468	0.0438	0.0415
CoCl ₂	0.522	0.479	0.463	0.459	0.462	0.470	0.479	0.492	0.511	0.531
CrCl ₃	0.331	0.298	0.294	0.300	0.314	0.335	0.362	0.397	0.436	0.481
Cr(NO ₃) ₃	0.319	0.285	0.279	0.281	0.291	0.304	0.322	0.344	0.371	0.401
Cr ₂ (SO ₄) ₃	0.0458	0.0300	0.0238	0.0207	0.0190	0.0182	0.0181	0.0185	0.0194	0.0208
CsBr	0.754	0.694	0.654	0.626	0.603	0.586	0.571	0.558	0.547	0.538
CsCl	0.756	0.694	0.656	0.628	0.606	0.589	0.575	0.563	0.553	0.544
CsI	0.754	0.692	0.651	0.621	0.599	0.581	0.567	0.554	0.543	0.533
CsNO ₃	0.733	0.655	0.602	0.561	0.528	0.501	0.478	0.458	0.439	0.422
CsOH	0.795	0.761	0.744	0.739	0.739	0.742	0.748	0.754	0.762	0.771
CsOAc	0.799	0.771	0.761	0.759	0.762	0.768	0.776	0.783	0.792	0.802
Cs ₂ SO ₄	0.456	0.382	0.338	0.311	0.291	0.274	0.262	0.251	0.242	0.235
CuCl ₂	0.508	0.455	0.429	0.417	0.411	0.409	0.409	0.410	0.413	0.417
Cu(NO ₃) ₂	0.511	0.460	0.439	0.429	0.426	0.427	0.431	0.437	0.445	0.455
CuSO ₄	0.150	0.104	0.0829	0.0704	0.0620	0.0559	0.0512	0.0475	0.0446	0.0423
FeCl ₂	0.5185	0.473	0.454	0.448	0.450	0.454	0.463	0.473	0.488	0.506
HBr	0.805	0.782	0.777	0.781	0.789	0.801	0.815	0.832	0.850	0.871
HCl	0.796	0.767	0.756	0.755	0.757	0.763	0.772	0.783	0.795	0.809
HClO ₄	0.803	0.778	0.768	0.766	0.769	0.776	0.785	0.795	0.808	0.823
HI	0.818	0.807	0.811	0.823	0.839	0.860	0.883	0.908	0.935	0.963
HNO ₃	0.791	0.754	0.735	0.725	0.720	0.717	0.717	0.718	0.721	0.724
H ₂ SO ₄	0.2655	0.2090	0.1826	—	0.1557	—	0.1417	—	—	0.1316
KBr	0.772	0.722	0.693	0.673	0.657	0.646	0.636	0.629	0.622	0.617
