Appendix A

Important Data Tables

Physical Constants

Name of the Constant	Value
Rest mass of electron	$m_e = 5.485799094 \times 10^{-4}$ u ($9.1093821 \times 10^{-28}$ g)
Rest mass of proton	$m_p = 1.0072764668$ u ($1.67262164 \times 10^{-24}$ g)
Rest mass of neutron	$m_n = 1.0086649160$ u ($1.67492721 \times 10^{-24}$ g)
Electron charge	$e = 1.60217649 \times 10^{-19}$ C
Atomic mass unit	$u = 1.66053878 \times 10^{-24}$ g
Gas constant	$R = 0.0820575$ L atm mol^{-1} K^{-1} = 8.31447 J mol^{-1} K^{-1} = 1.98721 cal mol^{-1} K^{-1}
Molar volume, ideal gas	= 22.4140 L (at STP)
Avogadro's constant	$= 6.0221418 \times 10^{23}$ things mol^{-1}
Speed of light in vacuum	$c = 2.99792458 \times 10^{8}$ m s^{-1} (exactly)
Planck's constant	$h = 6.6260690 \times 10^{-34}$ J s
Faraday constant	$F = 9.6485340 \times 10^{4}$ C mol^{-1}

Source: From James E. Brady, Fred Senese, Niel D. Jesperson, *Chemistry: Matter and Its Changes*, 5th ed., 2007, Wiley.

Properties of Elements

All physical properties are for a pressure of 1 atm unless otherwise specified.

Element	Symbol	Atomic Number Z	Molar Mass, g mol^{-1}	Density, g cm^{-3} at 20°C	Melting Point, °C	Boiling Point, °C	Specific Heat, J g^{-1} $°C^{-1}$ (at 25 °C)
Actinium	Ac	89	(227)	10.06	1323	(3473)	0.092
Aluminium	Al	13	26.9815	2.699	660	2450	0.900
Americium	Am	95	(243)	13.67	1541	—	—
Antimony	Sb	51	121.75	6.691	630.5	1380	0.205
Argon	Ar	18	39.948	1.6626×10^{-3}	–189.4	$^{-18}$5.8	0.523
Arsenic	As	33	74.9216	5.78	817 (28 atm)	613	0.331
Astatine	At	85	(210)	—	(302)	—	—
Barium	Ba	56	137.34	3.594	729	1640	0.205
Berkelium	Bk	97	(247)	14.79	—	—	—
Beryllium	Be	4	9.0122	1.848	1287	2770	1.83
Bismuth	Bi	83	208.980	9.747	271.37	1560	0.122
Bohrium	Bh	107	262.12	—	—	—	—
Boron	B	5	10.811	2.34	2030	—	1.11
Bromine	Br	35	79.909	3.12 (liquid)	$^{-7}$.2	58	0.293
Cadmium	Cd	48	112.40	8.65	321.03	765	0.226
Caesium	Cs	55	132.905	1.873	28.40	690	0.243
Calcium	Ca	20	40.08	1.55	838	1440	0.624
Californium	Cf	98	(251)	—	—	—	—
Carbon	C	6	12.01115	2.26	3727	4830	0.691
Cerium	Ce	58	140.12	6.768	804	3470	0.188
Chlorine	Cl	17	35.453	3.214×10^{-3} (0 °C)	––101	–34.7	0.486
Chromium	Cr	24	51.996	7.19	1857	2665	0.448
Cobalt	Co	27	58.9332	8.85	1495	2900	0.423
Copernicium	Cn	112	(285)	—	—	—	—
Copper	Cu	29	63.54	8.96	1083.40	2595	0.385
Curium	Cm	96	(247)	13.3	—	—	—
Darmstadtium	Ds	110	(271)	—	—	—	—
Dubnium	Db	105	262.114	—	—	—	—
Dysprosium	Dy	66	162.50	8.55	1409	2330	0.172
Einsteinium	Es	99	(254)	—	—	—	—
Erbium	Er	68	167.26	9.15	1522	2630	0.167
Europium	Eu	63	151.96	5.243	817	1490	0.163
Fermium	Fm	100	(237)	—	—	—	—
Fluorine	F	9	18.9984	1.696×10^{-3} (0 °C)	–219.6	–188.2	0.753
Francium	Fr	87	(223)	—	(27)	—	—

Gadolinium	Gd	64	157.25	7.90	1312	2730	0.234
Gallium	Ga	31	69.72	5.907	29.75	2237	0.377
Germanium	Ge	32	72.59	5.323	937.25	2830	0.322
Gold	Au	79	196.967	19.32	1064.43	2970	0.131
Hafnium	Hf	72	178.49	13.31	2227	5400	0.144
Hassium	Hs	108	(265)	—	—	—	—
Helium	He	2	4.0026	0.1664×10^{-3}	–269.7	–268.9	5.23
Holmium	Ho	67	164.930	8.79	1470	2330	0.165
Hydrogen	H	1	1.00797	0.08375×10^{-3}	–259.19	–252.7	14.4
Indium	In	49	114.82	7.31	156.634	2000	0.233
Iodine	I	53	126.9044	4.93	113.7	183	0.218
Iridium	Ir	77	192.2	22.5	2447	(5300)	0.130
Iron	Fe	26	55.847	7.874	1536.5	3000	0.447
Krypton	Kr	36	83.80	3.488×10^{-3}	–157.37	–152	0.247
Lanthanum	La	57	138.91	6.189	920	3470	0.195
Lawrencium	Lr	103	(257)	—	—	—	—
Lead	Pb	82	207.19	11.35	327.45	1725	0.129
Lithium	Li	3	6.939	0.534	180.55	1300	3.58
Lutetium	Lu	71	174.97	9.849	1663	1930	0.155
Magnesium	Mg	12	24.312	1.738	650	1107	1.03
Manganese	Mn	25	54.9380	7.44	1244	2150	0.481
Meitnerium	Mt	109	(266)	—	—	—	—
Mendelevium	Md	101	(256)	—	—	—	—
Mercury	Hg	80	200.59	13.55	–38.87	357	0.138
Molybdenum	Mo	42	95.94	10.22	2617	5560	0.251
Neodymium	Nd	60	144.24	7.007	1016	3180	0.188
Neon	Ne	10	20.183	0.8387×10^{-3}	–248.597	–246.0	1.03
Neptunium	Np	93	(237)	20.25	637	—	1.26
Nickel	Ni	28	58.71	8.902	1453	2730	0.444
Niobium	Nb	41	92.906	8.57	2468	4927	0.264
Nitrogen	N	7	14.0067	1.1649×10^{-3}	–210	–195.8	1.03
Nobelium	No	102	(255)	—	—	—	—
Osmium	Os	76	190.2	22.59	3027	5500	0.130
Oxygen	O	8	15.9994	1.3318×10^{-3}	–218.80	–183.0	0.913
Palladium	Pd	46	106.4	12.02	1552	3980	0.243
Phosphorus	P	15	30.9738	1.83	44.25	280	0.741
Platinum	Pt	78	195.09	21.45	1769	4530	0.134
Plutonium	Pu	94	(244)	19.8	640	3235	0.130
Polonium	Po	84	(210)	9.32	254	—	—
Potassium	K	19	39.102	0.862	63.20	760	0.758
Praseodymium	Pr	59	140.907	6.773	931	3020	0.197
Promethium	Pm	61	(145)	7.22	(1027)	—	—

