TABLE D.2 Thermodynamic Properties of Substances at 298.15 K*. Substances are at 1 bar pressure. For aqueous solutions, solutes are at unit activity (roughly 1 M). Data for ions in aqueous solution are relative to values of *zero* for ΔH_f°, ΔG_f°, and S° for H^+

Inorganic Substances				
	ΔH_f°, kJ mol^{-1}	ΔG_f°, kJ mol^{-1}	S°, J mol^{-1} K^{-1}	C_p, J mol^{-1} K^{-1}
Aluminum				
Al(s)	0	0	28.33	24.2
Al^{3+}(aq)	−531	−485	−321.7	—
$AlCl_3$(s)	−704.2	−628.8	110.7	91.1
Al_2Cl_6(g)	−1291	−1220.	490.	157.72
AlF_3(s)	−1504	−1425	66.44	75.1
Al_2O_3(α solid)	−1676	−1582	50.92	79.0
$Al(OH)_3$(s)	−1276	—	—	93.1
$Al_2(SO_4)_3$(s)	−3441	−3100.	239	259.4
Barium				
Ba(s)	0	0	62.8	28.1
Ba^{2+}(aq)	−537.6	−560.8	9.6	—
$BaCO_3$(s)	−1216	−1138	112.1	85.35
$BaCl_2$(s)	−858.6	−810.4	123.7	75.1
BaF_2(s)	−1207	−1157	96.36	71.2
BaO(s)	−553.5	−525.1	70.42	47.3
$Ba(OH)_2$(s)	−944.7	—	—	101.6
$Ba(OH)_2 \cdot 8\ H_2O$(s)	−3342	−2793	427	—
$BaSO_4$(s)	−1473	−1362	132.2	101.8
Beryllium				
Be(s)	0	0	9.50	16.4
$BeCl_2$(α solid)	−490.4	−445.6	82.68	62.4
BeF_2(α solid)	−1027	−979.4	53.35	51.8
BeO(s)	−609.6	−580.3	14.14	25.6
Bismuth				
Bi(s)	0	0	56.74	25.5
$BiCl_3$(s)	−379.1	−315.0	177.0	105.0
Bi_2O_3(s)	−573.9	−493.7	151.5	113.5
Boron				
B(s)	0	0	5.86	11.1
BCl_3(l)	−427.2	−387.4	206.3	106.7
BF_3(g)	−1137	−1120.	254.1	50.45
B_2H_6(g)	35.6	86.7	232.1	56.7
B_2O_3(s)	−1273	−1194	53.97	62.8
Bromine				
Br(g)	111.9	82.40	175.0	20.8
Br^-(aq)	−121.6	−104.0	82.4	−141.8
Br_2(g)	30.91	3.11	245.5	36.0
Br_2(l)	0	0	152.2	75.7
BrCl(g)	14.64	−0.98	240.1	35.0
BrF_3(g)	−255.6	−229.4	292.5	66.6
BrF_3(l)	−300.8	−240.5	178.2	124.6

*Data for inorganic substances and for organic compounds with up to two carbon atoms per molecule are adapted from D. D. Wagman, et al., "The NBS Tables of Chemical Thermodynamic Properties: Selected Values for Inorganic and C_1 and C_2 Organic Substances in SI Units" *Journal of Physical and Chemical Reference Data* 11 (1982) Supplement 2. Data for other organic compounds are from J. A. Dean, *Lange's Handbook of Chemistry*. 15th ed., McGraw-Hill, 1999, and other sources.

Inorganic Substances				
	ΔH_f°, kJ mol^{-1}	ΔG_f°, kJ mol^{-1}	S°, J mol^{-1} K^{-1}	C_p, J mol^{-1} K^{-1}
Cadmium				
Cd(s)	0	0	51.76	26.0
Cd^{2+}(aq)	−75.90	−77.61	−73.2	—
$CdCl_2$(s)	−391.5	−343.9	115.3	74.7
CdO(s)	−258.2	−228.4	54.8	43.4
Calcium				
Ca(s)	0	0	41.42	25.9
Ca^{2+}(aq)	−542.8	−553.6	−53.1	—
$CaCO_3$(s)	−1207	−1129	92.9	80.6
$CaCl_2$(s)	−795.8	−748.1	104.6	72.9
CaF_2(s)	−1220.	−1167	68.87	67.0
CaH_2(s)	−186.2	−147.2	42	41.0
$Ca(NO_3)_2$(s)	−938.4	−743.1	193.3	149.4
CaO(s)	−635.1	−604.0	39.75	42.0
$Ca(OH)_2$(s)	−986.1	−898.5	83.39	87.5
$Ca_3(PO_4)_2$(s)	−4121	−3885	236.0	227.8
$CaSO_4$(s)	−1434	−1322	106.7	99.7
Carbon (See also the table of organic substances.)				
C(g)	716.7	671.3	158.0	20.8
C(diamond)	1.90	2.90	2.38	6.1
C(graphite)	0	0	5.74	8.5
CCl_4(g)	−102.9	−60.59	309.9	83.3
CCl_4(l)	−135.4	−65.21	216.4	130.7
C_2N_2(g)	309.0	297.4	241.9	56.8
CO(g)	−110.5	−137.2	197.7	29.1
CO_2(g)	−393.5	−394.4	213.7	37.1
CO_3^{2-}(aq)	−677.1	−527.8	−56.9	—
C_3O_2(g)	−93.72	−109.8	276.5	67.0
C_3O_2(l)	−117.3	−105.0	181.1	—
$COCl_2$(g)	−218.8	−204.6	283.5	57.7
COS(g)	−142.1	−169.3	231.6	41.5
CS_2(l)	89.70	65.27	151.3	76.4
Chlorine				
Cl(g)	121.7	105.7	165.2	21.8
Cl^-(aq)	−167.2	−131.2	56.5	−136.4
Cl_2(g)	0	0	223.1	33.9
ClF_3(g)	−163.2	−123.0	281.6	63.9
ClO_2(g)	102.5	120.5	256.8	42.0
Cl_2O(g)	80.3	97.9	266.2	45.4
Chromium				
Cr(s)	0	0	23.77	23.4
$[Cr(H_2O)_6]^{3+}$(aq)	−1999	—	—	—
Cr_2O_3(s)	−1140.	−1058	81.2	118.7
CrO_4^{2-}(aq)	−881.2	−727.8	50.21	—
$Cr_2O_7^{2-}$(aq)	−1490.	−1301	261.9	—
Cobalt				
Co(s)	0	0	30.04	24.8
CoO(s)	−237.9	−214.2	52.97	55.2
$Co(OH)_2$(pink solid)	−539.7	−454.3	79	68.8

(continued)

