PERMITTIVITY AND VISCOSITY OF LIQUIDS

The table gives the static relative permittivity ε_r, i.e., the relative permittivity measured in static fields or at low frequencies where no relaxation effects occur.

The static permittivity refers to nominal atmospheric pressure as long as the corresponding temperature is below the normal boiling point. Otherwise, at temperatures above the normal boiling point, the pressure is understood to be the saturated vapor pressure of the substance considered.

Viscosity values correspond to a nominal pressure of 1 atmosphere.

T = 298,2 K

Mol. Form.	Name	ε	Viscosity in mPa s
Br_2	Bromine	3.1484	0.944
H_2O	Water	78.11	0.890
CCl_4	Tetrachloromethane	2.2379	0.908
CHN	Hydrogen cyanide	114.9	0.183
CH_2Cl_2	Dichloromethane	8.93	0.413
CH_3I	Iodomethane	6.97	0.469
CH_3NO	Formamide	111.0	3.343
CS_2	Carbon disulfide	2.6320	0.352
C_2H_3ClO	Acetyl chloride	15.8	0.368
C_2H_3N	Acetonitrile	36.64	0.369
$C_2H_4Cl_2$	1,2-Dichloroethane	10.42	0.779
$C_2H_4O_2$	Acetic acid	6.20	1.056
C_2H_6O	Ethanol	25.3	1.074
C_2H_6OS	Dimethyl sulfoxide	47.24	1.987
$C_2H_6O_2$	Ethylene glycol	41.4	16.1
C_3H_3N	Acrylonitrile	33.0	-
$C_3H_4O_3$	Ethylene carbonate	89.78	-
C_3H_5ClO	Epichlorohydrin	22.6	1.073
C_2H_5Br	Bromoethane	9.01	0.374
C_3H_6O	Acetone	21.01	0.306
C_3H_7NO	*N,N*-Dimethylformamide	38.25	0.794
C_3H_8O	1-Propanol	20.8	1.945
$C_3H_8O_3$	Glycerol	46.53	934
C_4H_4O	Furan	2.88	0.361
C_4H_5N	Pyrrole	8.00	1.225
C_4H_8O	Tetrahydrofuran	7.52	0.456
$C_4H_8O_2$	Ethyl acetate	6.0814	0.423
$C_4H_8O_2$	1,4-Dioxane	2.2189	1.177
$C_4H_{10}O$	1-Butanol	17.84	2.544
$C_4H_{10}O$	Diethyl ether	4.2666	0.224
$C_5H_4O_2$	Furfural	42.1	1.587
C_5H_5N	Pyridine	13.260	0.879
C_5H_{10}	1-Pentene	2.011	0.195
$C_5H_{11}N$	Piperidine	4.33	1.573
$C_5H_{12}O$	1-Pentanol	15.13	3.619
C_6F_6	Hexafluorobenzene	2.029	2.789
C_6H_5Br	Bromobenzene	5.45	1.074
C_6H_5Cl	Chlorobenzene	5.6895	0.753
$C_6H_5NO_2$	Nitrobenzene	35.6	1.863
C_6H_6	Benzene	2.2825	0.604
C_6H_7N	Aniline	7.06	3.847
C_6H_{14}	Hexane	1.8865	0.300
C_7H_8	Toluene	2.379	0.560
C_7H_8O	Anisole	4.30	1.056
C_7H_8O	*m*-Cresol	12.44	12.9
C_7H_9N	Benzylamine	5.18	1.624
C_7H_{14}	1-Heptene	2.092	0.340
C_7H_{16}	Heptane	1.9209	0.387
C_8H_8	Styrene	2.4737	0.695
C_8H_{10}	Ethylbenzene	2.4463	0.631

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PERMITTIVITY (DIELECTRIC CONSTANT) OF WATER AS A FUNCTION OF TEMPERATURE AND PRESSURE

The following table summarizes the relative permittivity (static dielectric constant) of liquid water and steam over a wide range of temperature and pressure. Values are given from slightly above the freezing point to 1000 K and at pressures from normal atmospheric to 1000 MPa (about 10000 atm). The values are generated from an equation that correlates the best experimental measurements from a large number of sources. The correlating equation and full details of the formulation may be found in Reference 1.

Temperatures are given on the ITS-90 scale. Liquid–vapor boundaries are indicated by horizontal lines.

	Pressure in MPa										
***T*/K**	**0.1**	**1**	**2**	**5**	**10**	**20**	**50**	**100**	**200**	**500**	**1000**
275	87,16	87,20	87,24	87,36	87,57	87,97	89,16	91 05	94,55	103,7	
280	85,19	85,23	85,27	85,39	85,59	85,98	87,14	88,98	92,38	101,3	
285	83,27	83,30	83,34	83,46	83,65	84,04	85,17	86,96	90,27	98,91	
290	81,39	81,42	81,46	81,57	81,76	82,14	83,24	84,99	88,22	96,64	
295	79,55	79,58	79,62	79 73	79,92	80,29	81,37	83,08	86,24	94,44	
300	77,75	77,78	77,82	77,93	78,11	78,48	79,54	81,22	84,31	92,31	
305	75,99	76,02	76,06	76,17	76,35	76,71	77,75	79,40	82,43	90,25	101,3
310	74,27	74,30	74,33	74,44	74,62	74,98	76,01	77,63	80,61	88,26	99,06
315	72,58	72,61	72,65	72,76	72,93	73,28	74,30	75,90	78,84	86,34	96,87
320	70,93	70,97	71,00	71,11	71,28	71,63	72,64	74,22	77,11	84,48	94,76
340	64,70	64,73	64,77	64,87	65,04	65,38	66,36	67,89	70,65	77,58	87,07
360	59,00	59,03	59 07	59,17	59,34	59,68	60,65	62,15	64,83	71,45	80,36
380	1,006	53,83	53,86	53,97	54,14	54,48	55,45	56,94	59,57	65,95	74,43
400	1,005	49,06	49,10	49,21	49,39	49,73	50,71	52,20	54,80	61,00	69,12
420	1,005	44,70	44,74	44,85	45,04	45,39	46,39	47,90	50,48	56,53	64,35
440	1,004	40,70	40,74	40 85	41,05	41,42	42,45	43,98	46,55	52,48	60,03
460	1,004	1,041	37,04	37,17	37,37	37,76	38,84	40,40	42,99	48,81	56,11
480	1,004	1,038	33,61	33,75	33,97	34,39	35,53	37,14	39,75	45,47	52,55
500	1,003	1,034	1,074	30,55	30,79	31,25	32,47	34,15	36,79	42,44	49,30
550	1,003	1,028	1,059	1,177	23,53	24,18	25,73	27,67	30,46	35,99	42,38
600	1,002	1,024	1,049	1,137	1,365	17,50	19,90	22,29	25,34	30,82	36,82
650	1,002	1,020	1,041	1,112	1,267	2,066	14,50	17,72	21,12	26,62	32,31
700	1,002	1,017	1,036	1,095	1,214	1,603	8,963	13,75	17,60	23,17	28,60
750	1,002	1,015	1,031	1,082	1,179	1,452	4,424	10,34	14,65	20,30	25,51
800	1,001	1,013	1,027	1,071	1,154	1,365	2,844	7,562	12,17	17,88	22,91
850	1,001	1,012	1,024	1,063	1,134	1,307	2,269	5,571	10,10	15,83	20,70
900	1,001	1,011	1,022	1,056	1,118	1,265	1,975	4,284	8,416	14,08	18,80
950	1,001	1,010	1,020	1,050	1,105	1,232	1,793	3,477	7,066	12,57	17,15
1000	1,001	1,009	1,018	1,046	1,095	1,206	1,668	2,956	6,003	11,27	15,72
1050	1,001	1,008	1,016	1,041	1,086	1,184	1,576	2,601	5,172	10,14	14,45
1100	1,001	1,007	1,015	1,038	1,078	1,167	1,505	2,347	4,523	9,160	13,34
1150	1,001	1,007	1,014	1,035	1,072	1,151	1,449	2,158	4,012	8,309	12,35
1200	1,001	1,006	1,013	1,032	1,066	1,139	1,403	2,011	3,606	7,569	11,47

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DISSOCIATION CONSTANTS

The data in this table are presented as values of pK_a, defined as the negative logarithm of the acid dissociation constant K_a. In the case of bases, the entry in the table is for the conjugate acid; e.g., ammonium ion for ammonia.

All values refer to dilute aqueous solutions at zero ionic strength at the temperature indicated. The table is arranged alphabetically by compound name.