KCl	0.770	0.718	0.688	0.666	0.649	0.637	0.626	0.618	0.610	0.604
KClO ₃	0.749	0.681	0.635	0.599	0.568	0.541	0.518	—	—	—
K ₂ CrO ₄	0.456	0.382	0.340	0.313	0.292	0.276	0.263	0.253	0.243	0.235
KF	0.775	0.727	0.700	0.682	0.670	0.661	0.654	0.650	0.646	0.645
K ₃ Fe(CN) ₆	0.268	0.212	0.184	0.167	0.155	0.146	0.140	0.135	0.131	0.128
K ₄ Fe(CN) ₆	0.139	0.0993	0.0808	0.0693	0.0614	0.0556	0.0512	0.0479	0.0454	—
KH ₂ PO ₄	0.731	0.653	0.602	0.561	0.529	0.501	0.477	0.456	0.438	0.421
KI	0.778	0.733	0.707	0.689	0.676	0.667	0.660	0.654	0.649	0.645
KNO ₃	0.739	0.663	0.614	0.576	0.545	0.519	0.496	0.476	0.459	0.443
KOAc	0.796	0.766	0.754	0.750	0.751	0.754	0.759	0.766	0.774	0.783
KOH	0.798	0.760	0.742	0.734	0.732	0.733	0.736	0.742	0.749	0.756
KSCN	0.769	0.716	0.685	0.663	0.646	0.633	0.623	0.614	0.606	0.599
K ₂ SO ₄	0.441	0.360	0.316	0.286	0.264	0.246	0.232	—	—	—
LiBr	0.796	0.766	0.756	0.752	0.753	0.758	0.767	0.777	0.789	0.803
LiCl	0.790	0.757	0.744	0.740	0.739	0.743	0.748	0.755	0.764	0.774
LiClO ₄	0.812	0.794	0.792	0.798	0.808	0.820	0.834	0.852	0.869	0.887
LiI	0.815	0.802	0.804	0.813	0.824	0.838	0.852	0.870	0.888	0.910
LiNO ₃	0.788	0.752	0.736	0.728	0.726	0.727	0.729	0.733	0.737	0.743
LiOH	0.760	0.702	0.665	0.638	0.617	0.599	0.585	0.573	0.563	0.554
LiOAc	0.784	0.742	0.721	0.709	0.700	0.691	0.689	0.688	0.688	0.689
Li ₂ SO ₄	0.468	0.398	0.361	0.337	0.319	0.307	0.297	0.289	0.282	0.277
MgCl ₂	0.529	0.489	0.477	0.475	0.481	0.491	0.506	0.522	0.544	0.570
MgSO ₄	0.150	0.107	0.0874	0.0756	0.0675	0.0616	0.0571	0.0536	0.0508	0.0485