Inorganic Substances				
	ΔH_f°, kJ mol^{-1}	ΔG_f°, kJ mol^{-1}	S°, J mol^{-1} K^{-1}	C_p, J mol^{-1} K^{-1}
Copper				
Cu(s)	0	0	33.15	24.4
Cu^{2+}(aq)	64.77	65.49	−99.6	—
$CuCO_3 \cdot Cu(OH)_2$(s)	−1051	−893.6	186.2	—
CuO(s)	−157.3	−129.7	42.63	42.3
$Cu(OH)_2$(s)	−449.8	—	—	95.19
$CuSO_4 \cdot 5\,H_2O$(s)	−2280.	−1880.	300.4	—
Fluorine				
F(g)	78.99	61.91	158.8	22.7
F^-(aq)	−332.6	−278.8	−13.8	−106.7
F_2(g)	0	0	202.8	31.3
Helium				
He(g)	0	0	126.2	20.8
Hydrogen				
H(g)	218.0	203.2	114.7	20.8
H^+(aq)	0	0	0	0
H_2(g)	0	0	130.7	28.8
HBr(g)	−36.40	−53.45	198.7	29.1
HCl(g)	−92.31	−95.30	186.9	29.1
HCl(aq)	−167.2	−131.2	56.5	−136.4
$HClO_2$(aq)	−51.9	5.9	188.3	—
HCN(g)	135.1	124.7	201.8	35.9
HF(g)	−271.1	−273.2	173.8	—
HI(g)	26.48	1.70	206.6	29.2
HNO_3(l)	−174.1	−80.71	155.6	109.9
HNO_3(aq)	−207.4	−111.3	146.4	−86.6
H_2O(g)	−241.8	−228.6	188.8	33.6
H_2O(l)	−285.8	−237.1	69.91	75.3
H_2O_2(g)	−136.3	−105.6	232.7	43.1
H_2O_2(l)	−187.8	−120.4	109.6	89.1
H_2S(g)	−20.63	−33.56	205.8	34.2
H_2SO_4(l)	−814.0	−690.0	156.9	138.9
H_2SO_4(aq)	−909.3	−744.5	20.1	−293.0
Iodine				
I(g)	106.8	70.25	180.8	20.8
I^-(aq)	−55.19	−51.57	111.3	−142.3
I_2(g)	62.44	19.33	260.7	36.9
I_2(s)	0	0	116.1	54.4
IBr(g)	40.84	3.69	258.8	36.4
ICl(g)	17.78	−5.46	247.6	35.6
ICl(l)	−23.89	−13.58	135.1	135.1
Iron				
Fe(s)	0	0	27.28	25.1
Fe^{2+}(aq)	−89.1	−78.90	−137.7	—
Fe^{3+}(aq)	−48.5	−4.7	−315.9	—
$FeCO_3$(s)	−740.6	−666.7	92.9	82.1
$FeCl_3$(s)	−399.5	−334.0	−142.3	96.7
FeO(s)	−272.0	—	—	49.91
Fe_2O_3(s)	−824.2	−742.2	87.40	103.9
Fe_3O_4(s)	−1118	−1015	146.4	143.4
$Fe(OH)_3$(s)	−823.0	−696.5	106.7	101.7

Inorganic Substances				
	ΔH_f°, kJ mol^{-1}	ΔG_f°, kJ mol^{-1}	S°, J mol^{-1} K^{-1}	C_p, J mol^{-1} K^{-1}
Lead				
Pb(s)	0	0	64.81	26.4
Pb^{2+}(aq)	−1.7	−24.43	10.5	—
PbI_2(s)	−175.5	−173.6	174.9	77.4
PbO_2(s)	−277.4	−217.3	68.6	64.6
$PbSO_4$(s)	−919.9	−813.1	148.6	103.2
Lithium				
Li(g)	159.4	126.7	138.8	20.8
Li(s)	0	0	29.12	24.8
Li^+(aq)	−278.5	−293.3	13.4	68.6
LiCl(s)	−408.6	−384.4	59.33	48.0
LiOH(s)	−484.9	−439.0	42.80	49.6
$LiNO_3$(s)	−483.1	−381.1	90.0	—
Magnesium				
Mg(s)	0	0	32.68	24.9
Mg^{2+}(aq)	−466.9	−454.8	−138.1	—
$MgCl_2$(s)	−641.3	−591.8	89.62	71.4
$MgCO_3$(s)	−1096	−1012	65.7	75.5
MgF_2(s)	−1123	−1070	57.24	61.6
MgO(s)	−601.7	−569.4	26.94	37.2
$Mg(OH)_2$(s)	−924.5	−833.5	63.18	77.0
MgS(s)	−346.0	−341.8	50.33	45.6
$MgSO_4$(s)	−1285	−1171	91.6	96.5
Manganese				
Mn(s)	0	0	32.01	26.3
Mn^{2+}(aq)	−220.8	−228.1	−73.6	50.0
MnO_2(s)	−520.0	−465.1	53.05	54.1
MnO_4^-(aq)	−541.4	−447.2	191.2	−82.0
Mercury				
Hg(g)	61.32	31.82	175.0	20.8
Hg(l)	0	0	76.02	28.0
HgO(s)	−90.83	−58.54	70.29	44.1
Nitrogen				
N(g)	472.7	455.6	153.3	20.8
N_2(g)	0	0	191.6	29.1
NF_3(g)	−124.7	−83.2	260.7	53.4
NH_3(g)	−46.11	−16.45	192.5	35.1
NH_3(aq)	−80.29	−26.50	111.3	—
NH_4^+(aq)	−132.5	−79.31	113.4	79.9
NH_4Br(s)	−270.8	−175.2	113	96.0
NH_4Cl(s)	−314.4	−202.9	94.6	84.1
NH_4F(s)	−464.0	−348.7	71.96	65.3
NH_4HCO_3(s)	−849.4	−665.9	120.9	—
NH_4I(s)	−201.4	−112.5	117	—
NH_4NO_3(s)	−365.6	−183.9	151.1	139.3
NH_4NO_3(aq)	−339.9	−190.6	259.8	−6.7
$(NH_4)_2SO_4$(s)	−1181	−901.7	220.1	187.5
N_2H_4(g)	95.40	159.4	238.5	48.4
N_2H_4(l)	50.63	149.3	121.2	98.9
NO(g)	90.25	86.55	210.8	29.9
N_2O(g)	82.05	104.2	219.9	38.6

(continued)