INORGANIC ACIDS AND BASES

Name	Formula	Step	t/°C	pK_a
Ammonia	NH_3		25	9.25
Arsenic acid	H_3AsO_4	1	25	2.26
		2	25	6.76
		3	25	11.29
Arsenious acid	H_2AsO_3		25	9.29
Barium(II) ion	Ba^{+2}		25	13.4
Boric acid	H_3BO_3	1	20	9.27
		2	20	>14
Calcium(II) ion	Ca^{+2}		25	12.6
Carbonic acid	H_2CO_3	1	25	6.35
		2	25	10.33
Chlorous acid	$HClO_2$		25	1.94
Hydrazoic acid	HN_3		25	4.6
Hydrocyanic acid	HCN		25	9.21
Hydrofluoric acid	HF		25	3.20
Hydrogen peroxide	H_2O_2		25	11.62
Hydrogen sulfide	H_2S	1	25	7.05
		2	25	19
Hypobromous acid	HBrO		25	8.55
Hypochlorous acid	HClO		25	7.40
Hypoiodous acid	HIO		25	10.5
Phosphoric acid	H_3PO_4	1	25	2.16
		2	25	7.21
		3	25	12.32
Sulfuric acid	H_2SO_4	2	25	1.99
Sulfurous acid	H_2SO_3	1	25	1.85
Thiocyanic acid	HSCN		25	-1.8
Water	H_2O		25	13.995

ORGANIC ACIDS AND BASES

Mol. Form.	Name	Step	t/°C	pK_a
CH_2O_2	Formic acid		25	3.75
CH_3NO_2	Nitromethane		25	10.21
CH_5N	Methylamine		25	10.66
$C_2HCl_3O_2$	Trichloroacetic acid		20	0.66
$C_2H_2O_4$	Oxalic acid	1	25	1.25
		2	25	3.81
$C_2H_3ClO_2$	Chloroacetic acid		25	2.87
$C_2H_4O_2$	Acetic acid		25	4.756
C_2H_5N	Ethyleneimine		25	8.04
C_2H_5NO	Acetamide		25	15.1
C_2H_7N	Ethylamine		25	10.65
C_2H_7N	Dimethylamine		25	10.73
$C_3H_3NO_2$	Cyanoacetic acid		25	2.47
$C_3H_4O_2$	Acrylic acid		25	4.25
$C_3H_4O_3$	Pyruvic acid		25	2.39
$C_3H_4O_4$	Malonic acid	1	25	2.85
		2	25	5.70
$C_3H_6O_2$	Propanoic acid		25	4.87
$C_3H_6O_3$	3-Hydroxypropanoic acid		25	4.51
$C_3H_8O_3$	Glycerol		25	14.15
C_3H_9N	Propylamine		25	10.54
$C_4H_4N_2$	Pyrimidine		20	1.23
$C_4H_4N_2O_3$	Barbituric acid		25	4.01
$C_4H_4O_4$	Maleic acid	1	25	1.92
		2	25	6.23
$C_4H_4O_4$	Fumaric acid	1	25	3.02
		2	25	4.38
$C_4H_6O_4$	Succinic acid	1	25	4.21
		2	25	5.64
$C_4H_6O_5$	Malic acid	1	25	3.40
		2	25	5.11
$C_4H_6O_6$	*DL*-Tartaric acid	1	25	3.03
		2	25	4.37
$C_4H_8O_2$	Butanoic acid		25	4.83
C_5H_5N	Pyridine		25	5.23
C_6H_7NO	2-Aminophenol	1	20	4.78
		2	20	9.97
$C_6H_8O_6$	*L*-Ascorbic acid	1	25	4.04
		2	16	11.7
$C_6H_8O_7$	Citric acid	1	25	3.13
		2	25	4.76
		3	25	6.40
$C_7H_5ClO_2$	2-Chlorobenzoic acid		25	2.90
$C_7H_5ClO_2$	3-Chlorobenzoic acid		25	3.84
$C_7H_5ClO_2$	4-Chlorobenzoic acid		25	4.00
$C_7H_6O_2$	Benzoic acid		25	4.204
$C_7H_6O_3$	2-Hydroxybenzoic acid	1	20	2.98
		2	20	13.6
$C_7H_6O_3$	3-Hydroxybenzoic acid	1	25	4.08
		2	19	9.92
C_7H_9N	Benzylamine		25	9.34
$C_8H_6O_4$	Terephthalic acid	1	25	3.54
		2	25	4.34
$C_8H_{16}O_2$	Octanoic acid		25	4.89

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ELECTRICAL CONDUCTIVITY OF WATER

This table gives the electrical conductivity of highly purified water over a range of temperature and pressure. The first column of conductivity data refers to water at its own vapor pressure. Equations for calculating the conductivity at any temperature and pressure may be found in the reference.

Conductivity in µS/cm at the indicated pressure

t/°C	Sat. vapor	50 MPa	100 MPa	200 MPa	400 MPa	600 MPa
0	0.0115	0.0150	0.0189	0.0275	0.0458	0.0667
25	0.0550	0.0686	0.0836	0.117	0.194	0.291
100	0.765	0.942	1.13	1.53	2.45	3.51
200	2.99	4.08	5.22	7.65	13.1	19.5
300	2.41	4.87	7.80	14.1	28.9	46.5
400		1.17	4.91	14.3	39.2	71.3
600			0.134	4.65	33.8	85.7

IONIC CONDUCTIVITY AND DIFFUSION AT INFINITE DILUTION

This table gives the molar (equivalent) conductivity λ for common ions at infinite dilution. All values refer to aqueous solutions at 25°C.

Ion	λ 10^{-4} m² S mol⁻¹	*D* 10^{-5} cm² s⁻¹
Inorganic Cations		
Ag^+	61.9	1.648
$1/3Al^{3+}$	61	0.541
$1/2Ba^{2+}$	63.6	0.847
Cs^+	77.2	2.056
$1/2Cu^{2+}$	53.6	0.714
$1/2Fe^{2+}$	54	0.719
$1/3Fe^{3+}$	68	0.604
H^+	349.65	9.311
$1/2Hg^{2+}$	68.6	0.913
K^+	73.48	1.957
$1/3La^{3+}$	69.7	0.619
Li^+	38.66	1.029
$1/2Mg^{2+}$	53.0	0.706
NH_4^+	73.5	1.957
$N_2H_5^+$	59	1.571
Na^+	50.08	1.334
Rb^+	77.8	2.072
$1/2Sr^{2+}$	59.4	0.791
Tl^+	74.7	1.989
Inorganic Anions		
Br^-	78.1	2.080
Br_3^-	43	1.145
BrO_3^-	55.7	1.483
CN^-	78	2.077
$1/2CO_3^{2-}$	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
F^-	55.4	1.475
$1/4[Fe(CN)_6]^{4-}$	110.4	0.735
$1/3[Fe(CN)_6]^{3-}$	100.9	0.896
HS^-	65	1.731
I^-	76.8	2.045
IO_3^-	40.5	1.078
IO_4^-	54.5	1.451
MnO_4^-	61.3	1.632
NO_3^-	–	1.902
OH^-	198	5.273
SCN^-	66	1.758
$1/2SO_3^{2-}$	72	0.959
$1/2SO_4^{2-}$	80.0	1.065
$1/2WO_4^{2-}$	69	0.919

Ion	λ 10^{-4} m² S mol⁻¹	*D* 10^{-5} cm² s⁻¹
Organic Cations		
Dipropylammonium⁺	30.1	0.802
Dodecylammonium⁺	23.8	0.634
Dodecyltrimethylammonium⁺	22.6	0.602
Ethanolammonium⁺	42.2	1.124
Ethylammonium⁺	47.2	1.257
Ethyltrimethylammonium⁺	40.5	1.078
Hexadecyltrimethylammonium⁺	20.9	0.557
Methylammonium⁺	58.7	1.563
Pentylammonium⁺	37	0.985
Piperidinium⁺	37.2	0.991
Propylammonium⁺	40.8	1.086
Pyrilammonium⁺	24.3	0.647
Tetraethylammonium⁺	32.6	0.868
Tetramethylammonium⁺	44.9	1.196
Triethylsulfonium⁺	36.1	0.961
Trimethylammonium⁺	47.23	1.258
Organic Anions		
Acetate⁻	40.9	–
1/2Azelate²⁻	40.6	0.541
Benzoate⁻	32.4	0.863
Bromoacetate⁻	39.2	1.044
Bromobenzoate⁻	30	0.799
Butyrate⁻	32.6	–
Chloroacetate⁻	39.8	1.060
1/3Citrate³⁻	70.2	0.623
Crotonate⁻	33.2	0.884
Cyanoacetate⁻	43.4	1.156
Dodecylsulfate⁻	24	0.639
Formate⁻	54.6	1.454
1/2Fumarate²⁻	61.8	0.823
1/2Glutarate²⁻	52.6	0.700
Hydrogenoxalate⁻	40.2	1.070
Isovalerate⁻	32.7	0.871
Lactate⁻	38.8	1.033
1/2Malate²⁻	58.8	0.783
Methylsulfate⁻	48.8	1.299
Picrate⁻	30.37	0.809
Pivalate⁻	31.9	0.849
Propionate⁻	35.8	0.953
Propylsulfate⁻	37.1	0.988
Salicylate⁻	–	0.959
1/2Succinate²⁻	58.8	0.783
p-Sulfonate	29.3	0.780
1/2Tartarate²⁻	59.6	0.794
Trichloroacetate⁻	35	0.932