Protactinium	Pa	91	(231)	15.37 (estimated)	(1230)	—	—
Radium	Ra	88	(226)	5.0	700	—	—
Radon	Rn	86	(222)	9.96×10^{-3} (0°C)	(–71)	–61.8	0.092
Rhenium	Re	75	186.2	21.02	3180	5900	0.134
Rhodium	Rh	45	102.905	12.41	1963	4500	0.243
Roentgenium	Rg	111	(280)	—	—	—	—
Rubidium	Rb	37	85.47	1.532	39.49	688	0.364
Ruthenium	Ru	44	101.107	12.37	2250	4900	0.239
Rutherfordium	Rf	104	261.11	—	—	—	—
Samarium	Sm	62	150.35	7.52	1072	1630	0.197
Scandium	Sc	21	44.956	2.99	1539	2730	0.569
Seaborgium	Sg	106	263.118	—	—	—	—
Selenium	Se	34	78.96	4.79	221	685	0.318
Silicon	Si	14	28.086	2.33	1412	2680	0.712
Silver	Ag	47	107.870	10.49	960.8	2210	0.234
Sodium	Na	11	22.9898	0.9712	97.85	892	1.23
Strontium	Sr	38	87.62	2.54	768	1380	0.737
Sulphur	S	16	32.064	2.07	119.0	444.6	0.707
Tantalum	Ta	73	180.948	16.6	3014	5425	0.138
Technetium	Tc	43	(99)	11.46	2200	—	0.209
Tellurium	Te	52	127.60	6.24	449.5	990	0.201
Terbium	Tb	65	158.924	8.229	1357	2530	0.180
Thallium	Tl	81	204.37	11.85	304	1457	0.130
Thorium	Th	90	(232)	11.72	1755	(3850)	0.117
Thulium	Tm	69	168.934	9.32	1545	1720	0.159
Tin	Sn	50	118.69	7.2984	231.868	2270	0.226
Titanium	Ti	22	47.90	4.54	1670	3260	0.523
Tungsten	W	74	183.85	19.3	3380	5930	0.134
Roentgenium	Rg	111	(280)	—	—	—	—
Copernicium	Cn	112	(285)	—	—	—	—
Unnamed	Uut	113	(284)	—	—	—	—
Fleuorium	Fl	114	(299)	—	—	—	—
Unnamed	Uup	115	(288)	—	—	—	—
Livermorium	Lv	116	(293)	—	—	—	—
Unnamed	Uus	117	—	—	—	—	—
Unnamed	Uuo	118	(293)	—	—	—	—
Uranium	U	92	(238)	18.95	1132	3818	0.117
Vanadium	V	23	50.942	6.11	1902	3400	0.490
Xenon	Xe	54	131.30	5.495×10^{-3}	–111.79	–108	0.159
Ytterbium	Yb	70	173.04	6.965	824	1530	0.155
Yttrium	Y	39	88.905	4.469	1526	3030	0.297
Zinc	Zn	30	65.37	7.133	419.58	906	0.389
Zirconium	Zr	40	91.22	6.506	1852	3580	0.276

The values in parentheses in the column of molar masses are the mass numbers of the longest-lived isotopes of those elements that are radioactive. Melting points and boiling points in parentheses are uncertain.

The data for gases are valid only when these are in their usual molecular state, such as H_2, He, O_2, Ne, etc. The specific heats of the gases are the values at constant pressure.
Source: Adapted from J. Emsley, *The Elements,* 3rd ed., 1998, Clarendon Press, Oxford. See also www.webelements.com for the latest values and newest elements.

Thermodynamic Data for Selected Elements, Compounds, and Ions (25°C)

Substance	ΔH_f^o (kJ mol^{-1})	$S°$(J mol^{-1} K^{-1})	ΔG_f^o (kJ mol^{-1})
Aluminum			
Al(s)	0	28.3	0
Al^{3+}(aq)	–524.7		–481.2
$AlCl_3$(s)	–704	110.7	–629
Al_2O_3(s)	–1669.8	51.0	–1576.4
$Al_2(SO_4)_3$(s)	–3441	239	–3100
Arsenic			
As(s)	0	35.1	0
AsH_3(g)	+66.4	223	+68.9
As_4O_6(s)	–1314	214	–1153
As_2O_5(s)	–925	105	–782
H_3AsO_3(aq)	–742.2		
H_3AsO_4(aq)	–902.5		
Barium			
Ba(s)	0	66.9	0
Ba^{2+}(aq)	–537.6	9.6	–560.8
$BaCO_3$(s)	–1219	112	–1139
$BaCrO_4$(s)	–1428.0		
$BaCl_2$(s)	–860.2	125	–810.8
BaO(s)	–553.5	70.4	–525.1
$Ba(OH)_2$(s)	–998.22	–8	–875.3
$Ba(NO_3)_2$(s)	–992	214	–795
$BaSO_4$(s)	–1465	132	–1353
Beryllium			
Be(s)	0	9.50	0
$BeCl_2$(s)	–468.6	89.9	–426.3
BeO(s)	–611	14	–582
Bismuth			
Bi(s)	0	56.9	0
$BiCl_3$(s)	–379	177	–315
Bi_2O_3(s)	–576	151	–497
Boron			
B(s)	0	5.87	0
BCl_3(g)	–404	290	–389
B_2H_6(g)	+36	232	+87
B_2O_3(s)	–1273	53.8	–1194
$B(OH)_3$(s)	–1094	88.8	–969
Bromine			
Br2(l)	0	152.2	0
Br_2(g)	+30.9	245.4	+3.11
HBr(g)	–36	198.5	+53.1
Br^-(aq)	–121.55	82.4	–103.96
Cadmium			