Inorganic Substances				
	ΔH_f°, kJ mol^{-1}	ΔG_f°, kJ mol^{-1}	S°, J mol^{-1} K^{-1}	C_p, J mol^{-1} K^{-1}
$NO_2(g)$	33.18	51.31	240.1	37.2
$N_2O_4(g)$	9.16	97.89	304.3	79.2
$N_2O_4(l)$	−19.50	97.54	209.2	142.7
$N_2O_5(g)$	11.3	115.1	355.7	95.3
$NO_3^-(aq)$	−205.0	−108.7	146.4	−86.6
NOBr(g)	82.17	82.42	273.7	45.5
NOCl(g)	51.71	66.08	261.7	44.7
Oxygen				
O(g)	249.2	231.7	161.1	21.9
$O_2(g)$	0	0	205.1	29.4
$O_3(g)$	142.7	163.2	238.9	39.2
$OH^-(aq)$	−230.0	−157.2	−10.75	−148.5
$OF_2(g)$	24.7	41.9	247.4	43.3
Phosphorus				
P(α white)	0	0	41.09	23.8
P(red)	−17.6	−12.1	22.80	21.2
$P_4(g)$	58.91	24.44	280.0	67.2
$PCl_3(g)$	−287.0	−267.8	311.8	71.8
$PCl_5(g)$	−374.9	−305.0	364.6	112.8
$PH_3(g)$	5.4	13.4	210.2	37.1
$P_4O_{10}(s)$	−2984	−2698	228.9	211.71
$PO_4^{3-}(aq)$	−1277	−1019	−222	—
Potassium				
K(g)	89.24	60.59	160.3	20.8
K(s)	0	0	64.18	29.6
$K^+(aq)$	−252.4	−283.3	102.5	21.8
KBr(s)	−393.8	−380.7	95.90	52.4
KCN(s)	−113.0	−101.9	128.5	66.3
KCl(s)	−436.7	−409.1	82.59	51.3
$KClO_3(s)$	−397.7	−296.3	143.1	100.3
$KClO_4(s)$	−432.8	−303.1	151.0	112.4
KF(s)	−567.3	−537.8	66.57	49.0
KI(s)	−327.9	−324.9	106.3	52.9
$KNO_3(s)$	−494.6	−394.9	133.1	96.4
KOH(s)	−424.8	−379.1	78.9	68.9
KOH(aq)	−482.4	−440.5	91.6	−126.8
$K_2SO_4(s)$	−1438	−1321	175.6	131.5
Silicon				
Si(s)	0	0	18.83	20.0
$SiH_4(g)$	34.3	56.9	204.6	42.8
$Si_2H_6(g)$	80.3	127.3	272.7	80.8
SiO_2(quartz)	−910.9	−856.6	41.84	44.4
Silver				
Ag(s)	0	0	42.55	25.4
$Ag^+(aq)$	105.6	77.11	72.68	21.8
AgBr(s)	−100.4	−96.90	107.1	52.4
AgCl(s)	−127.1	−109.8	96.2	50.8
AgI(s)	−61.84	−66.19	115.5	56.8
$AgNO_3(s)$	−124.4	−33.41	140.9	93.1
$Ag_2O(s)$	−31.05	−11.20	121.3	65.9
$Ag_2SO_4(s)$	−715.9	−618.4	200.4	131.4

Inorganic Substances				
	ΔH_f°, kJ mol^{-1}	ΔG_f°, kJ mol^{-1}	S°, J mol^{-1} K^{-1}	C_p, J mol^{-1} K^{-1}
Sodium				
Na(g)	107.3	76.76	153.7	20.8
Na(s)	0	0	51.21	28.2
Na^+(aq)	−240.1	−261.9	59.0	46.4
Na_2(g)	142.1	103.9	230.2	37.6
NaBr(s)	−361.1	−349.0	86.82	51.4
Na_2CO_3(s)	−1131	−1044	135.0	112.3
$NaHCO_3$(s)	−950.8	−851.0	101.7	87.6
NaCl(s)	−411.2	−384.1	72.13	50.5
NaCl(aq)	−407.3	−393.1	115.5	−90.0
$NaClO_3$(s)	−365.8	−262.3	123.4	—
$NaClO_4$(s)	−383.3	−254.9	142.3	111.3
NaF(s)	−573.6	−543.5	51.46	46.9
NaH(s)	−56.28	−33.46	40.02	36.4
NaI(s)	−287.8	−286.1	98.53	52.1
$NaNO_3$(s)	−467.9	−367.0	116.5	92.9
$NaNO_3$(aq)	−447.5	−373.2	205.4	−40.2
Na_2O_2(s)	−510.9	−447.7	95.0	89.2
NaOH(s)	−425.6	−379.5	64.46	59.5
NaOH(aq)	−470.1	−419.2	48.1	−102.1
NaH_2PO_4(s)	−1537	−1386	127.5	−116.86
Na_2HPO_4(s)	−1748	−1608	150.5	135.3
Na_3PO_4(s)	−1917	−1789	173.8	153.47
$NaHSO_4$(s)	−1126	−992.8	113.0	—
Na_2SO_4(s)	−1387	−1270	149.6	128.2
Na_2SO_4(aq)	−1390.	−1268	138.1	−201.0
$Na_2SO_4 \cdot 10\ H_2O$(s)	−4327	−3647	592.0	—
$Na_2S_2O_3$(s)	−1123	−1028	155	—
Sulfur				
S(g)	278.8	238.3	167.8	23.7
S(rhombic)	0	0	31.80	22.6
S_8(g)	102.3	49.63	431.0	156.06
S_2Cl_2(g)	−18.4	−31.8	331.5	124.3
SF_6(g)	−1209	−1105	291.8	97.0
SO_2(g)	−296.8	−300.2	248.2	39.9
SO_3(g)	−395.7	−371.1	256.8	50.7
SO_4^{2-}(aq)	−909.3	−744.5	20.1	−293.0
$S_2O_3^{2-}$(aq)	−648.5	−522.5	67	—
SO_2Cl_2(g)	−364.0	−320.0	311.9	77.0
SO_2Cl_2(l)	−394.1	—	—	−134.0
Tin				
Sn(white)	0	0	51.55	27.0
Sn(gray)	−2.09	0.13	44.14	25.8
$SnCl_4$(l)	−511.3	−440.1	258.6	165.3
SnO(s)	−285.8	−256.9	56.5	44.3
SnO_2(s)	−580.7	−519.6	52.3	52.6
Titanium				
Ti(s)	0	0	30.63	25.0
$TiCl_4$(g)	−763.2	−726.7	354.9	95.4
$TiCl_4$(l)	−804.2	−737.2	252.3	145.2
TiO_2(s)	−944.7	−889.5	50.33	55.0

(continued)

Inorganic Substances				
	ΔH_f°, kJ mol^{-1}	ΔG_f°, kJ mol^{-1}	S°, J mol^{-1} K^{-1}	C_p, J mol^{-1} K^{-1}
Uranium				
U(s)	0	0	50.21	27.7
UF_6(g)	−2147	−2064	377.9	129.6
UF_6(s)	−2197	−2069	227.6	166.8
UO_2(s)	−1085	−1032	77.03	63.6
Zinc				
Zn(s)	0	0	41.63	25.4
Zn^{2+}(aq)	−153.9	−147.1	112.1	46.0
ZnO(s)	−138.3	−318.3	43.64	40.3