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СТРУКТУРА КРИСТАЛЛИЧЕСКИХ ТЕЛ*

В графе «сингония» приняты следующие обозначения: I — кубическая, II — тетрагональная, III — гексагональная, IIIa — тригональная, IV — ромбическая, V — моноклинная, VI — триклинная.

Тип структуры неорганических соединений (третья графа) указан по Strukturbericht.

Пространственные группы (четвертая графа) даны в международном обозначении. Буквы и цифры в принятой последовательности определяют трансляционную решетку и тот минимум элементов симметрии, который полностью выражает данную пространственную группу. Размеры осей элементарной ячейки (пятая графа) приведены, как правило, в ангстремах (1 Å = 10^{-8} *см*). Значения, выраженные в kX, отмечены звездочкой. Соотношение между этими единицами выражается следующим образом:

$$1\ \text{kX} = 1{,}00202\ \text{Å} = 1{,}00202 \cdot 10^{-8}\ \text{см}$$

В последней графе таблицы указано число формульных весов в элементарной ячейке. В случае статистических структур общее число различных атомов, приходящееся на элементарную ячейку, обозначено буквой *A*.

Буквы α, β, γ и цифры I, II, III, IV, стоящие рядом с формулой, обозначают модификацию вещества.

Формула	Сингония	Тип структуры	Пространственная группа	Параметры ячейки *a*, *b*, *c* в Å и углы α, β, γ	Число формульных весов	The Madelung constant M†
AgCl	I	NaCl	*Fm*3*m*	5,556	4	1.74756
AgF	I	NaCl	*Fm*3*m*	4,93	4	—//—
AgBr	I	NaCl	*Fm*3*m*	5,776	4	—//—
CsBr	I	CsCl	*Pm*3*m*	4,296	1	1.76267
CsCl (25° C)	I	CsCl	*Pm*3*m*	4,10	1	—//—
CsF	I	NaCl	*Fm*3*m*	6,020	4	1.74756
CsJ	I	CsCl	*Pm*3*m*	4,5667	1	1.76267
KBr	I	NaCl	*Fm*3*m*	6,599	4	1.74756
KCl	I	NaCl	*Fm*3*m*	6,2910	4	—//—
KF	I	NaCl	*Fm*3*m*	5,344	4	—//—
KJ	I	NaCl	*Fm*3*m*	7,066	4	—//—
LiBr	I	NaCl	*Fm*3*m*	5,501	4	—//—
LiCl	I	NaCl	*Fm*3*m*	5,13988	4	—//—
LiF	I	NaCl	*Fm*3*m*	4,0279	4	—//—
LiJ	I	NaCl	*Fm*3*m*	6,012	4	—//—
NaBr	I	NaCl	*Fm*3*m*	5,97299	4	—//—
NaF	I	NaCl	*Fm*3*m*	5,63874*	...	—//—
NaCl (каменная соль)	I	NaCl	*Fm*3*m*	5,63874*	...	—//—
NaJ	I	NaCl	*Fm*3*m*	6,475	4	—//—

The Born Exponent†, n is:

Ion type	n
He, Li^+	5
Ne, Na^+, F^-	7
Ar, K^+, Cu^+, Cl^-	9
Kr, Rb^+, Ag^+, Br^-	10
Xe, Cs^+, Au^+, I^-	12

For a crystal with a mixed-ion type, an average of the values of n in this table is to be used (6 for LiF, for example).

* Справочник химика т. 1. Под ред. Никольского П.Б. 1966 г.

† CRC Handbook of Chemistry and Physics, 84th Edition, 2003-2004.

IONIC RADII IN CRYSTALS

Ionic radii are a useful tool for predicting and visualizing crystal structures. This table lists a set of ionic radii R_i in Å units for the most common coordination numbers *CN* of positive and negative ions. The values are based on experimental crystal structure determinations, supplemented by empirical relationships, and theoretical calculations. The notation sq after the coordination number indicates a square configuration, while py indicates pyramidal.

The advice of Howard T. Evans and Marvin J. Weber in preparing this table is appreciated.

REFERENCES

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2. Jia, Y.Q., *J. Solid State Chem.* 95, 184, 1991.