Cd(s)	0	51.8	0
Cd^{2+}(aq)	–75.90	–73.2	–77.61
$CdCl_2$(s)	–392	115	–344
CdO(s)	–258.2	54.8	–228.4
CdS(s)	–162	64.9	–156
$CdSO_4$(s)	–933.5	123	–822.6
Calcium			
Ca(s)	0	41.4	0
Ca^{2+}(aq)	–542.83	–53.1	–553.58
$CaCO_3$(s)	–1207	92.9	–1128.8
CaF_2(s)	–741	80.3	–1166
$CaCl_2$(s)	–795.0	114	–750.2
$CaBr_2$(s)	–682.8	130	–663.6
CaI_2(s)	–535.9	143	
CaO(s)	–635.5	40	–604.2
$Ca(OH)_2$(s)	–986.59	76.1	–896.76
$Ca_3(PO_4)_2$(s)	–4119	241	–3852
$CaSO_3$(s)	–1156		
$CaSO_4$(s)	–1433	107	–1320.3
$CaSO_4 \cdot \frac{1}{2} H_2O$(s)	–1575.2	131	–1435.2
$CaSO_4$ $2H_2O$(s)	–2021.1	194.0	–1795.7
Carbon			
C(s, graphite)	0	5.69	0
C(s, diamond)	+1.88	2.4	+2.9
CCl_4(l)	–134	214.4	–65.3
CO(g)	–110.5	197.9	–137.3
CO_2(g)	–393.5	213.6	–394.4
CO_2(aq)	–413.8	117.6	–385.98
H_2CO_3(aq)	–699.65	187.4	–623.08
HCO_3^-(aq)	–691.99	91.2	–586.77
CO_3^{2-}(aq)	–677.14	–56.9	–527.81
CS_2(l)	+89.5	151.3	+65.3
CS_2(g)	+117	237.7	+67.2
HCN(g)	+135.1	201.7	+124.7
CN^-(aq)	+150.6	94.1	+172.4
CH_4(g)	–74.848	186.2	–50.79
C_2H_2(g)	+226.75	200.8	+209
C_2H_4(g)	+52.284	219.8	+68.12
C_2H_6(g)	–84.667	229.5	–32.9
C_3H_8(g)	–104	269.9	–23
C_4H_{10}(g)	–126	310.2	–17.0
C_6H_6(l)	+49.0	173.3	+124.3
CH_3OH(l)	–238.6	126.8	–166.2
C_2H_5OH(l)	–277.63	161	–174.8
$HCHO_2$(g)	–363	251	+335
$HC_2H_3O_2$(l)	–487.0	160	–392.5

HCHO(g)	–108.6	218.8	–102.5
$CH_3CHO(g)$	–167	250	–129
$(CH_3)_2CO(l)$	–248.1	200.4	–155.4
$C_6H_5CO_2H(s)$	–385.1	167.6	–245.3
$CO(NH_2)_2(s)$	–333.19	104.6	–197.2
$CO(NH_2)_2(aq)$	–391.2	173.8	–203.8
$CH_2(NH_2)CO_2H(s)$	–532.9	103.5	–373.4
Chlorine			
$Cl_2(g)$	0	223.0	0
$Cl^-(aq)$	–167.2	56.5	–131.2
HCl(g)	–92.30	186.7	–95.27
HCl(aq)	–167.2	56.5	–131.2
HClO(aq)	–131.3	106.8	–80.21
Chromium			
Cr(s)	0	23.8	0
$Cr^{3+}(aq)$	–232		
$CrCl_2(s)$	–326	115	–282
$CrCl_3(s)$	–563.2	126	–493.7
$Cr_2O_3(s)$	–1141	81.2	–1059
$CrO_3(s)$	–585.8	72.0	–506.2
$(NH_4)_2Cr_2O_7(s)$	–1807		
$K_2Cr_2O_7(s)$	–2033.01		
Cobalt			
Co(s)	0	30.0	0
$Co^{2+}(aq)$	–59.4	–110	–53.6
$CoCl_2(s)$	–325.5	106	–282.4
$Co(NO_3)_2(s)$	–422.2	192	–230.5
CoO(s)	–237.9	53.0	–214.2
CoS(s)	–80.8	67.4	–82.8
Copper			
Cu(s)	0	33.15	0
$Cu^{2+}(aq)$	+64.77	–99.6	+65.49
CuCl(s)	–137.2	86.2	–119.87
$CuCl_2(s)$	–172	119	–131
$Cu_2O(s)$	–168.6	93.1	–146.0
CuO(s)	–155	42.6	–127
$Cu_2S(s)$	–79.5	121	–86.2
CuS(s)	–53.1	66.5	–53.6
$CuSO_4(s)$	–771.4	109	–661.8
$CuSO_4 \cdot 5H_2O(s)$	–2279.7	300.4	–1879.7
Fluorine			
$F_2(g)$	0	202.7	0
$F^-(aq)$	–332.6	–13.8	–278.8
HF(g)	–271	173.5	–273
Gold			
Au(s)	0	47.7	0
$Au_2O_3(s)$	+80.8	125	+163

$AuCl_3(s)$	–118	148	–48.5
Hydrogen			
$H_2(g)$	0	130.6	0
$H_2O(l)$	–285.9	69.96	–237.2
$H_2O(g)$	–241.8	188.7	–228.6
$H_2O_2(l)$	–187.6	109.6	–120.3
$H_2Se(g)$	+76	219	+62.3
$H_2Te(g)$	+154	234	+138
Iodine			
$I_2(s)$	0	116.1	0
$I_2(g)$	+62.4	260.7	+19.3
HI(g)	+26.6	206	+1.30
Iron			
Fe(s)	0	27	0
$Fe^{2+}(aq)$	–89.1	–137.7	–78.9
$Fe^{3+}(aq)$	–48.5	–315.9	–4.7
$Fe_2O_3(s)$	–822.2	90.0	–741.0
$Fe_3O_4(s)$	–1118.4	146.4	–1015.4
FeS(s)	–100.0	60.3	–100.4
$FeS_2(s)$	–178.2	52.9	–166.9
Lead			
Pb(s)	0	64.8	0
$Pb^{2+}(aq)$	–1.7	10.5	–24.4
$PbCl_2(s)$	–359.4	136	–314.1
PbO(s)	–219.2	67.8	–189.3
$PbO_2(s)$	–277	68.6	–219
$Pb(OH)_2(s)$	–515.9	88	–420.9
PbS(s)	–100	91.2	–98.7
$PbSO_4(s)$	–920.1	149	–811.3
Lithium			
Li(s)	0	28.4	0
$Li^+(aq)$	–278.6	10.3	
LiF(s)	–611.7	35.7	–583.3
LiCl(s)	–408	59.29	–383.7
LiBr(s)	–350.3	66.9	–338.87
$Li_2O(s)$	–596.5	37.9	–560.5
$Li_3N(s)$	–199	37.7	–155.4
Magnesium			
Mg(s)	0	32.5	0
$Mg^{2+}(aq)$	–466.9	–138.1	–454.8
$MgCO_3(s)$	–1113	65.7	–1029
$MgF_2(s)$	–1124	79.9	–1056
$MgCl_2(s)$	–641.8	89.5	–592.5
$MgCl_2 \cdot 2H_2O(s)$	–1280	180	–1118
$Mg_3N_2(s)$	–463.2	87.9	–411
MgO(s)	–601.7	26.9	–569.4
$Mg(OH)_2(s)$	–924.7	63.1	–833.9