Organic Substances					
	Name	ΔH_f°, kJ mol^{-1}	ΔG_f°, kJ mol^{-1}	S°, J mol^{-1} K^{-1}	C_p, J mol^{-1} K^{-1}
CH_4(g)	Methane(g)	−74.81	−50.72	186.3	35.7
C_2H_2(g)	Acetylene(g)	226.7	209.2	200.9	44.0
C_2H_4(g)	Ethylene(g)	52.26	68.15	219.6	42.9
C_2H_6(g)	Ethane(g)	−84.68	−32.82	229.6	52.5
C_3H_8(g)	Propane(g)	−103.8	−23.3	270.3	73.6
C_4H_{10}(g)	Butane(g)	−125.6	−17.1	310.2	97.5
C_6H_6(g)	Benzene(g)	82.6	129.8	269.3	82.4
C_6H_6(l)	Benzene(l)	49.0	124.5	173.4	136.0
C_6H_{12}(g)	Cyclohexane(g)	−123.4	32.0	298.4	106.3
C_6H_{12}(l)	Cyclohexane(l)	−156.4	26.9	204.4	154.9
$C_{10}H_8$(g)	Naphthalene(g)	150.6	224.2	333.2	131.9
$C_{10}H_8$(s)	Naphthalene(s)	77.9	201.7	167.5	165.7
CH_2O(g)	Formaldehyde(g)	−108.6	−102.5	218.8	35.4
CH_3CHO(g)	Acetaldehyde(g)	−166.2	−128.9	250.3	55.3
CH_3CHO(l)	Acetaldehyde(l)	−192.3	−128.1	160.2	89.0
CH_3OH(g)	Methanol(g)	−200.7	−162.0	239.8	44.1
CH_3OH(l)	Methanol(l)	−238.7	−166.3	126.8	81.1
CH_3CH_2OH(g)	Ethanol(g)	−235.1	−168.5	282.7	65.6
CH_3CH_2OH(l)	Ethanol(l)	−277.7	−174.8	160.7	112.3
C_6H_5OH(s)	Phenol(s)	−165.1	−50.4	144.0	127.4
$(CH_3)_2CO$(g)	Acetone(g)	−216.6	−153.0	295.0	74.5
$(CH_3)_2CO$(l)	Acetone(l)	−247.6	−155.6	200.5	126.3
CH_3COOH(g)	Acetic acid(g)	−432.3	−374.0	282.5	63.4
CH_3COOH(l)	Acetic acid(l)	−484.5	−389.9	159.8	123.3
CH_3COOH(aq)	Acetic acid(aq)	−485.8	−396.5	178.7	−6.3
C_6H_5COOH(s)	Benzoic acid(s)	−385.2	−245.3	167.6	146.8
CH_3NH_2(g)	Methylamine(g)	−22.97	32.16	243.4	50.1
$C_6H_5NH_2$(g)	Aniline(g)	86.86	166.8	319.3	107.9
$C_6H_5NH_2$(l)	Aniline(l)	31.6	149.2	191.3	191.9

TABLE D.3 Equilibrium Constants

A. Ionization Constants of Weak Acids at 25 °C

Name of acid	Formula	K_a	Name of acid	Formula	K_a
Acetic	$HC_2H_3O_2$	1.8×10^{-5}	Hyponitrous	$HON{=}NOH$	8.9×10^{-8}
Acrylic	$HC_3H_3O_2$	5.5×10^{-5}		$HON{=}NO^-$	4×10^{-12}
Arsenic	H_3AsO_4	6.0×10^{-3}	Iodic	HIO_3	1.6×10^{-1}
	$H_2AsO_4^-$	1.0×10^{-7}	Iodoacetic	$HC_2H_2IO_2$	6.7×10^{-4}
	$HAsO_4^{2-}$	3.2×10^{-12}	Malonic	$H_2C_3H_2O_4$	1.5×10^{-3}
Arsenous	H_3AsO_3	6.6×10^{-10}		$HC_3H_2O_4^-$	2.0×10^{-6}
Benzoic	$HC_7H_5O_2$	6.3×10^{-5}	Nitrous	HNO_2	7.2×10^{-4}
Bromoacetic	$HC_2H_2BrO_2$	1.3×10^{-3}	Oxalic	$H_2C_2O_4$	5.4×10^{-2}
Butyric	$HC_4H_7O_2$	1.5×10^{-5}		$HC_2O_4^-$	5.3×10^{-5}
Carbonic	H_2CO_3	4.4×10^{-7}	Phenol	HOC_6H_5	1.0×10^{-10}
	HCO_3^-	4.7×10^{-11}	Phenylacetic	$HC_8H_7O_2$	4.9×10^{-5}
Chloroacetic	$HC_2H_2ClO_2$	1.4×10^{-3}	Phosphoric	H_3PO_4	7.1×10^{-3}
Chlorous	$HClO_2$	1.1×10^{-2}		$H_2PO_4^-$	6.3×10^{-8}
Citric	$H_3C_6H_5O_7$	7.4×10^{-4}		HPO_4^{2-}	4.2×10^{-13}
	$H_2C_6H_5O_7^-$	1.7×10^{-5}	Phosphorous	H_3PO_3	3.7×10^{-2}
	$HC_6H_5O_7^{2-}$	4.0×10^{-7}		$H_2PO_3^-$	2.1×10^{-7}
Cyanic	HOCN	3.5×10^{-4}	Propionic	$HC_3H_5O_2$	1.3×10^{-5}
Dichloroacetic	$HC_2HCl_2O_2$	5.5×10^{-2}	Pyrophosphoric	$H_4P_2O_7$	3.0×10^{-2}
Fluoroacetic	$HC_2H_2FO_2$	2.6×10^{-3}		$H_3P_2O_7^-$	4.4×10^{-3}
Formic	$HCHO_2$	1.8×10^{-4}		$H_2P_2O_7^{2-}$	2.5×10^{-7}
Hydrazoic	HN_3	1.9×10^{-5}		$HP_2O_7^{3-}$	5.6×10^{-10}
Hydrocyanic	HCN	6.2×10^{-10}	Selenic	H_2SeO_4	strong acid
Hydrofluoric	HF	6.6×10^{-4}		$HSeO_4^-$	2.2×10^{-2}
Hydrogen peroxide	H_2O_2	2.2×10^{-12}	Selenous	H_2SeO_3	2.3×10^{-3}
Hydroselenic	H_2Se	1.3×10^{-4}		$HSeO_3^-$	5.4×10^{-9}
	HSe^-	1×10^{-11}	Succinic	$H_2C_4H_4O_4$	6.2×10^{-5}
Hydrosulfuric	H_2S	1.0×10^{-7}		$HC_4H_4O_4^-$	2.3×10^{-6}
	HS^-	1×10^{-19}	Sulfuric	H_2SO_4	strong acid
Hydrotelluric	H_2Te	2.3×10^{-3}		HSO_4^-	1.1×10^{-2}
	HTe^-	1.6×10^{-11}	Sulfurous	H_2SO_3	1.3×10^{-2}
Hypobromous	HOBr	2.5×10^{-9}		HSO_3^-	6.2×10^{-8}
Hypochlorous	HOCl	2.9×10^{-8}	Thiophenol	HSC_6H_5	3.2×10^{-7}
Hypoiodous	HOI	2.3×10^{-11}	Trichloroacetic	$HC_2Cl_3O_2$	3.0×10^{-1}