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
MnCl ₂	0.516	0.469	0.450	0.442	0.440	0.443	0.448	0.455	0.466	0.479
MnSO ₄	0.150	0.105	0.0848	0.0725	0.0640	0.0578	0.0530	0.0493	0.0463	0.0439
NH ₄ Cl	0.770	0.718	0.687	0.665	0.649	0.636	0.625	0.617	0.609	0.603
NH ₄ NO ₃	0.740	0.677	0.636	0.606	0.582	0.562	0.545	0.530	0.516	0.504
(NH ₄) ₂ SO ₄	0.439	0.356	0.311	0.280	0.257	0.240	0.226	0.214	0.205	0.196
NaBr	0.782	0.741	0.719	0.704	0.697	0.692	0.689	0.687	0.687	0.687
NaCl	0.778	0.735	0.710	0.693	0.681	0.673	0.667	0.662	0.659	0.657
NaClO ₃	0.772	0.720	0.688	0.664	0.645	0.630	0.617	0.606	0.597	0.589
NaClO ₄	0.775	0.729	0.701	0.683	0.668	0.656	0.648	0.641	0.635	0.629
Na ₂ CrO ₄	0.464	0.394	0.353	0.327	0.307	0.292	0.280	0.269	0.261	0.253
NaF	0.765	0.710	0.676	0.651	0.632	0.616	0.603	0.592	0.582	0.573
NaH ₂ PO ₄	0.744	0.675	0.629	0.593	0.563	0.539	0.517	0.499	0.483	0.468
NaI	0.787	0.751	0.735	0.727	0.723	0.723	0.724	0.727	0.731	0.736
NaNO ₃	0.762	0.703	0.666	0.638	0.617	0.599	0.583	0.570	0.558	0.548
NaOAc	0.791	0.757	0.744	0.737	0.735	0.736	0.740	0.745	0.752	0.757
NaOH	0.766	0.727	0.708	0.697	0.690	0.685	0.681	0.679	0.678	0.678
NaSCN	0.787	0.750	—	0.720	0.715	0.712	0.710	0.710	0.711	0.712
Na ₂ SO ₄	0.445	0.365	0.320	0.289	0.266	0.248	0.233	0.221	0.210	0.201
NiCl ₂	0.522	0.479	0.463	0.460	0.464	0.471	0.482	0.496	0.515	0.563
NiSO ₄	0.150	0.105	0.0841	0.0713	0.0627	0.0562	0.0515	0.0478	0.0448	0.0425
Pb(NO ₃) ₂	0.395	0.308	0.260	0.228	0.205	0.187	0.172	0.160	0.150	0.141
RbBr	0.763	0.706	0.673	0.650	0.632	0.617	0.605	0.595	0.586	0.578
RbCl	0.764	0.709	0.675	0.652	0.634	0.620	0.608	0.599	0.590	0.583
RbI	0.762	0.705	0.671	0.647	0.629	0.614	0.602	0.591	0.583	0.575
RbNO ₃	0.734	0.658	0.606	0.565	0.534	0.508	0.485	0.465	0.446	0.430
RbOAc	0.796	0.767	0.756	0.753	0.755	0.759	0.766	0.773	0.782	0.792
Rb ₂ SO ₄	0.451	0.374	0.331	0.301	0.279	0.263	0.249	0.238	0.228	0.219
SrCl ₂	0.511	0.462	0.442	0.433	0.430	0.431	0.434	0.441	0.449	0.461
TlClO ₄	0.730	0.652	0.599	0.559	0.527	—	—	—	—	—
TlNO ₃	0.702	0.606	0.545	0.500	—	—	—	—	—	—
UO ₂ Cl ₂	0.544	0.510	0.520	0.505	0.517	0.532	0.549	0.571	0.595	0.620
UO ₂ SO ₄	0.150	0.102	0.0807	0.0689	0.0611	0.0566	0.0515	0.0483	0.0458	0.0439
ZnCl ₂	0.515	0.462	0.432	0.411	0.394	0.380	0.369	0.357	0.348	0.339
Zn(NO ₃) ₂	0.531	0.489	0.474	0.469	0.473	0.480	0.489	0.501	0.518	0.535
ZnSO ₄	0.150	0.140	0.0835	0.0714	0.0630	0.0569	0.0523	0.0487	0.0458	0.0435