Manganese			
Mn(s)	0	32.0	0
Mn^{2+}(aq)	–223	–74.9	–228
MnO_4^-(aq)	–542.7	191	–449.4
$KMnO_4$(s)	–813.4	171.71	–713.8
MnO(s)	–385	60.2	–363
Mn_2O_3(s)	–959.8	110	–882.0
MnO_2(s)	–520.9	53.1	–466.1
Mn_3O_4(s)	–1387	149	–1280
$MnSO_4$(s)	–1064	112	–956
Mercury			
Hg(l)	0	76.1	0
Hg(g)	+61.32	175	+31.8
Hg_2Cl_2(s)	–265.2	192.5	–210.8
$HgCl_2$(s)	–224.3	146.0	–178.6
HgO(s)	–90.83	70.3	–58.54
HgS(s,red)	–58.2	82.4	–50.6
Nickel			
Ni(s)	0	30	0
$NiCl_2$(s)	–305	97.5	–259
NiO(s)	–244	38	–216
NiO_2(s)			–199
$NiSO_4$(s)	–891.2	77.8	–773.6
$NiCO_3$(s)	–664.0	91.6	–615.0
$Ni(CO)_4$(g)	–220	399	–567.4
Nitrogen			
N_2(g)	0	191.5	0
NH_3(g)	–46.19	192.5	–16.7
NH_4^+(aq)	–132.5	113	–79.37
N_2H_4(g)	+95.40	238.4	+159.3
N_2H_4(l)	+50.6	121.2	+149.4
NH_4Cl(s)	–315.4	94.6	–203.9
NO(g)	+90.37	210.6	+86.69
NO_2(g)	+33.8	240.5	+51.84
N_2O(g)	+81.57	220.0	+103.6
N_2O_4(g)	+9.67	304	+98.28
N_2O_5(g)	+11	356	+115
HNO_3(l)	–173.2	155.6	–79.91
NO_3^-(aq)	–205.0	146.4	–108.74
Oxygen			
O_2(g)	0	205.0	0
O_3(g)	+143	238.8	+163
OH^-(aq)	–230.0	–10.75	–157.24
Phosphorus			
P(s,white)	0	41.09	0
P_4(g)	+314.6	163.2	+278.3
PCl_3(g)	–287.0	311.8	–267.8

$PCl_5(g)$	–374.9	364.6	–305.0
$PH_3(g)$	+5.4	210.2	+12.9
$P_4O_6(s)$	–1640		
$POCl_3(g)$	–1109.7	646.5	–1019
$POCl_3(l)$	–1186	26.36	–1035
$P_4O_{10}(s)$	–2984	228.9	–2698
$H_3PO_4(s)$	–1279	110.5	–1119
Potassium			
K(s)	0	64.18	0
$K^+(aq)$	–252.4	102.5	–283.3
KF(s)	–567.3	66.6	–537.8
KCl(s)	–435.89	82.59	–408.3
KBr(s)	–393.8	95.9	–380.7
KI(s)	–327.9	106.3	–324.9
KOH(s)	–424.8	78.9	–379.1
$K_2O(s)$	–361	98.3	–322
$K_2SO_4(s)$	–1433.7	176	–1316.4
Silicon			
Si(s)	0	19	0
$SiH_4(g)$	+33	205	+52.3
SiO_2(s,alpha)	–910.0	41.8	–856
Silver			
Ag(s)	0	42.55	0
$Ag^+(aq)$	+105.58	72.68	+77.11
AgCl(s)	–127.0	96.2	–109.7
AgBr(s)	–100.4	107.1	–96.9
$AgNO_3(s)$	–124	141	–32
$Ag_2O(s)$	–31.1	121.3	–11.2
Sodium			
Na(s)	0	51.0	0
$Na^+(aq)$	–240.12	59.0	–261.91
NaF(s)	–571	51.5	–545
NaCl(s)	–411.0	72.38	–384.0
NaBr(s)	–360	83.7	–349
NaI(s)	–288	91.2	–286
$NaHCO_3(s)$	–947.7	102	–851.9
$Na_2CO_3(s)$	–1131	136	–1048
$Na_2O_2(s)$	–510.9	94.6	–447.7
$Na_2O(s)$	–510	72.8	–376
NaOH(s)	–426.8	64.18	–382
$Na_2SO_4(s)$	–1384.49	149.49	–1266.83
Sulphur			
S(s, rhombic)	0	31.9	0
$SO_2(g)$	–296.9	248.5	–300.4
$SO_3(g)$	–395.2	256.2	–370.4
$H_2S(g)$	–20.6	206	–33.6
$H_2SO_4(l)$	–811.32	157	–689.9

H_2SO_4(aq)	–909.3	20.1	–744.5
SF_6(g)	–1209	292	–1105
Tin			
Sn(s,white)	0	51.6	0
Sn^{2+}(aq)	–8.8	–17	–27.2
$SnCl_4$(l)	–511.3	258.6	–440.2
SnO(s)	–285.8	56.5	–256.9
SnO_2(s)	–580.7	52.3	–519.6
Zinc			
Zn(s)	0	41.6	0
Zn^{2+}(aq)	–153.9	–112.1	–147.06
$ZnCl_2$(s)	–415.1	111	–369.4
ZnO(s)	–348.3	43.6	–318.3
ZnS(s)	–205.6	57.7	–201.3
$ZnSO_4$(s)	–982.8	120	–874.5

Note: All values in this table are positive because forming the gaseous atoms from the elements is endothermic; it involves bond breaking.

Source: From James E. Brady, Fred Senese, Niel D. Jesperson, *Chemistry: Matter and Its Changes*, 5th ed., 2007, Wiley.

Heats of Formation of Gaseous Atoms from Elements in Their Standard States

Element	ΔH_f^o (kJ mol^{-1})	Element	ΔH_f^o (kJ mol^{-1})	Element	ΔH_f^o (kJ mol^{-1})
Group 1		***Group 13***		***Group 16***	
H	217.89	B	560	O	249.17
Li	161.5	Al	329.7	S	276.98
Na	107.8	***Group 14***		***Group 17***	
K	89.62	C	716.67	F	79.14
Rb	82.0	Si	450	Cl	121.47
Cs	78.2	***Group 15***		Br	112.38
Group 2		N	472.68	I	107.48
Be	324.3	P	332.2		
Mg	146.4				
Ca	178.2				
Sr	163.6				
Ba	177.8				

Source: From James E. Brady, Fred Senese, Niel D. Jesperson, *Chemistry: Matter and Its Changes*, 5th ed., 2007, Wiley.