B. Ionization Constants of Weak Bases at 25 °C

Name of base	Formula	K_b	Name of base	Formula	K_b
Ammonia	NH_3	1.8×10^{-5}	Isoquinoline	C_9H_7N	2.5×10^{-9}
Aniline	$C_6H_5NH_2$	7.4×10^{-10}	Methylamine	CH_3NH_2	4.2×10^{-4}
Codeine	$C_{18}H_{21}O_3N$	8.9×10^{-7}	Morphine	$C_{17}H_{19}O_3N$	7.4×10^{-7}
Diethylamine	$(C_2H_5)_2NH$	6.9×10^{-4}	Piperdine	$C_5H_{11}N$	1.3×10^{-3}
Dimethylamine	$(CH_3)_2NH$	5.9×10^{-4}	Pyridine	C_5H_5N	1.5×10^{-9}
Ethylamine	$C_2H_5NH_2$	4.3×10^{-4}	Quinoline	C_9H_7N	6.3×10^{-10}
Hydrazine	NH_2NH_2	8.5×10^{-7}	Triethanolamine	$C_6H_{15}O_3N$	5.8×10^{-7}
	$NH_2NH_3^+$	8.9×10^{-16}	Triethylamine	$(C_2H_5)_3N$	5.2×10^{-4}
Hydroxylamine	NH_2OH	9.1×10^{-9}	Trimethylamine	$(CH_3)_3N$	6.3×10^{-5}

(continued)

C. Solubility Product Constants[a]

Name of solute	Formula	K_{sp}	Name of solute	Formula	K_{sp}
Aluminum hydroxide	$Al(OH)_3$	1.3×10^{-33}	Lead(II) hydroxide	$Pb(OH)_2$	1.2×10^{-15}
Aluminum phosphate	$AlPO_4$	6.3×10^{-19}	Lead(II) iodide	PbI_2	7.1×10^{-9}
Barium carbonate	$BaCO_3$	5.1×10^{-9}	Lead(II) sulfate	$PbSO_4$	1.6×10^{-8}
Barium chromate	$BaCrO_4$	1.2×10^{-10}	Lead(II) sulfide[b]	PbS	3×10^{-28}
Barium fluoride	BaF_2	1.0×10^{-6}	Lithium carbonate	Li_2CO_3	2.5×10^{-2}
Barium hydroxide	$Ba(OH)_2$	5×10^{-3}	Lithium fluoride	LiF	3.8×10^{-3}
Barium sulfate	$BaSO_4$	1.1×10^{-10}	Lithium phosphate	Li_3PO_4	3.2×10^{-9}
Barium sulfite	$BaSO_3$	8×10^{-7}	Magnesium ammonium phosphate	$MgNH_4PO_4$	2.5×10^{-13}
Barium thiosulfate	BaS_2O_3	1.6×10^{-5}			
Bismuthyl chloride	BiOCl	1.8×10^{-31}	Magnesium carbonate	$MgCO_3$	3.5×10^{-8}
Bismuthyl hydroxide	BiOOH	4×10^{-10}	Magnesium fluoride	MgF_2	3.7×10^{-8}
Cadmium carbonate	$CdCO_3$	5.2×10^{-12}	Magnesium hydroxide	$Mg(OH)_2$	1.8×10^{-11}
Cadmium hydroxide	$Cd(OH)_2$	2.5×10^{-14}	Magnesium phosphate	$Mg_3(PO_4)_2$	1×10^{-25}
Cadmium sulfide[b]	CdS	8×10^{-28}	Manganese(II) carbonate	$MnCO_3$	1.8×10^{-11}
Calcium carbonate	$CaCO_3$	2.8×10^{-9}	Manganese(II) hydroxide	$Mn(OH)_2$	1.9×10^{-13}
Calcium chromate	$CaCrO_4$	7.1×10^{-4}	Manganese(II) sulfide[b]	MnS	3×10^{-14}
Calcium fluoride	CaF_2	5.3×10^{-9}	Mercury(I) bromide	Hg_2Br_2	5.6×10^{-23}
Calcium hydroxide	$Ca(OH)_2$	5.5×10^{-6}	Mercury(I) chloride	Hg_2Cl_2	1.3×10^{-18}
Calcium hydrogen phosphate	$CaHPO_4$	1×10^{-7}	Mercury(I) iodide	Hg_2I_2	4.5×10^{-29}
			Mercury(II) sulfide[b]	HgS	2×10^{-53}
Calcium oxalate	CaC_2O_4	4×10^{-9}	Nickel(II) carbonate	$NiCO_3$	6.6×10^{-9}
Calcium phosphate	$Ca_3(PO_4)_2$	2.0×10^{-29}	Nickel(II) hydroxide	$Ni(OH)_2$	2.0×10^{-15}
Calcium sulfate	$CaSO_4$	9.1×10^{-6}	Scandium fluoride	ScF_3	4.2×10^{-18}
Calcium sulfite	$CaSO_3$	6.8×10^{-8}	Scandium hydroxide	$Sc(OH)_3$	8.0×10^{-31}
Chromium(II) hydroxide	$Cr(OH)_2$	2×10^{-16}	Silver arsenate	Ag_3AsO_4	1.0×10^{-22}
Chromium(III) hydroxide	$Cr(OH)_3$	6.3×10^{-31}	Silver azide	AgN_3	2.8×10^{-9}
Cobalt(II) carbonate	$CoCO_3$	1.4×10^{-13}	Silver bromide	AgBr	5.0×10^{-13}
Cobalt(II) hydroxide	$Co(OH)_2$	1.6×10^{-15}	Silver carbonate	Ag_2CO_3	8.5×10^{-12}
Cobalt(III) hydroxide	$Co(OH)_3$	1.6×10^{-44}	Silver chloride	AgCl	1.8×10^{-10}
Copper(I) chloride	CuCl	1.2×10^{-6}	Silver chromate	Ag_2CrO_4	1.1×10^{-12}
Copper(I) cyanide	CuCN	3.2×10^{-20}	Silver cyanide	AgCN	1.2×10^{-16}
Copper(I) iodide	CuI	1.1×10^{-12}	Silver iodate	$AgIO_3$	3.0×10^{-8}
Copper(II) arsenate	$Cu_3(AsO_4)_2$	7.6×10^{-36}	Silver iodide	AgI	8.5×10^{-17}
Copper(II) carbonate	$CuCO_3$	1.4×10^{-10}	Silver nitrite	$AgNO_2$	6.0×10^{-4}
Copper(II) chromate	$CuCrO_4$	3.6×10^{-6}	Silver sulfate	Ag_2SO_4	1.4×10^{-5}
Copper(II) ferrocyanide	$Cu_2[Fe(CN)_6]$	1.3×10^{-16}	Silver sulfide[b]	Ag_2S	6×10^{-51}
Copper(II) hydroxide	$Cu(OH)_2$	2.2×10^{-20}	Silver sulfite	Ag_2SO_3	1.5×10^{-14}
Copper(II) sulfide[b]	CuS	6×10^{-37}	Silver thiocyanate	AgSCN	1.0×10^{-12}
Iron(II) carbonate	$FeCO_3$	3.2×10^{-11}	Strontium carbonate	$SrCO_3$	1.1×10^{-10}
Iron(II) hydroxide	$Fe(OH)_2$	8.0×10^{-16}	Strontium chromate	$SrCrO_4$	2.2×10^{-5}
Iron(II) sulfide[b]	FeS	6×10^{-19}	Strontium fluoride	SrF_2	2.5×10^{-9}
Iron(III) arsenate	$FeAsO_4$	5.7×10^{-21}	Strontium sulfate	$SrSO_4$	3.2×10^{-7}
Iron(III) ferrocyanide	$Fe_4[Fe(CN)_6]_3$	3.3×10^{-41}	Thallium(I) bromide	TlBr	3.4×10^{-6}
Iron(III) hydroxide	$Fe(OH)_3$	4×10^{-38}	Thallium(I) chloride	TlCl	1.7×10^{-4}
Iron(III) phosphate	$FePO_4$	1.3×10^{-22}	Thallium(I) iodide	TlI	6.5×10^{-8}
Lead(II) arsenate	$Pb_3(AsO_4)_2$	4.0×10^{-36}	Thallium(III) hydroxide	$Tl(OH)_3$	6.3×10^{-46}
Lead(II) azide	$Pb(N_3)_2$	2.5×10^{-9}	Tin(II) hydroxide	$Sn(OH)_2$	1.4×10^{-28}
Lead(II) bromide	$PbBr_2$	4.0×10^{-5}	Tin(II) sulfide[b]	SnS	1×10^{-26}
Lead(II) carbonate	$PbCO_3$	7.4×10^{-14}	Zinc carbonate	$ZnCO_3$	1.4×10^{-11}
Lead(II) chloride	$PbCl_2$	1.6×10^{-5}	Zinc hydroxide	$Zn(OH)_2$	1.2×10^{-17}
Lead(II) chromate	$PbCrO_4$	2.8×10^{-13}	Zinc oxalate	ZnC_2O_4	2.7×10^{-8}
Lead(II) fluoride	PbF_2	2.7×10^{-8}	Zinc phosphate	$Zn_3(PO_4)_2$	9.0×10^{-33}
			Zinc sulfide[b]	ZnS	2×10^{-25}