Ion	*CN*	R_i/Å
Anions		
F^{-1}	6	1.33
Cl^{-1}	6	1.81
Br^{-1}	6	1.96
I^{-1}	6	2.20
OH^{-1}	4	1.35
	6	1.37
O^{-2}	2	1.21
	6	1.40
	8	1.42
S^{-2}	6	1.84
Se^{-2}	6	1.98
Te^{-2}	6	2.21
Cations		
Ac^{+3}	6	1.12
Ag^{+1}	4	1.00
	6	1.15
	8	1.28
Ag^{+2}	4sq	0.79
	6	0.94
Al^{+3}	4	0.39
	5	0.48
	6	0.54
Am^{+3}	6	0.98
	8	1.09
Am^{+4}	6	0.85
	8	0.95
As^{+3}	6	0.58
As^{+5}	4	0.34
	6	0.46
Au^{+1}	6	1.37
Au^{+3}	4sq	0.64
	6	0.85
Ba^{+2}	6	1.35
	8	1.42
	12	1.61
Be^{+2}	4	0.27
	6	0.45
Bi^{+3}	5	0.96
	6	1.03
	8	1.17
Bi^{+5}	6	0.76
Bk^{+3}	6	0.96
Bk^{+4}	6	0.83
	8	0.93
Br^{+5}	3py	0.31
Br^{+7}	4	0.25
	6	0.39
C^{+4}	4	0.15
	6	0.16
Ca^{+2}	6	1.00
	8	1.12
	10	1.23
	12	1.34
Cd^{+2}	4	0.78
	6	0.95
	8	1.10
	12	1.31
Ce^{+3}	6	1.01
	8	1.14
	10	1.25
	12	1.34
Ce^{+4}	6	0.87
	8	0.97
	10	1.07
	12	1.14
Cf^{+3}	6	0.95
Cf^{+4}	6	0.82
	8	0.92
Cl^{+5}	3py	0.12
Cl^{+7}	4	0.08
Cm^{+3}	6	0.97
Cm^{+4}	6	0.85
	8	0.95
Co^{+2}	4	0.56
	6	0.65
	8	0.90
Co^{+3}	6	0.55
Cr^{+2}	6	0.73
Cr^{+3}	6	0.62
Cr^{+4}	4	0.41
	6	0.55
Cr^{+6}	4	0.26
	6	0.44
Cs^{+1}	6	1.67
	8	1.74
	10	1.81
	12	1.88
Cu^{+1}	2	0.46
	4	0.60
	6	0.77
Cu^{+2}	4sq	0.57
	6	0.73
Dy^{+2}	6	1.07
	8	1.19
Dy^{+3}	6	0.91
	8	1.03
Er^{+3}	6	0.89
	8	1.00
Eu^{+2}	6	1.17
	8	1.25
	10	1.35
Eu^{+3}	6	0.95
	8	1.07
F^{+7}	6	0.08
Fe^{+2}	4	0.63
	6	0.61
	8	0.92
Fe^{+3}	4	0.49
	6	0.55
	8	0.78
Fr^{+1}	6	1.80
Ga^{+3}	4	0.47
	6	0.62
Gd^{+3}	6	0.94
	8	1.05
Ge^{+2}	6	0.73
Ge^{+4}	4	0.39
	6	0.53
Hf^{+4}	4	0.58
	6	0.71
	8	0.83
Hg^{+1}	6	1.19
Hg^{+2}	2	0.69
	4	0.96
	6	1.02
	8	1.14
I^{+5}	3py	0.44
	6	0.95
I^{+7}	4	0.42
	6	0.53
In^{+3}	4	0.62
	6	0.80
Ir^{+3}	6	0.68
Ir^{+4}	6	0.63
Ir^{+5}	6	0.57
K^{+1}	4	1.37
	6	1.38
	8	1.51
	12	1.64
La^{+3}	6	1.03
	8	1.16
	10	1.27
	12	1.36
Li^{+1}	4	0.59
	6	0.76
	8	0.92
Lu^{+3}	6	0.86
	8	0.97
Mg^{+2}	4	0.57
	6	0.72
	8	0.89
Mn^{+2}	4	0.66
	6	0.83
	8	0.96
Mn^{+3}	6	0.58
Mn^{+4}	4	0.39
	6	0.53
Mn^{+5}	4	0.33
Mn^{+6}	4	0.26
Mn^{+7}	4	0.25
Mo^{+3}	6	0.69
Mo^{+4}	6	0.65
Mo^{+5}	4	0.46
	6	0.61
Mo^{+6}	4	0.41
	6	0.59
	7	0.73
N^{+3}	6	0.16
N^{+5}	6	0.13
Na^{+1}	4	0.99
	6	1.02
	8	1.18
	9	1.24
	12	1.39
Nb^{+3}	6	0.72
	8	0.79
Nb^{+4}	6	0.68
Nb^{+5}	4	0.48
	6	0.64
	8	0.74
Nd^{+3}	6	0.98
	8	1.12
	9	1.16
	12	1.27
Ni^{+2}	4sq	0.49
	6	0.69
Ni^{+3}	6	0.56
Np^{+3}	6	1.01
Np^{+4}	6	0.87
Np^{+5}	6	0.75
Np^{+6}	6	0.72
Os^{+4}	6	0.63
Os^{+5}	6	0.58
Os^{+6}	6	0.55
Os^{+8}	4	0.39
P^{+5}	4	0.17
	6	0.38
Pa^{+3}	6	1.04
Pa^{+4}	6	0.90
Pa^{+5}	6	0.78
Pb^{+2}	6	1.19
	8	1.29
	10	1.40
	12	1.49
Pb^{+4}	4	0.65
	6	0.78
	8	0.94
Pd^{+2}	4sq	0.64
	6	0.86
Pd^{+3}	6	0.76
Pd^{+4}	6	0.62
Pm^{+3}	6	0.97
	8	1.09
Po^{+4}	6	0.97
Pr^{+3}	6	0.99
	8	1.13
Pr^{+4}	6	0.85
	8	0.96
Pt^{+2}	4sq	0.60
	6	0.80
Pt^{+4}	6	0.63
Pu^{+3}	6	1.00
Pu^{+4}	6	0.86
Pu^{+5}	6	0.74
Pu^{+6}	6	0.71
Ra^{+2}	8	1.48
	12	1.70
Rb^{+1}	6	1.52
	8	1.61
	10	1.66
	12	1.72
Re^{+4}	6	0.63
Re^{+5}	6	0.58
Re^{+6}	6	0.55
Re^{+7}	4	0.38
	6	0.53
Rh^{+3}	6	0.67
Rh^{+4}	6	0.60
Rh^{+5}	6	0.55
Ru^{+3}	6	0.68
Ru^{+4}	6	0.62
Ru^{+5}	6	0.57
Ru^{+7}	4	0.38
Ru^{+8}	4	0.36
S^{+4}	6	0.37
S^{+6}	4	0.12
	6	0.29
Sb^{+3}	4py	0.76
	6	0.76
Sb^{+5}	6	0.60
Sc^{+3}	6	0.75
	8	0.87
Se^{+4}	6	0.50
Se^{+6}	4	0.28
	6	0.42
Si^{+4}	4	0.26
	6	0.40
Sm^{+2}	6	1.19
	8	1.27
Sm^{+3}	6	0.96
	8	1.08
	12	1.24
Sn^{+4}	4	0.55
	6	0.69
	8	0.81
Sr^{+2}	6	1.18
	8	1.26
	10	1.36
	12	1.44
Ta^{+3}	6	0.72
Ta^{+4}	6	0.68
Ta^{+5}	6	0.64
Tb^{+3}	6	0.92
	8	1.04
Tb^{+4}	6	0.76
	8	0.88
Tc^{+4}	6	0.65
Te^{+4}	4	0.66
	6	0.97
Te^{+6}	4	0.43
	6	0.56
Th^{+4}	6	0.94
	8	1.05
	10	1.13
	12	1.21
Ti^{+2}	6	0.86
Ti^{+3}	6	0.67
Ti^{+4}	4	0.42
	6	0.61
	8	0.74
Tl^{+1}	6	1.50
	8	1.59
	12	1.70
Tl^{+3}	4	0.75
	6	0.89
	8	0.98
Tm^{+2}	6	1.01
	7	1.09
Tm^{+3}	6	0.88
	8	0.99
U^{+3}	6	1.03
U^{+4}	6	0.89
	8	1.00
	12	1.17
U^{+5}	6	0.76
U^{+6}	2	0.45
	4	0.52
	6	0.73
	8	0.86
V^{+2}	6	0.79
V^{+3}	6	0.64
V^{+4}	5	0.53
	6	0.58
	8	0.72
V^{+5}	4	0.36
	5	0.46
	6	0.54
W^{+4}	6	0.66
W^{+5}	6	0.62
W^{+6}	4	0.42
	5	0.51
	6	0.60
Y^{+3}	6	0.90
	8	1.02
	9	1.08
Yb^{+2}	6	1.02
	8	1.14
Yb^{+3}	8	0.99
	9	1.04
Zn^{+2}	4	0.60
	6	0.74
	8	0.90
Zr^{+4}	4	0.59
	6	0.72
	8	0.84
	9	0.89

ELECTROCHEMICAL SERIES

There are three tables for this electrochemical series. Each table lists standard reduction potentials, $E°$ values, at 298.15 K (25°C), and at a pressure of 101.325 kPa (1 atm).