MEAN ACTIVITY COEFFICIENTS OF ELECTROLYTES AS A FUNCTION OF CONCENTRATION

The mean activity coefficient γ of an electrolyte $X_a Y_b$ is defined as

$$\gamma = (\gamma_+^a \gamma_-^b)^{1/(a+b)}$$

where γ_+ and γ_- are activity coefficients of the individual ions (which cannot be directly measured). This table gives the mean activity coefficients of about 100 electrolytes in aqueous solution as a function of concentration, expressed in molality terms. All

values refer to a temperature of 25°C. Substances are arranged in alphabetical order by formula.

References

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Mean Activity Coefficient at 25°C

<i>m</i> /mol kg ⁻¹	AgNO₃	BaBr₂	BaCl₂	BaI₂	CaBr₂	CaCl₂	CaI₂
0.001	0.964	0.881	0.887	0.890	0.890	0.888	0.890
0.002	0.950	0.850	0.849	0.853	0.853	0.851	0.853
0.005	0.924	0.785	0.782	0.792	0.791	0.787	0.791
0.010	0.896	0.727	0.721	0.737	0.735	0.727	0.736
0.020	0.859	0.661	0.653	0.678	0.674	0.664	0.677
0.050	0.794	0.573	0.559	0.600	0.594	0.577	0.600
0.100	0.732	0.517	0.492	0.551	0.540	0.517	0.552
0.200	0.656	0.463	0.436	0.520	0.502	0.469	0.524
0.500	0.536	0.435	0.391	0.536	0.500	0.444	0.554
1.000	0.430	0.470	0.393	0.664	0.604	0.495	0.729
2.000	0.316	0.654		1.242	1.125	0.784	
5.000	0.181				18.7	5.907	
10.000	0.108					43.1	
15.000	0.085						
<i>m</i> /mol kg ⁻¹	Cd(NO₂)₂	Cd(NO₃)₂	CoBr₂	CoCl₂	CoI₂	Co(NO₃)₂	CsBr
0.001	0.881	0.888	0.890	0.889	0.887	0.888	0.965
0.002	0.837	0.851	0.854	0.852	0.849	0.850	0.951
0.005	0.759	0.787	0.794	0.789	0.783	0.786	0.925
0.010	0.681	0.728	0.740	0.732	0.724	0.728	0.898
0.020	0.589	0.664	0.681	0.670	0.661	0.663	0.864
0.050	0.451	0.576	0.605	0.586	0.582	0.576	0.806
0.100	0.344	0.515	0.556	0.528	0.540	0.516	0.752
0.200	0.247	0.465	0.523	0.483	0.527	0.469	0.691
0.500	0.148	0.428	0.538	0.465	0.596	0.446	0.605
1.000	0.098	0.437	0.685	0.532	0.845	0.492	0.540
2.000	0.069	0.517	1.421	0.864	2.287	0.722	0.485
5.000	0.054		13.9		55.3	3.338	0.454
10.000					196		
<i>m</i> /mol kg ⁻¹	CsCl	CsF	CsI	CsNO₃	CsOH	Cs₂SO₄	CuBr₂
0.001	0.965	0.965	0.965	0.964	0.966	0.885	0.889
0.002	0.951	0.952	0.951	0.951	0.953	0.845	0.853
0.005	0.925	0.929	0.925	0.924	0.930	0.775	0.791
0.010	0.898	0.905	0.898	0.897	0.906	0.709	0.735
0.020	0.864	0.876	0.863	0.860	0.878	0.634	0.674
0.050	0.805	0.830	0.804	0.796	0.836	0.526	0.594
0.100	0.751	0.792	0.749	0.733	0.802	0.444	0.541
0.200	0.691	0.755	0.688	0.655	0.772	0.369	0.504
0.500	0.607	0.721	0.601	0.529	0.755	0.285	0.503
1.000	0.546	0.726	0.534	0.421	0.782	0.233	0.591
2.000	0.496	0.803	0.470				0.859
5.000	0.474						
10.000	0.508						