D. Complex-Ion Formation Constants[c, d]

Formula	K_f	Formula	K_f	Formula	K_f
$[Ag(CN)_2]^-$	5.6×10^{18}	$[Co(ox)_3]^{3-}$	10^{20}	$[HgI_4]^{2-}$	6.8×10^{29}
$[Ag(EDTA)]^{3-}$	2.1×10^{7}	$[Cr(EDTA)]^-$	10^{23}	$[Hg(ox)_2]^{2-}$	9.5×10^{6}
$[Ag(en)_2]^+$	5.0×10^{7}	$[Cr(OH)_4]^-$	8×10^{29}	$[Ni(CN)_4]^{2-}$	2×10^{31}
$[Ag(NH_3)_2]^+$	1.6×10^{7}	$[CuCl_3]^{2-}$	5×10^{5}	$[Ni(EDTA)]^{2-}$	3.6×10^{18}
$[Ag(SCN)_4]^{3-}$	1.2×10^{10}	$[Cu(CN)_4]^{3-}$	2.0×10^{30}	$[Ni(en)_3]^{2+}$	2.1×10^{18}
$[Ag(S_2O_3)_2]^{3-}$	1.7×10^{13}	$[Cu(EDTA)]^{2-}$	5×10^{18}	$[Ni(NH_3)_6]^{2+}$	5.5×10^{8}
$[Al(EDTA)]^-$	1.3×10^{16}	$[Cu(en)_2]^{2+}$	1×10^{20}	$[Ni(ox)_3]^{4-}$	3×10^{8}
$[Al(OH)_4]^-$	1.1×10^{33}	$[Cu(NH_3)_4]^{2+}$	1.1×10^{13}	$[PbCl_3]^-$	2.4×10^{1}
$[Al(ox)_3]^{3-}$	2×10^{16}	$[Cu(ox)_2]^{2-}$	3×10^{8}	$[Pb(EDTA)]^{2-}$	2×10^{18}
$[CdCl_4]^{2-}$	6.3×10^{2}	$[Fe(CN)_6]^{4-}$	10^{37}	$[PbI_4]^{2-}$	3.0×10^{4}
$[Cd(CN)_4]^{2-}$	6.0×10^{18}	$[Fe(EDTA)]^{2-}$	2.1×10^{14}	$[Pb(OH)_3]^-$	3.8×10^{14}
$[Cd(en)_3]^{2+}$	1.2×10^{12}	$[Fe(en)_3]^{2+}$	5.0×10^{9}	$[Pb(ox)_2]^{2-}$	3.5×10^{6}
$[Cd(NH_3)_4]^{2+}$	1.3×10^{7}	$[Fe(ox)_3]^{4-}$	1.7×10^{5}	$[Pb(S_2O_3)_3]^{4-}$	2.2×10^{6}
$[Co(EDTA)]^{2-}$	2.0×10^{16}	$[Fe(CN)_6]^{3-}$	10^{42}	$[PtCl_4]^{2-}$	1×10^{16}
$[Co(en)_3]^{2+}$	8.7×10^{13}	$[Fe(EDTA)]^-$	1.7×10^{24}	$[Pt(NH_3)_6]^{2+}$	2×10^{35}
$[Co(NH_3)_6]^{2+}$	1.3×10^{5}	$[Fe(ox)_3]^{3-}$	2×10^{20}	$[Zn(CN)_4]^{2-}$	1×10^{18}
$[Co(ox)_3]^{4-}$	5×10^{9}	$[Fe(SCN)]^{2+}$	8.9×10^{2}	$[Zn(EDTA)]^{2-}$	3×10^{16}
$[Co(SCN)_4]^{2-}$	1.0×10^{3}	$[HgCl_4]^{2-}$	1.2×10^{15}	$[Zn(en)_3]^{2+}$	1.3×10^{14}
$[Co(EDTA)]^-$	10^{36}	$[Hg(CN)_4]^{2-}$	3×10^{41}	$[Zn(NH_3)_4]^{2+}$	4.1×10^{8}
$[Co(en)_3]^{3+}$	4.9×10^{48}	$[Hg(EDTA)]^{2-}$	6.3×10^{21}	$[Zn(OH)_4]^{2-}$	4.6×10^{17}
$[Co(NH_3)_6]^{3+}$	4.5×10^{33}	$[Hg(en)_2]^{2+}$	2×10^{23}	$[Zn(ox)_3]^{4-}$	1.4×10^{8}

[a]Data are at various temperatures around "room" temperature, from 18 to 25 °C.
[b]For a solubility equilibrium of the type $MS(s) + H_2O \rightleftharpoons M^{2+}(aq) + HS^-(aq) + OH^-(aq)$.
[c]The ligands referred to in this table are monodentate: Cl^-, CN^-, I^-, NH_3, OH^-, SCN^-, $S_2O_3^{2-}$; bidentate: ethylenediamine (en), oxalate ion (ox); tetradentate: ethylenediaminetetraacetato ion, $EDTA^{4-}$.
[d]The K_f values are cumulative or overall formation constants (see page 1094).