Alphabetical Listing

Reaction	$E°$/V
$Ag^+ + e \rightleftharpoons Ag$	0.7996
$AgBr + e \rightleftharpoons Ag + Br^-$	0.07133
$AgCl + e \rightleftharpoons Ag + Cl^-$	0.22233
$AgCN + e \rightleftharpoons Ag + CN^-$	−0.017
$AgF + e \rightleftharpoons Ag + F^-$	0.779
$AgI + e \rightleftharpoons Ag + I^-$	−0.15224
$Al^{3+} + 3 e \rightleftharpoons Al$	−1.662
$Au^+ + e \rightleftharpoons Au$	1.692
$AuBr_4^- + 3 e \rightleftharpoons Au + 4 Br^-$	0.854
$AuCl_4^- + 3 e \rightleftharpoons Au + 4 Cl^-$	1.002
$Bi^{3+} + 3 e \rightleftharpoons Bi$	0.308
$Br_2(aq) + 2 e \rightleftharpoons 2 Br^-$	1.0873
$Br_2(l) + 2 e \rightleftharpoons 2 Br^-$	1.066
$BrO_3^- + 6 H^+ + 6 e \rightleftharpoons Br^- + 3 H_2O$	1.423
$BrO_3^- + 6 H^+ + 5 e \rightleftharpoons 1/2\ Br_2 + 3 H_2O$	1.482
Calomel electrode, 1 molal KCl	0.2800
Calomel electrode, 1 molar KCl (NCE)	0.2801
Calomel electrode, 0.1 molar KCl	0.3337
Calomel electrode, saturated KCl (SCE)	0.2412
Calomel electrode, saturated NaCl (SSCE)	0.2360
$Cd^{2+} + 2 e \rightleftharpoons Cd$	−0.4030
$Cd(OH)_4^{2-} + 2 e \rightleftharpoons Cd + 4 OH^-$	−0.658
$Ce^{3+} + 3 e \rightleftharpoons Ce$	−2.336
$Cl_2(g) + 2 e \rightleftharpoons 2 Cl^-$	1.35827
$ClO_3^- + 6 H^+ + 5 e \rightleftharpoons 1/2\ Cl_2 + 3 H_2O$	1.47
$ClO_3^- + 6 H^+ + 6 e \rightleftharpoons Cl^- + 3 H_2O$	1.451
$Co^{2+} + 2 e \rightleftharpoons Co$	−0.28
$Co^{3+} + e \rightleftharpoons Co^{2+}$	1.92
$[Co(NH_3)_6]^{3+} + e \rightleftharpoons [Co(NH_3)_6]^{2+}$	0.108
$Co(OH)_3 + e \rightleftharpoons Co(OH)_2 + OH^-$	0.17
$Cr^{2+} + 2 e \rightleftharpoons Cr$	−0.913
$Cr^{3+} + e \rightleftharpoons Cr^{2+}$	−0.407
$Cr^{3+} + 3 e \rightleftharpoons Cr$	−0.744
$Cr^{III}EDTA^- + e \leftrightarrow Cr^{II}EDTA^{2-}$	**-0.953**
$Cu^{2+} + 2 e \rightleftharpoons Cu$	0.3419
$Cu^{2+} + 2 CN^- + e \rightleftharpoons [Cu(CN)_2]^-$	1.103
$Cu(OH)_2 + 2 e \rightleftharpoons Cu + 2 OH^-$	−0.222
$F_2 + 2 H^+ + 2 e \rightleftharpoons 2 HF$	3.053
$F_2 + 2 e \rightleftharpoons 2 F^-$	2.866
$Fe^{2+} + 2 e \rightleftharpoons Fe$	−0.447
$Fe^{3+} + 3 e \rightleftharpoons Fe$	−0.037
$Fe^{3+} + e \rightleftharpoons Fe^{2+}$	0.771
$[Fe(CN)_6]^{3-} + e \rightleftharpoons [Fe(CN)_6]^{4-}$	0.358
$2 H^+ + 2 e \rightleftharpoons H_2$	0.00000
$H_2 + 2 e \rightleftharpoons 2 H^-$	−2.23
$2 H_2O + 2 e \rightleftharpoons H_2 + 2 OH^-$	−0.8277
$H_2O_2 + 2 H^+ + 2 e \rightleftharpoons 2 H_2O$	1.776
$Hg^{2+} + 2 e \rightleftharpoons Hg$	0.851
$2 Hg^{2+} + 2 e \rightleftharpoons Hg_2^{2+}$	0.920
$Hg_2^{2+} + 2 e \rightleftharpoons 2 Hg$	0.7973
$Hg_2Cl_2 + 2 e \rightleftharpoons 2 Hg + 2 Cl^-$	0.26808
$I_2 + 2 e \rightleftharpoons 2 I^-$	0.5355
$I_3^- + 2 e \rightleftharpoons 3 I^-$	0.536
$2 IO_3^- + 12 H^+ + 10 e \rightleftharpoons I_2 + 6 H_2O$	1.195
$IO_3^- + 6 H^+ + 6 e \rightleftharpoons I^- + 3 H_2O$	1.085
$IO_3^- + 2 H_2O + 4 e \rightleftharpoons IO^- + 4 OH^-$	0.15
$In^{3+} + 3 e \rightleftharpoons In$	−0.3382
$Ir^{3+} + 3 e \rightleftharpoons Ir$	1.156
$[IrCl_6]^{2-} + e \rightleftharpoons [IrCl_6]^{3-}$	0.8665
$[IrCl_6]^{3-} + 3 e \rightleftharpoons Ir + 6 Cl^-$	0.77
$K^+ + e \rightleftharpoons K$	−2.931
$La^{3+} + 3 e \rightleftharpoons La$	−2.379
$Mn^{2+} + 2 e \rightleftharpoons Mn$	−1.185
$Mn^{3+} + 3e \rightleftharpoons Mn^{2+}$	1.5415
$MnO_2 + 4 H^+ + 2 e \rightleftharpoons Mn^{2+} + 2 H_2O$	1.224
$MnO_4^- + 2 H_2O + 3 e \rightleftharpoons MnO_2 + 4 OH^-$	0.595
$MnO_4^- + 8 H^+ + 5 e \rightleftharpoons Mn^{2+} + 4 H_2O$	1.507
$MnO_4^{2-} + 2 H_2O + 2 e \rightleftharpoons MnO_2 + 4 OH^-$	0.60
$Ni^{2+} + 2 e \rightleftharpoons Ni$	−0.257
$O_2 + 2 H^+ + 2 e \rightleftharpoons H_2O_2$	0.695
$O_2 + 4 H^+ + 4 e \rightleftharpoons 2 H_2O$	1.229
$O_2 + H_2O + 2 e \rightleftharpoons HO_2^- + OH^-$	−0.076
$O_2 + 2 H_2O + 2 e \rightleftharpoons H_2O_2 + 2 OH^-$	−0.146
$O_2 + 2 H_2O + 4 e \rightleftharpoons 4 OH^-$	0.401
$O(g) + 2 H^+ + 2 e \rightleftharpoons H_2O$	2.421
$OH + e \rightleftharpoons OH^-$	2.02
$Pb^{2+} + 2 e \rightleftharpoons Pb$	−0.1262
$PbCl_2 + 2 e \rightleftharpoons Pb + 2 Cl^-$	−0.2675
$PbO + H_2O + 2 e \rightleftharpoons Pb + 2 OH^-$	−0.580
$PbO_2 + 4 H^+ + 2 e \rightleftharpoons Pb^{2+} + 2 H_2O$	1.455
$PbSO_4 + 2 e \rightleftharpoons Pb + SO_4^{2-}$	−0.3588
$Pd^{2+} + 2 e \rightleftharpoons Pd$	0.951
$[PdCl_4]^{2-} + 2 e \rightleftharpoons Pd + 4 Cl^-$	0.591
$[PdCl_6]^{2-} + 2 e \rightleftharpoons [PdCl_4]^{2-} + 2 Cl^-$	1.288
$Pt^{2+} + 2 e \rightleftharpoons Pt$	1.18
$[PtCl_4]^{2-} + 2 e \rightleftharpoons Pt + 4 Cl^-$	0.755
$[PtCl_6]^{2-} + 2 e \rightleftharpoons [PtCl_4]^{2-} + 2 Cl^-$	0.68
$Rb^+ + e \rightleftharpoons Rb$	−2.98
$[RhCl_6]^{3-} + 3 e \rightleftharpoons Rh + 6 Cl^-$	0.431
$S + 2 e \rightleftharpoons S^{2-}$	−0.47627
$S + 2H^+ + 2 e \rightleftharpoons H_2S(aq)$	0.142
$S + H_2O + 2 e \rightleftharpoons SH^- + OH^-$	−0.478
$2 S + 2 e \rightleftharpoons S_2^{2-}$	−0.42836
$S_2O_6^{2-} + 4 H^+ + 2 e \rightleftharpoons 2 H_2SO_3$	0.564
$S_2O_8^{2-} + 2 e \rightleftharpoons 2 SO_4^{2-}$	2.010
$S_2O_8^{2-} + 2 H^+ + 2 e \rightleftharpoons 2 HSO_4^-$	2.123
$S_4O_6^{2-} + 2 e \rightleftharpoons 2 S_2O_3^{2-}$	0.08
$2 H_2SO_3 + H^+ + 2 e \rightleftharpoons HS_2O_4^- + 2 H_2O$	−0.056
$H_2SO_3 + 4 H^+ + 4 e \rightleftharpoons S + 3 H_2O$	0.449
$2 SO_3^{2-} + 2 H_2O + 2 e \rightleftharpoons S_2O_4^{2-} + 4 OH^-$	−1.12
$2 SO_3^{2-} + 3 H_2O + 4 e \rightleftharpoons S_2O_3^{2-} + 6 OH^-$	−0.571
$SO_4^{2-} + 4 H^+ + 2 e \rightleftharpoons H_2SO_3 + H_2O$	0.172
$2 SO_4^{2-} + 4 H^+ + 2 e \rightleftharpoons S_2O_6^{2-} + H_2O$	−0.22
$SO_4^{2-} + H_2O + 2 e \rightleftharpoons SO_3^{2-} + 2 OH^-$	−0.93
$Sn^{2+} + 2 e \rightleftharpoons Sn$	−0.1375
$Sn^{4+} + 2 e \rightleftharpoons Sn^{2+}$	0.151
$Sr^+ + e \rightleftharpoons Sr$	−4.10
$TcO_4^- + 8 H^+ + 7 e \rightleftharpoons Tc + 4 H_2O$	0.472
$TeO_4^- + 8 H^+ + 7 e \rightleftharpoons Te + 4 H_2O$	0.472
$Ti^{3+} + e \rightleftharpoons Ti^{2+}$	−0.9
$Tl(OH)_3 + 2 e \rightleftharpoons TlOH + 2 OH^-$	−0.05
$U^{3+} + 3 e \rightleftharpoons U$	−1.798
$UO_2^{2+} + 4 H^+ + 6 e \rightleftharpoons U + 2 H_2O$	−1.444
$V^{2+} + 2 e \rightleftharpoons V$	−1.175
$V^{3+} + e \rightleftharpoons V^{2+}$	−0.255
$VO_2^+ + 2 H^+ + e \rightleftharpoons VO^{2+} + H_2O$	0.991
$WO_3 + 6 H^+ + 6 e \rightleftharpoons W + 3 H_2O$	−0.090
$Zn^{2+} + 2 e \rightleftharpoons Zn$	−0.7618
$Zn(OH)_4^{2-} + 2 e \rightleftharpoons Zn + 4 OH^-$	−1.199