Mean Activity Coefficients of Electrolytes as a Function of Concentration

<i>m</i> /mol kg ⁻¹	CuCl₂	Cu(ClO₄)₂	Cu(NO₃)₂	FeCl₂	HBr	HCl	HClO₄
0.001	0.887	0.890	0.888	0.888	0.966	0.965	0.966
0.002	0.849	0.854	0.851	0.850	0.953	0.952	0.953
0.005	0.783	0.795	0.787	0.785	0.930	0.929	0.929
0.010	0.722	0.741	0.729	0.725	0.907	0.905	0.906
0.020	0.654	0.685	0.664	0.659	0.879	0.876	0.878
0.050	0.561	0.613	0.577	0.570	0.837	0.832	0.836
0.100	0.495	0.572	0.516	0.509	0.806	0.797	0.803
0.200	0.441	0.553	0.466	0.462	0.783	0.768	0.776
0.500	0.401	0.617	0.431	0.443	0.790	0.759	0.769
1.000	0.405	0.892	0.456	0.500	0.872	0.811	0.826
2.000	0.453	2.445	0.615	0.782	1.167	1.009	1.055
5.000	0.601		2.083		3.800	2.380	3.100
10.000					33.4	10.4	30.8
15.000							323
<i>m</i> /mol kg ⁻¹	HF	HI	HNO₃	H₂SO₄	KBr	KCNS	KCl
0.001	0.551	0.966	0.965	0.804	0.965	0.965	0.965
0.002	0.429	0.953	0.952	0.740	0.952	0.951	0.951
0.005	0.302	0.931	0.929	0.634	0.927	0.927	0.927
0.010	0.225	0.909	0.905	0.542	0.902	0.901	0.901
0.020	0.163	0.884	0.875	0.445	0.870	0.869	0.869
0.050	0.106	0.847	0.829	0.325	0.817	0.815	0.816
0.100	0.0766	0.823	0.792	0.251	0.771	0.768	0.768
0.200	0.0550	0.811	0.756	0.195	0.772	0.716	0.717
0.500	0.0352	0.845	0.725	0.146	0.658	0.647	0.649
1.000	0.0249	0.969	0.730	0.125	0.617	0.598	0.604
2.000	0.0175	1.363	0.788	0.119	0.593	0.556	0.573
5.000	0.0110	4.760	1.063	0.197	0.626	0.525	0.593
10.000	0.0085	49.100	1.644	0.527			
15.000	0.0077		2.212	1.077			
20.000	0.0075		2.607	1.701			
<i>m</i> /mol kg ⁻¹	KClO₃	K₂CrO₄	KF	KH₂PO₄*	K₂HPO₄**	KI	KNO₃
0.001	0.965	0.886	0.965	0.964	0.886	0.965	0.964
0.002	0.951	0.847	0.952	0.950	0.847	0.952	0.950
0.005	0.926	0.779	0.927	0.924	0.779	0.927	0.924
0.010	0.899	0.715	0.902	0.896	0.715	0.902	0.896
0.020	0.865	0.643	0.870	0.859	0.643	0.871	0.860
0.050	0.805	0.539	0.818	0.793	0.538	0.820	0.797
0.100	0.749	0.460	0.773	0.730	0.457	0.776	0.735
0.200	0.681	0.385	0.726	0.652	0.379	0.731	0.662
0.500	0.569	0.296	0.670	0.529	0.283	0.676	0.546
1.000		0.239	0.645	0.422		0.646	0.444
2.000		0.199	0.658			0.638	0.332
5.000			0.871				
10.000			1.715				
15.000			3.120				
<i>m</i> /mol kg ⁻¹	KOH	K₂SO₄	LiBr	LiCl	LiClO₄	LiI	LiNO₃
0.001	0.965	0.885	0.965	0.965	0.966	0.966	0.965
0.002	0.952	0.844	0.952	0.952	0.953	0.953	0.952
0.005	0.927	0.772	0.929	0.928	0.931	0.930	0.928
0.010	0.902	0.704	0.905	0.904	0.908	0.908	0.904
0.020	0.871	0.625	0.877	0.874	0.882	0.882	0.874
0.050	0.821	0.511	0.832	0.827	0.843	0.843	0.827
0.100	0.779	0.424	0.797	0.789	0.815	0.817	0.788
0.200	0.740	0.343	0.767	0.756	0.795	0.802	0.753
0.500	0.710	0.251	0.754	0.739	0.806	0.824	0.726
1.000	0.733		0.803	0.775	0.887	0.912	0.743
2.000	0.860		1.012	0.924	1.161	1.197	0.837
5.000	1.697		2.696	2.000			1.298