Average Bond Enthalpies

Some average single bond enthalpies (kJ mol^{-1}).

	I	***Br***	***Cl***	***F***	***S***	***O***	***P***	***N***	***Si***	***C***	***H***
H	297	368	431	565	339	464	318	389	293	414	435
C	238	276	330	439	259	351	263	293	289	347	
Si	213	289	360	539	226	368	213[a]	—	176		
N	—	243	201	272	—	201	209[a]	159			
P	213	272	330	489	230[a]	351[a]	213				
O	201	—	205	184	—	138					
S	—	213	251	284	213						
F	—	255	184	159							
Cl	209	217	243								
Br	180	193									
I	151										

[a] *Indicates value estimated using electronegativity difference.*

Source: From James E. Brady, Fred Senese, Niel D. Jesperson, *Chemistry: Matter and Its Changes*, 5th ed., 2007, Wiley.

Vapor Pressure of Water at Various Temperatures

Temp (°C)	Vapor Pressure (torr)	Temp (°C)	Vapor Pressure (torr)
0	4.58	51	97.2
1	4.93	52	102.1
2	5.29	53	107.2
3	5.68	54	112.5
4	6.10	55	118.0
5	6.54	56	123.8
6	7.01	57	129.8
7	7.51	58	136.1
8	8.04	59	142.6
9	8.61	60	149.4
10	9.21	61	156.4
11	9.84	62	163.8
12	10.5	63	171.4
13	11.2	64	179.3
14	12.0	65	187.5
15	12.8	66	196.1
16	13.6	67	205.0
17	14.5	68	214.2
18	15.5	69	223.7
19	16.5	70	233.7
20	17.5	71	243.9
21	18.7	72	254.6
22	19.8	73	265.7
23	21.1	74	277.2
24	22.4	75	289.1
25	23.8	76	301.4
26	25.2	77	314.1
27	26.7	78	327.3
28	28.3	79	341.0
29	30.0	80	355.1
30	31.8	81	369.7
31	33.7	82	384.9
32	35.7	83	400.6
33	37.7	84	416.8
34	39.9	85	433.6
35	41.2	86	450.9
36	44.6	87	468.7
37	47.1	88	487.1
38	49.7	89	506.1
39	52.4	90	525.8
40	55.3	91	546.0
41	58.3	92	567.0
42	61.5	93	588.6
43	64.8	94	610.9
44	68.3	95	633.9
45	71.9	96	657.6

46	75.6	97	682.1
47	79.6	98	707.3
48	83.7	99	733.2
49	88.0	100	760.0
50	92.5		

Source: From James E. Brady, Fred Senese, Niel D. Jesperson, *Chemistry: Matter and Its Changes*, 5th ed., 2007, Wiley.

Solubility Product Constants

Type	Salt	Ions of Salt	K_{sp} (25 °C)
Halides	CaF_2	$Ca^{2+} + 2F^-$	3.9×10^{-11}
	AgCl	$Ag^+ + Cl^-$	1.8×10^{-10}
	AgBr	$Ag_+ + Br^-$	5.0×10^{-13}
	AgI	$Ag_+ + I^-$	8.3×10^{-17}
	PbF_2	$Pb^{2+} + 2F^-$	3.6×10^{-8}
	$PbCl_2$	$Pb^{2+} + 2Cl^-$	1.7×10^{-5}
	$PbBr_2$	$Pb^{2+} + 2Br^-$	2.1×10^{-6}
	PbI_2	$Pb^{2+} + 2I^-$	7.9×10^{-9}
Hydroxides	$Al(OH)_3$	$Al^{3+} + 3OH^-$	3×10^{-34}
	$Ca(OH)_2$	$Ca^{2+} + 2OH^-$	6.5×10^{-6}
	$Fe(OH)_2$	$Fe^{2+} + 2OH^-$	7.9×10^{-16}
	$Fe(OH)_3$	$Fe^{3+} + 3OH^-$	1.6×10^{-39}
	$Mg(OH)_2$	$Mg^{2+} + 2OH^-$	7.1×10^{-12}
	$Zn(OH)_2$	$Zn^{2+} + 2OH^-$	3.0×10^{-16}
Carbonates	Ag_2CO_3	$2Ag^+ + CO_3^{2-}$	8.1×10^{-12}
	$MgCO_3$	$Mg^{2+} + CO_3^{2-}$	3.5×10^{-8}
	$CaCO_3$	$Ca^{2+} + CO_3^{2-}$	4.5×10^{-9}
	$SrCO_3$	$Sr^{2+} + CO_3^{2-}$	9.3×10^{-10}
	$BaCO_3$	$Ba^{2+} + CO_3^{2-}$	5.0×10^{-9}
	$CoCO_3$	$Co^{2+} + CO_3^{2-}$	1.0×10^{-10}
	$NiCO_3$	$Ni^{2+} + CO_3^{2-}$	1.3×10^{-7}
	$ZnCO_3$	$Zn^{2+} + CO_3^{2-}$	1.0×10^{-10}
Chromates	Ag_2CrO_4	$2Ag^+ + CrO_4^{2-}$	1.2×10^{-12}
	$PbCrO_4$	$Pb^{2+} + CrO_4^{2-}$	1.8×10^{-14}
Sulphates	$CaSO_4$	$Ca^{2+} + SO_4^{2-}$	2.4×10^{-5}
	$SrSO_4$	$Sr^{2+} + SO_4^{2-}$	3.2×10^{-7}
	$BaSO_4$	$Ba^{2+} + SO_4^{2-}$	1.1×10^{-10}
	$PbSO_4$	$Pb^{2+} + SO_4^{2-}$	6.3×10^{-7}
Oxalates	CaC_2O_4	$Ca^{2+} + C_2O_4^{2-}$	2.3×10^{-9}
	MgC_2O_4	$Mg^{2+} + C_2O_4^{2-}$	8.6×10^{-5}
	BaC_2O_4	$Ba^{2+} + C_2O_4^{2-}$	1.2×10^{-7}
	FeC_2O_4	$Fe^{2+} + C_2O_4^{2-}$	2.1×10^{-7}
	PbC_2O_4	$Pb^{2+} + C_2O_4^{2-}$	2.7×10^{-11}

Source: From James E. Brady, Fred Senese, Niel D. Jesperson, *Chemistry: Matter and Its Changes*, 5th ed., 2007, Wiley.