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SOLUBILITY PRODUCT CONSTANTS

The solubility product constant K_{sp} is a useful parameter for calculating the aqueous solubility of sparingly soluble compounds under various conditions. It may be determined by direct measurement or calculated from the standard Gibbs energies of formation $\Delta_f G°$ of the species involved at their standard states. $K_{sp} = [M^+]^m [A^-]^n$ is the equilibrium constant for the reaction

$$M_mA_n(s) \rightleftharpoons mM^+(aq) + nA^-(aq),$$

where M_mA_n is the slightly soluble substance and M^+ and A^- are the ions produced in solution by the dissociation of M_mA_n

Formula	K_{sp}
$AlPO_4$	$9.84\cdot10^{-21}$
$Ba(BrO_3)_2$	$2.43\cdot10^{-4}$
$BaCO_3$	$2.58\cdot10^{-9}$
$BaCrO_4$	$1.17\cdot10^{-10}$
BaF_2	$1.84\cdot10^{-7}$
$Ba(OH)_2\cdot8H_2O$	$2.55\cdot10^{-4}$
$Ba(IO_3)_2$	$4.01\cdot10^{-9}$
$Ba(IO_3)_2\cdot H_2O$	$1.67\cdot10^{-9}$
$BaMoO_4$	$3.54\cdot10^{-8}$
$Ba(NO_3)_2$	$4.64\cdot10^{-3}$
$BaSeO_4$	$3.40\cdot10^{-8}$
$BaSO_4$	$1.08\cdot10^{-10}$
$BaSO_3$	$5.0\cdot10^{-10}$
$Be(OH)_2$	$6.92\cdot10^{-22}$
$BiAsO_4$	$4.43\cdot10^{-10}$
BiI_3	$7.71\cdot10^{-19}$
$Cd_3(AsO_4)_2$	$2.2\cdot10^{-33}$
$CdCO_3$	$1.0\cdot10^{-12}$
CdF_2	$6.44\cdot10^{-3}$
$Cd(OH)_2$	$7.2\cdot10^{-15}$
$Cd(IO_3)_2$	$2.5\cdot10^{-8}$
$CdC_2O_4\cdot3H_2O$	$1.42\cdot10^{-8}$
$Cd_3(PO_4)_2$	$2.53\cdot10^{-33}$
$CaCO_3$	$3.36\cdot10^{-9}$
CaF_2	$3.45\cdot10^{-11}$
$Ca(OH)_2$	$5.02\cdot10^{-6}$
$Ca(IO_3)_2$	$6.47\cdot10^{-6}$
$Ca(IO_3)_2\cdot6H_2O$	$7.10\cdot10^{-7}$
$CaMoO_4$	$1.46\cdot10^{-8}$
$CaC_2O_4\cdot H_2O$	$2.32\cdot10^{-9}$
$Ca_3(PO_4)_2$	$2.07\cdot10^{-33}$
$CaSO_4$	$4.93\cdot10^{-5}$
$CaSO_4\cdot2H_2O$	$3.14\cdot10^{-5}$
$CaSO_3\cdot0.5H_2O$	$3.1\cdot10^{-7}$
$CsClO_4$	$3.95\cdot10^{-3}$
$CsIO_4$	$5.16\cdot10^{-6}$
$Co_3(AsO_4)_2$	$6.80\cdot10^{-29}$
$Co(OH)_2$	$5.92\cdot10^{-15}$
$Co(IO_3)_2\cdot2H_2O$	$1.21\cdot10^{-2}$
$Co_3(PO_4)_2$	$2.05\cdot10^{-35}$
$CuBr$	$6.27\cdot10^{-9}$
$CuCl$	$1.72\cdot10^{-7}$
$CuCN$	$3.47\cdot10^{-20}$
CuI	$1.27\cdot10^{-12}$
$CuSCN$	$1.77\cdot10^{-13}$
$Cu_3(AsO_4)_2$	$7.95\cdot10^{-36}$
$Cu(IO_3)_2\cdot H_2O$	$6.94\cdot10^{-8}$
CuC_2O_4	$4.43\cdot10^{-10}$
$Cu_3(PO_4)_2$	$1.40\cdot10^{-37}$
$Eu(OH)_3$	$9.38\cdot10^{-27}$
$Ga(OH)_3$	$7.28\cdot10^{-36}$
$FeCO_3$	$3.13\cdot10^{-11}$
FeF_2	$2.36\cdot10^{-6}$
$Fe(OH)_2$	$4.87\cdot10^{-17}$
$Fe(OH)_3$	$2.79\cdot10^{-39}$
$FePO_4\cdot2H_2O$	$9.91\cdot10^{-16}$
$La(IO_3)_3$	$7.50\cdot10^{-12}$
$PbBr_2$	$6.60\cdot10^{-6}$

Formula	K_{sp}
$PbCO_3$	$7.40\cdot10^{-14}$
$PbCl_2$	$1.70\cdot10^{-5}$
PbF_2	$3.3\cdot10^{-8}$
$Pb(OH)_2$	$1.43\cdot10^{-20}$
$Pb(IO_3)_2$	$3.69\cdot10^{-13}$
PbI_2	$9.8\cdot10^{-9}$
$PbSeO_4$	$1.37\cdot10^{-7}$
$PbSO_4$	$2.53\cdot10^{-8}$
Li_2CO_3	$8.15\cdot10^{-4}$
LiF	$1.84\cdot10^{-3}$
Li_3PO_4	$2.37\cdot10^{-11}$
$MgCO_3$	$6.82\cdot10^{-6}$
$MgCO_3\cdot3H_2O$	$2.38\cdot10^{-6}$
$MgCO_3\cdot5H_2O$	$3.79\cdot10^{-6}$
MgF_2	$5.16\cdot10^{-11}$
$Mg(OH)_2$	$5.61\cdot10^{-12}$
$MgC_2O_4\cdot2H_2O$	$4.83\cdot10^{-6}$
$Mg_3(PO_4)_2$	$1.04\cdot10^{-24}$
$MnCO_3$	$2.24\cdot10^{-11}$
$Mn(IO_3)_2$	$4.37\cdot10^{-7}$
$MnC_2O_4\cdot2H_2O$	$1.70\cdot10^{-7}$
Hg_2Br_2	$6.40\cdot10^{-23}$
Hg_2CO_3	$3.6\cdot10^{-17}$
Hg_2Cl_2	$1.43\cdot10^{-18}$
Hg_2F_2	$3.10\cdot10^{-6}$
Hg_2I_2	$5.2\cdot10^{-29}$
$Hg_2C_2O_4$	$1.75\cdot10^{-13}$
Hg_2SO_4	$6.5\cdot10^{-7}$
$Hg_2(SCN)_2$	$3.2\cdot10^{-20}$
$HgBr_2$	$6.2\cdot10^{-20}$
HgI_2	$2.9\cdot10^{-29}$
$Nd_2(CO_3)_3$	$1.08\cdot10^{-33}$
$NiCO_3$	$1.42\cdot10^{-7}$
$Ni(OH)_2$	$5.48\cdot10^{-16}$
$Ni(IO_3)_2$	$4.71\cdot10^{-5}$
$Ni_3(PO_4)_2$	$4.74\cdot10^{-32}$
$Pd(SCN)_2$	$4.39\cdot10^{-23}$
K_2PtCl_6	$7.48\cdot10^{-6}$
$KClO_4$	$1.05\cdot10^{-2}$
KIO_4	$3.71\cdot10^{-4}$
$Pr(OH)_3$	$3.39\cdot10^{-24}$
$Ra(IO_3)_2$	$1.16\cdot10^{-9}$
$RaSO_4$	$3.66\cdot10^{-11}$
$RbClO_4$	$3.00\cdot10^{-3}$
ScF_3	$5.81\cdot10^{-24}$
$Sc(OH)_3$	$2.22\cdot10^{-31}$
$AgCH_3COO$	$1.94\cdot10^{-3}$
Ag_3AsO_4	$1.03\cdot10^{-22}$
$AgBrO_3$	$5.38\cdot10^{-5}$
$AgBr$	$5.35\cdot10^{-13}$
Ag_2CO_3	$8.46\cdot10^{-12}$
$AgCl$	$1.77\cdot10^{-10}$
Ag_2CrO_4	$1.12\cdot10^{-12}$
$AgCN$	$5.97\cdot10^{-17}$
$AgIO_3$	$3.17\cdot10^{-8}$
AgI	$8.52\cdot10^{-17}$