<i>m</i> /mol kg ⁻¹	KOH	K ₂ SO ₄	LiBr	LiCl	LiClO ₄	LiI	LiNO ₃
10.000	6.110		20.0	9.600			2.500
15.000	19.9		147	30.9			3.960
20.000	46.4		486				4.970
<i>m</i> /mol kg ⁻¹	LiOH	Li ₂ SO ₄	MgBr ₂	MgCl ₂	MgI ₂	MnBr ₂	MnCl ₂
0.001	0.964	0.887	0.889	0.889	0.889	0.889	0.888
0.002	0.950	0.847	0.852	0.852	0.853	0.853	0.850
0.005	0.923	0.780	0.790	0.790	0.791	0.791	0.786
0.010	0.895	0.716	0.733	0.734	0.736	0.735	0.727
0.020	0.858	0.645	0.672	0.672	0.677	0.674	0.662
0.050	0.794	0.544	0.593	0.590	0.602	0.595	0.574
0.100	0.735	0.469	0.543	0.535	0.556	0.543	0.513
0.200	0.668	0.400	0.512	0.493	0.535	0.508	0.464
0.500	0.579	0.325	0.540	0.485	0.594	0.519	0.437
1.000	0.522	0.284	0.715	0.577	0.858	0.650	0.477
2.000	0.484	0.270	1.590	1.065	2.326	1.224	0.661
5.000	0.493		36.1	14.40	109.8	6.697	1.539
<i>m</i> /mol kg ⁻¹	Mn(ClO ₄) ₂	NH ₄ Cl	NH ₄ ClO ₄	(NH ₄) ₂ HPO ₄ **	NH ₄ NO ₃	NaBr	NaBrO ₃
0.001	0.892	0.965	0.964	0.882	0.964	0.965	0.965
0.002	0.858	0.952	0.950	0.839	0.951	0.952	0.951
0.005	0.801	0.927	0.924	0.763	0.925	0.928	0.926
0.010	0.752	0.901	0.895	0.688	0.897	0.903	0.900
0.020	0.700	0.869	0.859	0.600	0.862	0.873	0.867
0.050	0.637	0.816	0.794	0.469	0.801	0.824	0.811
0.100	0.604	0.769	0.734	0.367	0.744	0.783	0.759
0.200	0.596	0.718	0.663	0.273	0.678	0.742	0.698
0.500	0.686	0.649	0.560	0.171	0.582	0.697	0.605
1.000	1.030	0.603	0.479	0.114	0.502	0.687	0.528
2.000	3.072	0.569	0.399	0.074	0.419	0.730	0.449
5.000		0.563			0.303	1.083	
10.000					0.220		
15.000					0.179		
20.000					0.154		
<i>m</i> /mol kg ⁻¹	Na ₂ CO ₃	NaCl	NaClO ₃	NaClO ₄	Na ₂ CrO ₄	NaF	Na ₂ HPO ₄ *
0.001	0.887	0.965	0.965	0.965	0.887	0.965	0.887
0.002	0.847	0.952	0.952	0.952	0.849	0.951	0.848
0.005	0.780	0.928	0.927	0.928	0.783	0.926	0.780
0.010	0.716	0.903	0.902	0.903	0.722	0.901	0.717
0.020	0.644	0.872	0.870	0.872	0.653	0.868	0.644
0.050	0.541	0.822	0.818	0.821	0.554	0.813	0.539
0.100	0.462	0.779	0.771	0.777	0.479	0.764	0.456
0.200	0.385	0.734	0.719	0.729	0.406	0.710	0.373
0.500	0.292	0.681	0.646	0.668	0.318	0.633	0.266
1.000	0.229	0.657	0.590	0.630	0.261	0.573	0.191
2.000	0.182	0.668	0.537	0.608	0.231		0.133
5.000		0.874		0.648			
<i>m</i> /mol kg ⁻¹	NaI	NaNO ₃	NaOH	Na ₂ SO ₃	Na ₂ SO ₄	Na ₂ WO ₄	NiBr ₂
0.001	0.965	0.965	0.965	0.887	0.886	0.886	0.889
0.002	0.952	0.951	0.952	0.847	0.846	0.846	0.853
0.005	0.928	0.926	0.927	0.779	0.777	0.777	0.791
0.010	0.904	0.900	0.902	0.716	0.712	0.712	0.735
0.020	0.874	0.866	0.870	0.644	0.637	0.638	0.675
0.050	0.827	0.810	0.819	0.540	0.529	0.534	0.596
0.100	0.789	0.759	0.775	0.462	0.446	0.457	0.546
0.200	0.753	0.701	0.731	0.386	0.366	0.388	0.514
0.500	0.722	0.617	0.685	0.296	0.268	0.320	0.535
1.000	0.734	0.550	0.674	0.237	0.204	0.291	0.692
2.000	0.823	0.480	0.714	0.196	0.155	0.291	1.476