Formation Constants of Complexes

Complex Ion Equilibrium	K_{form}
Halide Complexes	
$Al^{3+} + 6F^- \rightleftharpoons [AlF_6]^{3-}$	1×10^{20}
$Al^{3+} + 4F^- \rightleftharpoons [AlF_4]^-$	2.0×10^{8}
$Be^{2+} + 4F^- \rightleftharpoons [BeF_4]^{2-}$	1.3×10^{13}
$Sn^{4+} + 6F^- \rightleftharpoons [SnF_6]^{2-}$	1×10^{25}
$Cu^{+} + 2Cl^- \rightleftharpoons [CuCl_2]^-$	3×10^{5}
$Ag^{+} + 2Cl^- \rightleftharpoons [AgCl_2]^-$	1.8×10^{5}
$Pb^{2+} + 2Cl^- \rightleftharpoons [PbCl_4]^{2-}$	2.5×10^{15}
$Zn^{2+} + 2Cl^- \rightleftharpoons [ZnCl_4]^{2-}$	1.6
$Hg^{2+} + 4Cl^- \rightleftharpoons [HgCl_4]^{2-}$	5.0×10^{15}
$Cu^{+} + 2Br^- \rightleftharpoons [CuBr_2]^-$	8×10^{5}
$Ag^{+} + 2Br^- \rightleftharpoons [AgBr_2]^-$	1.7×10^{7}
$Hg^{2+} + 4Br^- \rightleftharpoons [HgBr_4]^{2-}$	1×10^{21}
$Cu^{+} + 2I^- \rightleftharpoons [CuI_2]^-$	8×10^{8}
$Ag^{+} + 2I^- \rightleftharpoons [AgI_2]^-$	1×10^{11}
$Pb^{2-} + 4I^- \rightleftharpoons [PbI_4]^{2-}$	3×10^{4}
$Hg^{2+} + 4I^- \rightleftharpoons [HgI_4]^{2-}$	1.9×10^{30}
Ammonia Complexes	
$Ag^{+} + 2NH_3 \rightleftharpoons [Ag(NH_3)_2]^{+}$	1.6×10^{7}
$Zn^{2+} + 4NH_3 \rightleftharpoons [Zn(NH_3)_4]^{2+}$	7.8×10^{8}
$Cu^{2+} + 4NH_3 \rightleftharpoons [Cu(NH_3)_4]^{2+}$	1.1×10^{13}
$Hg^{2+} + 4NH_3 \rightleftharpoons [Hg(NH_3)_4]^{2+}$	1.8×10^{19}
$Co^{2+} + 6NH_3 \rightleftharpoons [Co(NH_3)_6]^{2+}$	5.0×10^{4}
$Co^{3+} + 6NH_3 \rightleftharpoons [Co(NH_3)_6]^{3+}$	4.6×10^{33}
$Cd^{2+} + 6NH_3 \rightleftharpoons [Cd(NH_3)_6]^{2+}$	2.6×10^{5}
$Cd^{3+} + 6NH_3 \rightleftharpoons [Cd(NH_3)_6]^{3+}$	2.0×10^{8}
Cyanide Complexes	
$Fe^{2+} + 6CN^- \rightleftharpoons [Fe(CN)_6]^{4-}$	1.0×10^{24}
$Fe^{3+} + 6CN^- \rightleftharpoons [Fe(CN)_6]^{3-}$	1.0×10^{31}
$Ag^{+} + 2CN^- \rightleftharpoons [Ag(CN)_2]^-$	5.3×10^{18}
$Cu^{+} + 2CN^- \rightleftharpoons [Cu(CN)_2]^-$	1.0×10^{16}
$Cd^{2+} + 4CN^- \rightleftharpoons [Cd(CN)_4]^{2-}$	7.7×10^{16}
$Au^{+} + 2CN^- \rightleftharpoons [Au(CN)_2]^-$	2×10^{38}
Complexes with Other Monodentate Ligands Methylamine (CH_3NH_2)	
$Ag^{+} + 2CH_3NH_2 \rightleftharpoons [Ag(CH_3NH_2)_2]^{+}$	7.8×10^{6}

***Thiocyanate ion* (SCN^-)**	
$Cd^{2+} + 4SCN^- \rightleftharpoons [Cd(SCN)_4]^{2-}$	1×10^3
$Cu^{2+} + 2SCN^- \rightleftharpoons [Cu(SCN)_2]$	5.6×10^3
$Fe^{3+} + 3SCN^- \rightleftharpoons [Fe(SCN)_3]$	2×10^6
$Hg^{2+} + 4SCN^- \rightleftharpoons [Hg(SCN)_4]^{2-}$	5.0×10^{21}
***Hydroxide ion* (OH^-)**	
$Cu^{2+} + 4OH^- \rightleftharpoons [Cu(OH)_4]^{2-}$	1.3×10^{16}
$Zn^{2+} + 4OH^- \rightleftharpoons [Zn(OH)_4]^{2-}$	2×10^{20}
Complexes with Bidentate Ligands *	
$Mn^{2+} + 3en \rightleftharpoons [Mn(en)_3]^{2+}$	6.5×10^5
$Fe^{2+} + 3en \rightleftharpoons [Fe(en)_3]^{2+}$	5.2×10^9
$Co^{2+} + 3en \rightleftharpoons [Co(en)_3]^{2+}$	1.3×10^{14}
$Co^{3+} + 3en \rightleftharpoons [Co(en)_3]^{3+}$	4.8×10^{48}
$Ni^{2+} + 3en \rightleftharpoons [Ni(en)_3]^{2+}$	4.1×10^{17}
$Cu^{2+} + 2en \rightleftharpoons [Cu(en)_2]^{2+}$	3.5×10^{19}
$Mn^{2+} + 3bipy \rightleftharpoons [Mn(bipy)_3]^{2+}$	1×10^6
$Fe^{2+} + 3bipy \rightleftharpoons [Fe(bipy)_3]^{2+}$	1.6×10^{17}
$Ni^{2+} + 3bipy \rightleftharpoons [Ni(bipy)_3]^{2+}$	3.0×10^{20}
$Co^{2+} + 3bipy \rightleftharpoons [Co(bipy)_3]^{2+}$	8×10^{15}
$Mn^{2+} + 3phen \rightleftharpoons [Mn(phen)_3]^{2+}$	2×10^{10}
$Fe^{2+} + 3phen \rightleftharpoons [Fe(phen)_3]^{2+}$	1×10^{21}
$Co^{2+} + 3phen \rightleftharpoons [Co(phen)_3]^{2+}$	6×10^{19}
$Ni^{2+} + 3phen \rightleftharpoons [Ni(phen)_3]^{2+}$	2×10^{24}
$Co^{2+} + 3C_2O_4^{2-} \rightleftharpoons [Co(C_2O_4)_3]^{4-}$	4.5×10^6
$Fe^{3+} + 3C_2O_4^{2-} \rightleftharpoons [Fe(C_2O_4)_3]^{3-}$	3.3×10^{20}
Complexes of Other Polydentate Ligands *	
$Zn^{2+} + EDTA^{4-} \rightleftharpoons [Zn(EDTA)]^{2-}$	3.8×10^{16}
$Mg^{2+} + 2NTA^{3-} \rightleftharpoons [Mg(NTA)_2]^{4-}$	1.6×10^{10}
$Ca^{2+} + 2NTA^{3-} \rightleftharpoons [Ca(NTA)_2]^{4-}$	3.2×10^{11}

Source: From James E. Brady, Fred Senese, Niel D. Jesperson, *Chemistry: Matter and Its Changes*, 5th ed., 2007, Wiley.