TABLE D.4 Standard Electrode (Reduction) Potentials at 25 °C

Reduction half-reaction	$E°$, V
$F_2(g) + 2\,e^- \longrightarrow 2\,F^-(aq)$	+2.866
$OF_2(g) + 2\,H^+(aq) + 4\,e^- \longrightarrow H_2O(l) + 2\,F^-(aq)$	+2.1
$O_3(g) + 2\,H^+(aq) + 2\,e^- \longrightarrow O_2(g) + H_2O(l)$	+2.075
$S_2O_8^{2-}(aq) + 2\,e^- \longrightarrow 2\,SO_4^{2-}(aq)$	+2.01
$Ag^{2+}(aq) + e^- \longrightarrow Ag^+(aq)$	+1.98
$H_2O_2(aq) + 2\,H^+(aq) + 2\,e^- \longrightarrow 2\,H_2O(l)$	+1.763
$MnO_4^-(aq) + 4\,H^+(aq) + 3\,e^- \longrightarrow MnO_2(s) + 2\,H_2O(l)$	+1.70
$PbO_2(s) + SO_4^{2-}(aq) + 4\,H^+(aq) + 2\,e^- \longrightarrow PbSO_4(s) + 2\,H_2O(l)$	+1.69
$Au^{3+}(aq) + 3\,e^- \longrightarrow Au(s)$	+1.52
$MnO_4^-(aq) + 8\,H^+(aq) + 5\,e^- \longrightarrow Mn^{2+}(aq) + 4\,H_2O(l)$	+1.51
$2\,BrO_3^-(aq) + 12\,H^+(aq) + 10\,e^- \longrightarrow Br_2(l) + 6\,H_2O(l)$	+1.478
$PbO_2(s) + 4\,H^+(aq) + 2\,e^- \longrightarrow Pb^{2+}(aq) + 2\,H_2O(l)$	+1.455
$ClO_3^-(aq) + 6\,H^+(aq) + 6\,e^- \longrightarrow Cl^-(aq) + 3\,H_2O(l)$	+1.450
$Au^{3+}(aq) + 2\,e^- \longrightarrow Au^+(aq)$	+1.36
$Cl_2(g) + 2\,e^- \longrightarrow 2\,Cl^-(aq)$	+1.358
$Cr_2O_7^{2-}(aq) + 14\,H^+(aq) + 6\,e^- \longrightarrow 2\,Cr^{3+}(aq) + 7\,H_2O(l)$	+1.33
$MnO_2(s) + 4\,H^+(aq) + 2\,e^- \longrightarrow Mn^{2+}(aq) + 2\,H_2O(l)$	+1.23
$O_2(g) + 4\,H^+(aq) + 4\,e^- \longrightarrow 2\,H_2O(l)$	+1.229

(continued)

Reduction half-reaction	$E°$, V
$2\,IO_3^-(aq) + 12\,H^+(aq) + 10\,e^- \longrightarrow I_2(s) + 6\,H_2O(l)$	+1.20
$ClO_4^-(aq) + 2\,H^+(aq) + 2\,e^- \longrightarrow ClO_3^-(aq) + H_2O(l)$	+1.189
$ClO_3^-(aq) + 2\,H^+(aq) + e^- \longrightarrow ClO_2(g) + H_2O(l)$	+1.175
$NO_2(g) + H^+(aq) + e^- \longrightarrow HNO_2(aq)$	+1.07
$Br_2(l) + 2\,e^- \longrightarrow 2\,Br^-(aq)$	+1.065
$NO_2(g) + 2\,H^+(aq) + 2\,e^- \longrightarrow NO(g) + H_2O(l)$	+1.03
$[AuCl_4]^-(aq) + 3\,e^- \longrightarrow Au(s) + 4\,Cl^-(aq)$	+1.002
$VO_2^+(aq) + 2\,H^+(aq) + e^- \longrightarrow VO^{2+}(aq) + H_2O(l)$	+1.000
$NO_3^-(aq) + 4\,H^+(aq) + 3\,e^- \longrightarrow NO(g) + 2\,H_2O(l)$	+0.956
$Cu^{2+}(aq) + I^-(aq) + e^- \longrightarrow CuI(s)$	+0.86
$Hg^{2+}(aq) + 2\,e^- \longrightarrow Hg(l)$	+0.854
$Ag^+(aq) + e^- \longrightarrow Ag(s)$	+0.800
$Fe^{3+}(aq) + e^- \longrightarrow Fe^{2+}(aq)$	+0.771
$O_2(g) + 2\,H^+(aq) + 2\,e^- \longrightarrow H_2O_2(aq)$	+0.695
$2\,HgCl_2(aq) + 2\,e^- \longrightarrow Hg_2Cl_2(s) + 2\,Cl^-(aq)$	+0.63
$MnO_4^-(aq) + e^- \longrightarrow MnO_4^{2-}(aq)$	+0.56
$I_2(s) + 2\,e^- \longrightarrow 2\,I^-(aq)$	+0.535
$Cu^+(aq) + e^- \longrightarrow Cu(s)$	+0.520
$H_2SO_3(aq) + 4\,H^+(aq) + 4\,e^- \longrightarrow S(s) + 3\,H_2O(l)$	+0.449
$C_2N_2(g) + 2\,H^+(aq) + 2\,e^- \longrightarrow 2\,HCN(aq)$	+0.37
$[Fe(CN)_6]^{3-}(aq) + e^- \longrightarrow [Fe(CN)_6]^{4-}(aq)$	+0.361
$VO^{2+}(aq) + 2\,H^+(aq) + e^- \longrightarrow V^{3+}(aq) + H_2O(l)$	+0.337
$Cu^{2+}(aq) + 2\,e^- \longrightarrow Cu(s)$	+0.340
$PbO_2(s) + 2\,H^+(aq) + 2\,e^- \longrightarrow PbO(s) + H_2O(l)$	+0.28
$Hg_2Cl_2(s) + 2\,e^- \longrightarrow 2\,Hg(l) + 2\,Cl^-(aq)$	+0.2676
$HAsO_2(aq) + 3\,H^+(aq) + 3\,e^- \longrightarrow As(s) + 2\,H_2O(l)$	+0.240
$AgCl(s) + e^- \longrightarrow Ag(s) + Cl^-(aq)$	+0.2223
$SO_4^{2-}(aq) + 4\,H^+(aq) + 2\,e^- \longrightarrow 2\,H_2O(l) + SO_2(g)$	+0.17
$Cu^{2+}(aq) + e^- \longrightarrow Cu^+(aq)$	+0.159
$Sn^{4+}(aq) + 2\,e^- \longrightarrow Sn^{2+}(aq)$	+0.154
$S(s) + 2\,H^+(aq) + 2\,e^- \longrightarrow H_2S(g)$	+0.144
$AgBr(s) + e^- \longrightarrow Ag(s) + Br^-(aq)$	+0.071
$2\,H^+(aq) + 2\,e^- \longrightarrow H_2(g)$	0
$Pb^{2+}(aq) + 2\,e^- \longrightarrow Pb(s)$	−0.125
$Sn^{2+}(aq) + 2\,e^- \longrightarrow Sn(s)$	−0.137
$AgI(s) + e^- \longrightarrow Ag(s) + I^-(aq)$	−0.152
$V^{3+}(aq) + e^- \longrightarrow V^{2+}(aq)$	−0.255
$Ni^{2+}(aq) + 2\,e^- \longrightarrow Ni(s)$	−0.257
$H_3PO_4(aq) + 2\,H^+(aq) + 2\,e^- \longrightarrow H_3PO_3(aq) + H_2O(l)$	−0.276
$Co^{2+}(aq) + 2\,e^- \longrightarrow Co(s)$	−0.277
$In^{3+}(aq) + 3\,e^- \longrightarrow In(s)$	−0.338
$PbSO_4(s) + 2\,e^- \longrightarrow Pb(s) + SO_4^{2-}(aq)$	−0.356
$Cd^{2+}(aq) + 2\,e^- \longrightarrow Cd(s)$	−0.403
$Cr^{3+}(aq) + e^- \longrightarrow Cr^{2+}(aq)$	−0.424
$Fe^{2+}(aq) + 2\,e^- \longrightarrow Fe(s)$	−0.440
$2\,CO_2(g) + 2\,H^+(aq) + 2\,e^- \longrightarrow H_2C_2O_4(aq)$	−0.49
$Zn^{2+}(aq) + 2\,e^- \longrightarrow Zn(s)$	−0.763