Mean Activity Coefficients of Electrolytes as a Function of Concentration

$m/\text{mol kg}^{-1}$	NaI	NaNO ₃	NaOH	Na ₂ SO ₃	Na ₂ SO ₄	Na ₂ WO ₄	NiBr ₂
5.000	1.402	0.388	1.076				
10.000	4.011	0.329	3.258				
15.000			9.796				
20.000			19.410				

$m/\text{mol kg}^{-1}$	NiCl ₂	Ni(ClO ₄) ₂	Ni(NO ₃) ₂	Pb(ClO ₄) ₂	Pb(NO ₃) ₂	RbBr	RbCl
0.001	0.889	0.891	0.889	0.889	0.882	0.965	0.965
0.002	0.852	0.855	0.851	0.851	0.840	0.951	0.951
0.005	0.789	0.797	0.787	0.787	0.764	0.926	0.926
0.010	0.732	0.745	0.730	0.729	0.690	0.900	0.900
0.020	0.669	0.690	0.666	0.666	0.604	0.866	0.867
0.050	0.584	0.621	0.581	0.580	0.476	0.811	0.811
0.100	0.527	0.582	0.524	0.522	0.379	0.760	0.761
0.200	0.482	0.567	0.481	0.476	0.291	0.705	0.707
0.500	0.465	0.639	0.467	0.458	0.195	0.630	0.633
1.000	0.538	0.946	0.528	0.516	0.136	0.578	0.583
2.000	0.915	2.812	0.797	0.799		0.535	0.546
5.000	4.785			4.043		0.514	0.544
10.000				33.8			

$m/\text{mol kg}^{-1}$	RbF	RbI	RbNO ₃	Rb ₂ SO ₄	SrBr ₂	SrCl ₂	SrI ₂
0.001	0.965	0.965	0.964	0.886	0.889	0.888	0.890
0.002	0.952	0.951	0.950	0.845	0.852	0.850	0.854
0.005	0.927	0.926	0.924	0.776	0.790	0.785	0.793
0.010	0.902	0.900	0.896	0.710	0.734	0.725	0.740
0.020	0.871	0.866	0.859	0.635	0.673	0.659	0.681
0.050	0.821	0.810	0.795	0.526	0.591	0.569	0.606
0.100	0.780	0.759	0.733	0.443	0.535	0.506	0.557
0.200	0.739	0.703	0.657	0.365	0.492	0.455	0.526
0.500	0.701	0.627	0.536	0.274	0.476	0.421	0.542
1.000	0.697	0.574	0.430	0.217	0.545	0.451	0.686
2.000	0.724	0.532	0.320		0.921	0.650	
5.000		0.517					

$m/\text{mol kg}^{-1}$	UO ₂ Cl ₂	UO ₂ (NO ₃) ₂	ZnBr ₂	ZnCl ₂	ZnI ₂
0.001	0.888	0.888	0.890	0.887	0.893
0.002	0.851	0.849	0.854	0.847	0.859
0.005	0.787	0.784	0.794	0.781	0.804
0.010	0.729	0.726	0.741	0.719	0.757
0.020	0.666	0.663	0.683	0.652	0.708
0.050	0.583	0.583	0.606	0.561	0.644
0.100	0.529	0.535	0.553	0.499	0.601
0.200	0.493	0.509	0.515	0.447	0.574
0.500	0.501	0.532	0.516	0.384	0.635
1.000	0.601	0.673	0.558	0.330	0.836
2.000	0.948	1.223	0.578	0.283	1.062
5.000		3.020	0.788	0.342	1.546
10.000			2.317	0.876	4.698
15.000			5.381	1.914	
20.000			7.965	2.968	

* The anion is H₂PO₄⁻.** The anion is HPO₄⁻².