Ionization Constants of Weak Acids and Bases

K_a and pK_a Values for Weak Monoprotic Acids at 25 °C

Name of Acid	Formula	K_a	pK_a
Iodic acid	HIO_3	1.7×10^{-1}	0.77
Chloroacetic acid	$ClCH_2COOH$	1.36×10^{-3}	2.87
Nitrous acid	HNO_2	7.1×10^{-4}	3.15
Hydrofluoric acid	HF	6.8×10^{-4}	3.17
Cyanic acid	HOCN	3.5×10^{-4}	3.46
Formic acid	HCOOH	1.8×10^{-4}	3.74
Barbituric acid	$HC_4H_3N_2O_3$	9.8×10^{-5}	4.01
Acetic acid	CH_3COOH	1.8×10^{-5}	4.74
Hydrazoic acid	HN_3	1.8×10^{-5}	4.74
Butanoic acid	$CH_3CH_2CH_2COOH$	1.52×10^{-5}	4.82
Propanoic acid	CH_3CH_2COOH	1.34×10^{-5}	4.87
Hypochlorous acid	HOCl	3.0×10^{-8}	7.52
Hydrocyanic acid (aq)	HCN	6.2×10^{-10}	9.21
Phenol	C_6H_5OH	1.3×10^{-10}	9.89
Hydrogen peroxide	H_2O_2	1.8×10^{-12}	11.74

K_b and pK_b Values for Weak Molecular Bases at 25 °C

Name of Base	Formula	K_b	pK_b
Butylamine	$C_4H_9NH_2$	5.9×10^{-4}	3.23
Methylamine	CH_3NH_2	4.4×10^{-4}	3.36
Ammonia	NH_3	1.8×10^{-5}	4.74
Strychnine	$C_{21}H_{22}N_2O_2$	1.0×10^{-6}	6.00
Hydrazine	N_2H_4	9.6×10^{-7}	6.02
Morphine	$C_{17}H_{19}NO_3$	7.5×10^{-7}	6.13
Hydroxylamine	$HONH_2$	6.6×10^{-9}	8.18
Pyridine	C_5H_5N	1.5×10^{-9}	8.82
Aniline	$C_6H_5NH_2$	4.1×10^{-10}	9.39

Acid Ionization Constants for Polyprotic Acids

Name	Formula	Acid Ionization Constant for Successive Ionizations (25 °C)		
		K_{a1}	K_{a2}	K_{a3}
Carbonic acid	H_2CO_3	4.5×10^{-7}	$4.7 \times 10^{-1}1$	
Hydrosulphuric acid	$H_2S(aq)$	9.5×10^{-8}	$1 \times 10^{-1}9$	
Phosphoric acid	H_3PO_4	7.1×10^{-3}	6.3×10^{-8}	4.5×10^{-13}
Arsenic acid	H_3AsO_4	5.6×10^{-3}	1.7×10^{-7}	4.0×10^{-12}
Sulphuric acid	H_2SO_4	Large	1.0×10^{-2}	
Selenic acid	H_2SeO_4	Large	1.2×10^{-2}	
Telluric acid	H_6TeO_6	2×10^{-8}	1×10^{-11}	
Sulphurous acid	H_2SO_3	1.2×10^{-2}	6.6×10^{-8}	
Selenous acid	H_2SeO_3	4.5×10^{-3}	1.1×10^{-8}	
Tellurous acid	H_2TeO_3	3.3×10^{-3}	2.0×10^{-8}	
Ascorbic acid (vitamin C)	$H_2C_6H_6O_6$	6.8×10^{-5}	2.7×10^{-12}	
Oxalic acid	$H_2C_2O_4$	5.6×10^{-2}	5.4×10^{-5}	
Citric acid (18 °C)	$H_3C_6H_5O_7$	7.1×10^{-4}	1.7×10^{-5}	6.3×10^{-6}

Ionization Enthalpies

The values given below are the standard enthalpies (in kJ mol^{-1}) of stepwise electron removal (ionization), $\Delta_{ion}H^{o}(n)$ (kJ mol^{-1}).

	Element	*First*	*Second*	*Third*	*Fourth*
1	H	1311			
2	He	2372	5249		
3	Li	520.0	7297	11810	
4	Be	899.1	1758	14850	21000
5	B	800.5	2428	2394	25020
6	C	1086	2353	4618	6512
7	N	1403	2855	4577	7473
8	O	1410	3388	5297	7450
9	F	1681	3375	6045	8409
10	Ne	2080	3963	6130	9363
11	Na	495.8	4561	6913	9543
12	Mg	737.5	1450	7731	10540
13	Al	577.5	1817	2745	11580
14	Si	786.3	1577	3228	4355
15	P	1012	1903	2910	4955
16	S	999.3	2260	3380	4562
17	Cl	1255	2297	3850	5160
18	Ar	1520	2665	3950	5771
19	K	418.7	3069	4400	5876
20	Ca	589.6	1146	4942	6500
21	Sc	631	1235	2389	7130
22	Ti	656	1309	2650	4173
23	V	650	1414	2828	4600
24	Cr	652.5	1592	3056	4900
25	Mn	717.1	1509	3251	
26	Fe	762	1561	2956	
27	Co	758	1644	3231	
28	Ni	736.5	1752	3489	
29	Cu	745.2	1958	3545	
30	Zn	906.1	1734	3831	
31	Ga	579	1979	2962	6190
32	Ge	760	1537	3301	4410
33	As	947	1798	2735	4830
34	Se	941	2070	3090	4140
35	Br	1142	2080	3460	4560
36	Kr	1351	2370	3560	
37	Rb	402.9	2650	3900	
38	Sr	549.3	1064	5500	
39	Y	616	1180	1979	
40	Zr	674.1	1268	2217	3313
41	Nb	664	1381	2416	3700
42	Mo	685	1558	2618	4480
43	Tc	703	1472	2850	
44	Ru	710.6	1617	2746	