Formula	K_{sp}
$Ag_2C_2O_4$	$5.40\cdot10^{-12}$
Ag_3PO_4	$8.89\cdot10^{-17}$
Ag_2SO_4	$1.20\cdot10^{-5}$
Ag_2SO_3	$1.50\cdot10^{-14}$
$AgSCN$	$1.03\cdot10^{-12}$
$Sr_3(AsO_4)_2$	$4.29\cdot10^{-19}$
$SrCO_3$	$5.60\cdot10^{-10}$
SrF_2	$4.33\cdot10^{-9}$
$Sr(IO_3)_2$	$1.14\cdot10^{-7}$
$Sr(IO_3)_2\cdot H_2O$	$3.77\cdot10^{-7}$
$Sr(IO_3)_2\cdot6H_2O$	$4.55\cdot10^{-7}$
$SrSO_4$	$3.44\cdot10^{-7}$
$TlBrO_3$	$1.10\cdot10^{-4}$
$TlBr$	$3.71\cdot10^{-6}$
$TlCl$	$1.86\cdot10^{-4}$
Tl_2CrO_4	$8.67\cdot10^{-13}$
$TlIO_3$	$3.12\cdot10^{-6}$
TlI	$5.54\cdot10^{-8}$
$TlSCN$	$1.57\cdot10^{-4}$
$Tl(OH)_3$	$1.68\cdot10^{-44}$
$Sn(OH)_2$	$5.45\cdot10^{-27}$
$Y_2(CO_3)_3$	$1.03\cdot10^{-31}$
YF_3	$8.62\cdot10^{-21}$
$Y(OH)_3$	$1.00\cdot10^{-22}$
$Y(IO_3)_3$	$1.12\cdot10^{-10}$
$Zn_3(AsO_4)_2$	$2.8\cdot10^{-28}$
$ZnCO_3$	$1.46\cdot10^{-10}$
$ZnCO_3\cdot H_2O$	$5.42\cdot10^{-11}$
ZnF_2	$3.04\cdot10^{-2}$
$Zn(OH)_2$	$3\cdot10^{-17}$
$Zn(IO_3)_2\cdot2H_2O$	$4.1\cdot10^{-6}$
$ZnC_2O_4\cdot2H_2O$	$1.38\cdot10^{-9}$
$ZnSe$	$3.6\cdot10^{-26}$
$ZnSeO_3\cdot H_2O$	$1.59\cdot10^{-7}$

Sulfides

CdS	$1,2\cdot10^{-28}$
CuS	$3,2\cdot10^{-38}$
FeS	$3,8\cdot10^{-20}$
PbS	$3,6\cdot10^{-29}$
MnS	$1,4\cdot10^{-15}$
HgS	$3\cdot10^{-54}$
Ag_2S	$5,7\cdot10^{-51}$
SnS	$1\cdot10^{-27}$
ZnS	$6,9\cdot10^{-26}$

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PHYSICAL CONSTANTS OF SOME METALS

Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm⁻³
Al	7429-90-5	26.982	silv-wh metal cub cry	660.32	2519	2.70
Sb	7440-36-0	121.760	silv metal hex	630.63	1587	6.68
As	7440-38-2	74.922	gray metal rhomb	817 tp (3.70 MPa)	603 sp	5.75
Ba	7440-39-3	137.327	silv-yel metal cub	727	1897	3.62
Be	7440-41-7	9.012	hex	1287	2471	1.85
Bi	7440-69-9	208.980	gray-wh soft metal	271.40	1564	9.79
Br_2	7726-95-6	159.808	red lq	-7.2	58.8	3.1028
Cd	7440-43-9	112.411	silv-wh metal	321.07	767	8.69
Ca	7440-70-2	40.078	silv-wh metal	842	1484	1.54
Ce	7440-45-1	140.116	silv metal cub or hex	798	3443	6.770
Cs	7440-46-2	132.905	silv-wh metal	28.5	671	1.93
Cr	7440-47-3	51.996	blue-wh metal cub	1907	2671	7.15
Co	7440-48-4	58.933	gray metal hex or cub	1495	2927	8.86
Cu	7440-50-8	63.546	red metal cub	1084.62	2562	8.96
Eu	7440-53-1	151.964	soft silv metal cub	822	1529	5.24
Fr	7440-73-5	223	short-lived alkal metal	27		
Gd	7440-54-2	157.25	silv metal hex	1313	3273	7.90
Ga	7440-55-3	69.723	silv lq or gray orth cry	29.771 tp	2204	5.91
Ge	7440-56-4	72.61	gray-wh cub cry	938.25	2833	5.3234
Au	7440-57-5	196.967	soft yel metal	1064.18	2856	19.3
Hf	7440-58-6	178.49	gray metal hex	2233	4603	13.3
In	7440-74-6	114.818	soft wh metal	156.60	2072	7.31
Fe	7439-89-6	55.845	silv-wh or gray met	1538	2861	7.87
La	7439-91-0	138.906	silv metal hex	918	3464	6.15
Pb	7439-92-1	207.2	soft silv-gray metal cub	327.46	1749	11.3
Li	7439-93-2	6.941	soft silv-wh metal	180.50	1342	0.534
Mg	7439-95-4	24.305	silv-wh metal	650	1090	1.74
Mn	7439-96-5	54.938	hard gray metal	1246	2061	7.3
Hg	7439-97-6	200.59	heavy silv lq	-38.837 tp	356.73	13.5336
Mo	7439-98-7	95.94	gray-bk metal cub	2623	4639	10.2
Ni	7440-02-0	58.693	wh metal cub	1455	2913	8.90
Nb	7440-03-1	92.906	gray metal cub	2477	4744	8.57
Os	7440-04-2	190.23	blue-wh metal hex	3033	5012	22.59
Pd	7440-05-3	106.42	silv-wh metal cub	1554.9	2963	12.0
Pt	7440-06-4	195.08	silv-gray metal cub	1768.4	3825	21.5
K	7440-09-7	39.098	soft silv-wh metal cub	63.5	759	0.89
Re	7440-15-5	186.207	silv-gray metal	3186	5596	20.8
Rb	7440-17-7	85.468	soft silv metal cub	39.30	688	1.53
Se	7782-49-2	78.96	gray metallic cry; hex	220.5	685	4.81
Ag	7440-22-4	107.868	silv metal cub	961.78	2162	10.5
Na	7440-23-5	22.990	soft silv met cub	97.80	883	0.97
Sr	7440-24-6	87.62	silv-wh metal cub	777	1382	2.64
Tc	7440-26-8	98	hex cry	2157	4265	11
Tl	7440-28-0	204.383	soft blue-wh metal	304	1473	11.8
Sn	7440-31-5	118.710	cub cry	trans to wh Sn 13.2	2602	5.769
Ti	7440-32-6	47.867	gray metal hex	1668	3287	4.506
W	7440-33-7	183.84	gray-wh metal cub	3422	5555	19.3
U	7440-61-1	238.029	silv-wh orth cry	1135	4131	19.1
V	7440-62-2	50.942	gray-wh metal cub	1910	3407	6.0
Zn	7440-66-6	65.39	blue-wh metal hex	419.53	907	7.14
Zr	7440-67-7	91.224	gray-wh metal hex	1855	4409	6.52

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Константы нестойкости комплексных соединений

В пятой графе дается последовательная константа нестойкости *k*, представляющая собой константу равновесия реакции типа (3) или (4).

$$MA_n \rightleftarrows MA_{n-1} + A \qquad (3)$$

$$MA_{n-1} \rightleftarrows MA_{n-2} + A \text{ и т. д.} \qquad (4)$$

В седьмой графе представлены значения общей константы нестойкости *K*, являющейся константой равновесия реакции (1).