Reduction half-reaction	$E°$, V
$Cr^{2+}(aq) + 2\,e^- \longrightarrow Cr(s)$	−0.90
$Mn^{2+}(aq) + 2\,e^- \longrightarrow Mn(s)$	−1.18
$Ti^{2+}(aq) + 2\,e^- \longrightarrow Ti(s)$	−1.63
$U^{3+}(aq) + 3\,e^- \longrightarrow U(s)$	−1.66
$Al^{3+}(aq) + 3\,e^- \longrightarrow Al(s)$	−1.676
$Mg^{2+}(aq) + 2\,e^- \longrightarrow Mg(s)$	−2.356
$La^{3+}(aq) + 3\,e^- \longrightarrow La(s)$	−2.38
$Na^{+}(aq) + e^- \longrightarrow Na(s)$	−2.713
$Ca^{2+}(aq) + 2\,e^- \longrightarrow Ca(s)$	−2.84
$Sr^{2+}(aq) + 2\,e^- \longrightarrow Sr(s)$	−2.89
$Ba^{2+}(aq) + 2\,e^- \longrightarrow Ba(s)$	−2.92
$Cs^{+}(aq) + e^- \longrightarrow Cs(s)$	−2.923
$K^{+}(aq) + e^- \longrightarrow K(s)$	−2.924
$Rb^{+}(aq) + e^- \longrightarrow Rb(s)$	−2.924
$Li^{+}(aq) + e^- \longrightarrow Li(s)$	−3.040
Basic solution	
$O_3(g) + H_2O(l) + 2\,e^- \longrightarrow O_2(g) + 2\,OH^-(aq)$	+1.246
$ClO^-(aq) + H_2O(l) + 2\,e^- \longrightarrow Cl^-(aq) + 2\,OH^-(aq)$	+0.890
$H_2O_2(aq) + 2\,e^- \longrightarrow 2\,OH^-(aq)$	+0.88
$BrO^-(aq) + H_2O(l) + 2\,e^- \longrightarrow Br^-(aq) + 2\,OH^-(aq)$	+0.766
$ClO_3^-(aq) + 3\,H_2O(l) + 6\,e^- \longrightarrow Cl^-(aq) + 6\,OH^-(aq)$	+0.622
$2\,AgO(s) + H_2O(l) + 2\,e^- \longrightarrow Ag_2O(s) + 2\,OH^-(aq)$	+0.604
$MnO_4^-(aq) + 2\,H_2O(l) + 3\,e^- \longrightarrow MnO_2(s) + 4\,OH^-(aq)$	+0.60
$BrO_3^-(aq) + 3\,H_2O(l) + 6\,e^- \longrightarrow Br^-(aq) + 6\,OH^-(aq)$	+0.584
$2\,BrO^-(aq) + 2\,H_2O(l) + 2\,e^- \longrightarrow Br_2(l) + 4\,OH^-(aq)$	+0.455
$2\,IO^-(aq) + 2\,H_2O(l) + 2\,e^- \longrightarrow I_2(s) + 4\,OH^-(aq)$	+0.42
$O_2(g) + 2\,H_2O(l) + 4\,e^- \longrightarrow 4\,OH^-(aq)$	+0.401
$Ag_2O(s) + H_2O(l) + 2\,e^- \longrightarrow 2\,Ag(s) + 2\,OH^-(aq)$	+0.342
$Co(OH)_3(s) + e^- \longrightarrow Co(OH)_2(s) + OH^-(aq)$	+0.17
$2\,MnO_2(s) + H_2O(l) + 2\,e^- \longrightarrow Mn_2O_3(s) + 2\,OH^-(aq)$	+0.118
$NO_3^-(aq) + H_2O(l) + 2\,e^- \longrightarrow NO_2^-(aq) + 2\,OH^-(aq)$	+0.01
$CrO_4^{2-}(aq) + 4\,H_2O(l) + 3\,e^- \longrightarrow Cr(OH)_3(s) + 5\,OH^-(aq)$	−0.11
$S(s) + 2\,e^- \longrightarrow S^{2-}(aq)$	−0.48
$HPbO_2^-(aq) + H_2O(l) + 2\,e^- \longrightarrow Pb(s) + 3\,OH^-(aq)$	−0.54
$HCHO(aq) + 2\,H_2O(l) + 2\,e^- \longrightarrow CH_3OH(aq) + 2\,OH^-(aq)$	−0.59
$SO_3^{2-}(aq) + 3\,H_2O(l) + 4\,e^- \longrightarrow S(s) + 6\,OH^-(aq)$	−0.66
$AsO_4^{3-}(aq) + 2\,H_2O(l) + 2\,e^- \longrightarrow AsO_2^-(aq) + 4\,OH^-(aq)$	−0.67
$AsO_2^-(aq) + 2\,H_2O(l) + 3\,e^- \longrightarrow As(s) + 4\,OH^-(aq)$	−0.68
$Cd(OH)_2(s) + 2\,e^- \longrightarrow Cd(s) + 2\,OH^-(aq)$	−0.824
$2\,H_2O(l) + 2\,e^- \longrightarrow H_2(g) + 2\,OH^-(aq)$	−0.828
$OCN^-(aq) + H_2O(l) + 2\,e^- \longrightarrow CN^-(aq) + 2\,OH^-(aq)$	−0.97
$As(s) + 3\,H_2O(l) + 3\,e^- \longrightarrow AsH_3(g) + 3\,OH^-(aq)$	−1.21
$Zn(OH)_2(s) + 2\,e^- \longrightarrow Zn(s) + 2\,OH^-(aq)$	−1.246
$Sb(s) + 3\,H_2O(l) + 3\,e^- \longrightarrow SbH_3(g) + 3\,OH^-(aq)$	−1.338
$Al(OH)_4^-(aq) + 3\,e^- \longrightarrow Al(s) + 4\,OH^-(aq)$	−2.310
$Mg(OH)_2(s) + 2\,e^- \longrightarrow Mg(s) + 2\,OH^-(aq)$	−2.687