45	Rh	720	1744	2996	
46	Pd	804	1874	3177	
47	Ag	730.8	2072	3360	
48	Cd	876.4	1630	3615	
49	In	558.1	1820	2705	5250
50	Sn	708.2	1411	2942	3928
51	Sb	833.5	1590	2440	4250
52	Te	869	1800	3000	3600
53	I	1191	1842		
54	Xe	1169	2050	3100	
55	Cs	375.5	2420		
56	Ba	502.5	964		
57	La	541	1103	1849	
72	Hf	760	1440	2250	3210
73	Ta	760	1560		
74	W	770	1710		
75	Re	759	1600		
76	Os	840	1640		
77	Ir	900			
78	Pt	870	1791		
79	Au	889	1980		
80	Hg	1007	1809	3300	
81	Tl	588.9	1970	2880	4890
82	Pb	715.3	1450	3080	4082
83	Bi	702.9	1609	2465	4370
84	Po	813			
86	Rn	1037			
88	Ra	509.1	978.6		
89	Ac	670	1170		

Standard Reduction Potential Values at 25°C

Stronger oxidizing agent	
Half-Reaction	***E*° (V)**
$F_2(g) + 2e^- \rightleftharpoons 2F^-(aq)$	+2.87
$S_2O_8^{2-}(aq) + 2e^- \rightleftharpoons 2SO_4^{2-}(aq)$	+2.01
$PbO_2(s) + HSO_4^-(aq) + 3H^+(aq) + 2e^- \rightleftharpoons PbSO_4(s) + 2H_2O$	+1.69
$2HOCl(aq) + 2H^+(aq) + 2e^- \rightleftharpoons Cl_2(g) + 2H_2O$	+1.63
$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightleftharpoons Mn^{2+}(aq) + 4H_2O$	+1.51
$PbO_2(s) + 4H^+(aq) + 2e^- \rightleftharpoons Pb^{2+}(aq) + 2H_2O$	+1.46
$BrO_3^-(aq) + 6H^+(aq) + 6e^- \rightleftharpoons Br^-(aq) + 3H_2O$	+1.44
$Au^{3+}(aq) + 3e^- \rightleftharpoons Au(s)$	+1.42
$Cl_2(g) + 2e^- \rightleftharpoons 2Cl^-(aq)$	+1.36
$O_2(g) + 4H^+(aq) + 4e^- \rightleftharpoons 2H_2O$	+1.23
$Br_2(aq) + 2e^- \rightleftharpoons 2Br^-(aq)$	+1.07
$NO_3^-(aq) + 4H^+(aq) + 4e^- \rightleftharpoons 2H_2O$	+0.96
$Ag^+(aq) + e^- \rightleftharpoons Ag(s)$	+0.80
$Fe^{3+}(aq) + e^- \rightleftharpoons Fe^{2+}(aq)$	+0.77
$I_2(s) + 2e^- \rightleftharpoons 2I^-(aq)$	+0.54
$NiO_2(s) + 2H_2O + 2e^- \rightleftharpoons Ni(OH)_2(s) + 2OH^-(aq)$	+0.49
$Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu(s)$	+0.34
$SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \rightleftharpoons H_2SO_3(aq) + H_2O$	+0.17
$AgBr(s) + e^- \rightleftharpoons Ag(s) + Br^-(aq)$	+0.07
$2H^+(aq) + 2e^- \rightleftharpoons H_2(g)$	0
$Sn^{2+}(aq) + 2e^- \rightleftharpoons Sn(s)$	–0.14
$Ni^{2+}(aq) + 2e^- \rightleftharpoons Ni(s)$	–0.25
$Co^{2+}(aq) + 2e^- \rightleftharpoons Co(s)$	–0.28
$PbSO_4(s) + H^+(aq) + 2e^- \rightleftharpoons Pb(s) + HSO_4^-(aq)$	–0.36
$Cd^{2+}(aq) + 2e^- \rightleftharpoons Cd(s)$	–0.40
$Fe^{2+}(aq) + 2e^- \rightleftharpoons Fe(s)$	–0.44
$Cr^{3+}(aq) + 3e^- \rightleftharpoons Cr(s)$	–0.74
$Zn^{2+}(aq) + 2e^- \rightleftharpoons Zn(s)$	–0.76
$2H_2O + 2e^- \rightleftharpoons H_2(g) + 2OH^-(aq)$	–0.83
$Al^{3+}(aq) + 3e^- \rightleftharpoons Al(s)$	–1.66
$Mg^{2+}(aq) + 2e^- \rightleftharpoons Mg(s)$	–2.37
$Na^+(aq) + e^- \rightleftharpoons Na(s)$	–2.71
$Ca^{2+}(aq) + 2e^- \rightleftharpoons Ca(s)$	–2.76
$K^+(aq) + e^- \rightleftharpoons K(s)$	–2.92

$Li^+(aq) + e^- \rightleftharpoons Li(s)$	-3.05
	Stronger reducing agent

Comparison of Electronegativity Values

Element	χ^{a}_{spec}	χ^{b}_{P}	$\chi^{c}_{\text{A\&R}}$	χ^{d}_{M}
H	2.300	2.20	2.20	3.059
Li	0.912	0.98	0.97	1.282
Be	1.576	1.57	1.47	1.987
B	2.051	2.04	2.01	1.828
C	2.544	2.55	2.50	2.671
N	3.066	3.04	3.07	3.083
O	3.610	3.44	3.50	3.215
F	4.193	3.98	4.10	4.438
Ne	4.787	4.597		
Na	0.869	0.93	1.01	1.212
Mg	1.293	1.31	1.23	1.630
Al	1.613	1.61	1.47	1.373
Si	1.916	1.90	1.74	2.033
P	2.253	2.19	2.06	2.394
S	2.589	2.58	2.44	2.651
Cl	2.869	3.16	2.83	3.535
Ar	3.242	3.359		
K	0.734	0.82	0.91	1.032
Ca	1.034	1.00	1.04	1.303
Ga	1.756	1.81	1.82	1.343
Ge	1.944	2.01	2.02	1.949
As	2.211	2.18	2.20	2.256
Se	2.424	2.55	2.48	2.509
Br	2.685	2.96	2.74	3.236
Kr	2.966	2.984		
Rb	0.706	0.82	0.89	0.994
Sr	0.963	0.95	0.99	0.214
In	1.656	1.78	1.49	1.298
Sn	1.824	1.96	1.72	1.833
Sb	1.984	2.05	1.82	2.061
Te	2.158	2.10	2.01	2.341
I	2.359	2.66	2.21	2.880
Xe	2.582	2.586		

Source:
[a]L.C. Allen, *J. Am. Chem. Soc.* 1989, 111, 9003.
[b]Pauling's values, taken from A.L. Allred, *J. Inorg. Nucl. Chem.*, 1961, 17, 215.
[c]A.L. Allred and E. G. Rochow, *J. Inorg. Nucl. Chem.*, 1958, 5, 264.
[d]Mulliken's values, taken from H. Hotop and W. C. Lineberger, *J. Phys. Chem, Ref. Data*, 1985, 14, 731.