В тех случаях, когда $n = 1$, значения последовательной и общей констант нестойкости совпадают.

$$MA_n \rightleftarrows M + nA \qquad (1)$$

Комплекс	Температура, °C	Ионная сила	Метод	*k*	p*k*	*K*	p*K*
$CuNH_3^{2+}$	30	0,5—5,0	»	$7,10 \cdot 10^{-5}$	4,15	$7,10 \cdot 10^{-5}$	4,15
$Cu(NH_3)_2^{2+}$	30	0,5—5,0	»	$3,16 \cdot 10^{-4}$	3,50	$2,24 \cdot 10^{-8}$	7,65
$Cu(NH_3)_3^{2+}$	30	0,5—5,0	»	$1,29 \cdot 10^{-3}$	2,89	$2,89 \cdot 10^{-11}$	10,54
$Cu(NH_3)_4^{2+}$	30	0,5—5,0	»	$7,40 \cdot 10^{-3}$	2,13	$2,14 \cdot 10^{-13}$	12,67
$Cu(NH_3)_5^{2+}$	. .	. . . .	»	3,0	—0,5	$6,42 \cdot 10^{-13}$	12,2
$\overset{I}{Cu}NH_3^{+}$	. .	. . . .	. . . . .	$6,6 \cdot 10^{-7}$	6,18	$6,6 \cdot 10^{-7}$	6,18
$\overset{I}{Cu}(NH_3)_2^{+}$	. .	. . . .	. . . . .	$2,04 \cdot 10^{-5}$	4,69	$1,35 \cdot 10^{-11}$	10,87
$NiNH_3^{2+}$	30	0,5—5,0	»	$1,62 \cdot 10^{-3}$	2,79	$1,62 \cdot 10^{-3}$	2,79
$Ni(NH_3)_2^{2+}$	30	0,5—5,0	»	$5,75 \cdot 10^{-3}$	2,24	$9,31 \cdot 10^{-6}$	5,03
$Ni(NH_3)_3^{2+}$	30	0,5—5,0	»	$1,86 \cdot 10^{-2}$	1,73	$1,73 \cdot 10^{-7}$	6,76
$Ni(NH_3)_4^{2+}$	30	0,5—5,0	»	$6,45 \cdot 10^{-2}$	1,19	$1,12 \cdot 10^{-8}$	7,95
$Ni(NH_3)_5^{2+}$	30	0,5—5,0	»	0,178	0,75	$2,00 \cdot 10^{-9}$	8,70
$Ni(NH_3)_6^{2+}$	30	0,5—5,0	»	0,934	0,03	$1,86 \cdot 10^{-9}$	8,73
$ZnNH_3^{2+}$	30	0,5—5,0	»	$4,26 \cdot 10^{-3}$	2,37	$4,26 \cdot 10^{-3}$	2,37
$Zn(NH_3)_2^{2+}$	30	0,5—5,0	»	$3,63 \cdot 10^{-3}$	2,44	$1,54 \cdot 10^{-5}$	4,81
$Zn(NH_3)_3^{2+}$	30	0,5—5,0	»	$3,16 \cdot 10^{-3}$	2,50	$4,87 \cdot 10^{-8}$	7,31
$Zn(NH_3)_4^{2+}$	30	0,5—5,0	»	$7,10 \cdot 10^{-3}$	2,15	$3,46 \cdot 10^{-10}$	9,46
$\overset{II}{Fe}OH^{+}$	25	0	потенц., расч.	$1,3 \cdot 10^{-4}$	3,9	$1,3 \cdot 10^{-4}$	3,9
$\overset{III}{Fe}OH^{2+}$	25	0	спектр., расч.	$1,55 \cdot 10^{-12}$	11,81	$1,55 \cdot 10^{-12}$	11,81
	25	0,1	потенц.	$7,9 \cdot 10^{-12}$	11,10	$7,9 \cdot 10^{-12}$	11,10
	25	3,0	»	$1,12 \cdot 10^{-11}$	10,95	$1,12 \cdot 10^{-11}$	10,95
$\overset{III}{Fe}(OH)_2^{+}$	25	0,1	»	$1,82 \cdot 10^{-11}$	10,74	$2,04 \cdot 10^{-22}$	21,69
$Zn(OH)_4^{2-}$	25	переменная	раств.	. . . .	. . .	$3,6 \cdot 10^{-16}$	15,44
$Ag(S_2O_3)_2^{3-}$	комн.	. . . .	потенц.	. . . . .	. . .	$2,5 \cdot 10^{-14}$	13,60
BaS_2O_3	25	0	раств.	$4,7 \cdot 10^{-3}$	2,33	$4,7 \cdot 10^{-3}$	2,33
CaS_2O_3	25	0	»	$1,04 \cdot 10^{-2}$	1,98	$1,04 \cdot 10^{-2}$	1,98
$CdCN^{+}$	25	3,0	»	$2,9 \cdot 10^{-6}$	5,54	$2,9 \cdot 10^{-6}$	5,54
$Cd(CN)_2$	25	3,0	»	$8,7 \cdot 10^{-6}$	5,06	$2,5 \cdot 10^{-11}$	10,60
$Cd(CN)_3^{-}$	25	3,0	»	$2,0 \cdot 10^{-5}$	4,70	$5,0 \cdot 10^{-16}$	15,30
$Cd(CN)_4^{2-}$	25	3,0	»	$2,8 \cdot 10^{-4}$	3,55	$1,41 \cdot 10^{-19}$	18,85
$\overset{I}{Cu}(CN)_2^{-}$	25	0	»	. . . . .	. . .	$1 \cdot 10^{-24}$	24
$\overset{I}{Cu}(CN)_3^{2-}$	25	0	спектр.	$2,6 \cdot 10^{-5}$	4,59	$2,6 \cdot 10^{-29}$	28,59
$\overset{I}{Cu}(CN)_4^{3-}$	25	0	»	$2 \cdot 10^{-2}$	1,70	$5 \cdot 10^{-31}$	30,30
$\overset{II}{Fe}(CN)_6^{4-}$	25	. . . .	термодин.	. . . . .	. . .	$1 \cdot 10^{-24}$	24
$\overset{III}{Fe}(CN)_6^{3-}$	25	. . . .	»	. . . . .	. . .	$1 \cdot 10^{-31}$	31
$\overset{II}{Hg}(CN)_4^{2-}$	25	0,05—0,20	потенц.	. . . . .	. . .	$4 \cdot 10^{-42}$	41,4

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Значения равновесного потенциала (E_p), коэффициента переноса (α) для восстановления Bi^{3+} в растворах ($HClO_4 + NaClO_4$), коэффициенты диффузии $D_{Bi(III)}$ и измеряемые константы скорости переноса электрона.

$C(HClO_4 + NaClO_4)$, моль/л	a_{H2O}	E_p, В отн. нас.к.э.	α	$10^6\ D_{Bi(III)}$, $см^2\ с^{-1}$	$10^4\ k_s$, $см\ с^{-1}$
1	0.965	0.084	0.29	5.92	2.17
2	0.927	0.074	0.28	5.00	1.97
3	0.885	0.081	0.24	5.10	2.25
4	0.832	0.089	0.33	5.00	3.87
5	0.774	0.094	0.54	3.97	24.20
6	0.704	0.102	0.67	3.50	56.70
7	0.628	0.109	0.82	3.00	70.60
8	0.543	0.138	0.72	1.60	60.60

Гетерогенные константы скорости и коэффициенты переноса для реакций восстановления некоторых соединений на ртутном электроде

реагент/продукт	коэффициент переноса	гетерогенная константа скорости, $см{\cdot}с^{-1}$
$Fe(CN)_6^{3-}/Fe(CN)_6^{4-}$	0.5	0.1
$RhCl_6^{3-}/Rh$	0.4	$9.41{\cdot}10^{-8}$
TcO_4^-/Tc	0.3	$6.14{\cdot}10^{-8}$
$PtCl_6^{2-}/PtCl_4^{2-}$	0.5	0.12
$IrCl_6^{3-}/Ir$	0.3	$7.26{\cdot}10^{-8}$
BrO_3^-/Br^-	0.5	0.15
$PdCl_4^{2-}/Pd$	0.5	$1.38{\cdot}10^{-9}$
$AuBr_4^-/Au$	0.4	$3.2{\cdot}10^{-9}$
$Cr^{III}EDTA^-/Cr^{II}EDTA^{2-}$	0.5	0.45

Токи обмена для водородной и кислородной реакций

электрод	электролит	водородная реакция, $А/см^2$	кислородная реакция, $А/см^2$
платина	1-3 М NaOH		$4{\cdot}10^{-8}$
никель	0.007-0.08 М NaOH	$7.7{\cdot}10^{-5}$	
никель	1-3 М NaOH	$3,5{\cdot}10^{-3}$	