

PROPERTIES OF WATER

Density:	0.99987 g/mL at 0 °C 1.00000 g/mL at 4 °C 0.99707 g/mL at 25 °C 0.95838 g/mL at 100 °C
Heat (enthalpy) of fusion:	6.008 kJ/mol at 0 °C
Heat (enthalpy) of vaporization:	44.94 kJ/mol at 0 °C 44.02 kJ/mol at 25 °C 40.67 kJ/mol at 100 °C
Ion-product constant, K_w :	1.14×10^{-15} at 0 °C 1.01×10^{-14} at 25 °C 5.47×10^{-14} at 50 °C
Specific heat:	2.092 J/g-K = 2.092 J/g · °C for ice at -3 °C 4.184 J/g-K = 4.184 J/g · °C for water at 25 °C 1.841 J/g-K = 1.841 J/g · °C for steam at 100 °C

Vapor Pressure (torr) at Different Temperatures

T(°C)	P	T(°C)	P	T(°C)	P	T(°C)	P
0	4.58	21	18.65	35	42.2	92	567.0
5	6.54	22	19.83	40	55.3	94	610.9
10	9.21	23	21.07	45	71.9	96	657.6
12	10.52	24	22.38	50	92.5	98	707.3
14	11.99	25	23.76	55	118.0	100	760.0
16	13.63	26	25.21	60	149.4	102	815.9
17	14.53	27	26.74	65	187.5	104	875.1
18	15.48	28	28.35	70	233.7	106	937.9
19	16.48	29	30.04	80	355.1	108	1004.4
20	17.54	30	31.82	90	525.8	110	1074.6

TABLE 8.4 • Average Bond Enthalpies (kJ/mol)

Single Bonds							
C—H	413	N—H	391	O—H	463	F—F	155
C—C	348	N—N	163	O—O	146		
C—N	293	N—O	201	O—F	190	Cl—F	253
C—O	358	N—F	272	O—Cl	203	Cl—Cl	242
C—F	485	N—Cl	200	O—I	234		
C—Cl	328	N—Br	243			Br—F	237
C—Br	276			S—H	339	Br—Cl	218
C—I	240	H—H	436	S—F	327	Br—Br	193
C—S	259	H—F	567	S—Cl	253		
		H—Cl	431	S—Br	218	I—Cl	208
Si—H	323	H—Br	366	S—S	266	I—Br	175
Si—Si	226	H—I	299			I—I	151
Si—C	301						
Si—O	368						
Si—Cl	464						
Multiple Bonds							
C=C	614	N=N	418	O ₂	495		
C≡C	839	N≡N	941				
C=N	615	N=O	607	S=O	523		
C≡N	891			S=S	418		
C=O	799						
C≡O	1072						

THERMODYNAMIC QUANTITIES FOR SELECTED SUBSTANCES AT 298.15 K (25 °C)

Substance	ΔH_f° (kJ/mol)	ΔG_f° (kJ/mol)	S° (J/mol-K)	Substance	ΔH_f° (kJ/mol)	ΔG_f° (kJ/mol)	S° (J/mol-K)
Aluminum				C ₂ H ₄ (g)	52.30	68.11	219.4
Al(s)	0	0	28.32	C ₂ H ₆ (g)	-84.68	-32.89	229.5
AlCl ₃ (s)	-705.6	-630.0	109.3	C ₃ H ₈ (g)	-103.85	-23.47	269.9
Al ₂ O ₃ (s)	-1669.8	-1576.5	51.00	C ₄ H ₁₀ (g)	-124.73	-15.71	310.0
Barium				C ₄ H ₁₀ (l)	-147.6	-15.0	231.0
Ba(s)	0	0	63.2	C ₆ H ₆ (g)	82.9	129.7	269.2
BaCO ₃ (s)	-1216.3	-1137.6	112.1	C ₆ H ₆ (l)	49.0	124.5	172.8
BaO(s)	-553.5	-525.1	70.42	CH ₃ OH(g)	-201.2	-161.9	237.6
Beryllium				CH ₃ OH(l)	-238.6	-166.23	126.8
Be(s)	0	0	9.44	C ₂ H ₅ OH(g)	-235.1	-168.5	282.7
BeO(s)	-608.4	-579.1	13.77	C ₂ H ₅ OH(l)	-277.7	-174.76	160.7
Be(OH) ₂ (s)	-905.8	-817.9	50.21	C ₆ H ₁₂ O ₆ (s)	-1273.02	-910.4	212.1
Bromine				CO(g)	-110.5	-137.2	197.9
Br(g)	111.8	82.38	174.9	CO ₂ (g)	-393.5	-394.4	213.6
Br ⁻ (aq)	-120.9	-102.8	80.71	CH ₃ COOH(l)	-487.0	-392.4	159.8
Br ₂ (g)	30.71	3.14	245.3	Cesium			
Br ₂ (l)	0	0	152.3	Cs(g)	76.50	49.53	175.6
HBr(g)	-36.23	-53.22	198.49	Cs(l)	2.09	0.03	92.07
Calcium				Cs(s)	0	0	85.15
Ca(g)	179.3	145.5	154.8	CsCl(s)	-442.8	-414.4	101.2
Ca(s)	0	0	41.4	Chlorine			
CaCO ₃ (s, calcite)	-1207.1	-1128.76	92.88	Cl(g)	121.7	105.7	165.2
CaCl ₂ (s)	-795.8	-748.1	104.6	Cl(aq)	-167.2	-131.2	56.5
CaF ₂ (s)	-1219.6	-1167.3	68.87	Cl ₂ (g)	0	0	222.96
CaO(s)	-635.5	-604.17	39.75	HCl(aq)	-167.2	-131.2	56.5
Ca(OH) ₂ (s)	-986.2	-898.5	83.4	HCl(g)	-92.30	-95.27	186.69
CaSO ₄ (s)	-1434.0	-1321.8	106.7	Chromium			
Carbon				Cr(g)	397.5	352.6	174.2
C(g)	718.4	672.9	158.0	Cr(s)	0	0	23.6
C(s, diamond)	1.88	2.84	2.43	Cr ₂ O ₃ (s)	-1139.7	-1058.1	81.2
C(s, graphite)	0	0	5.69	Cobalt			
CCl ₄ (g)	-106.7	-64.0	309.4	Co(g)	439	393	179
CCl ₄ (l)	-139.3	-68.6	214.4	Co(s)	0	0	28.4
CF ₄ (g)	-679.9	-635.1	262.3	Copper			
CH ₄ (g)	-74.8	-50.8	186.3	Cu(g)	338.4	298.6	166.3
C ₂ H ₂ (g)	226.77	209.2	200.8	Cu(s)	0	0	33.30

Substance	ΔH_f° (kJ/mol)	ΔG_f° (kJ/mol)	S° (J/mol-K)	Substance	ΔH_f° (kJ/mol)	ΔG_f° (kJ/mol)	S° (J/mol-K)
CuCl ₂ (s)	-205.9	-161.7	108.1	MgO(s)	-601.8	-569.6	26.8
CuO(s)	-156.1	-128.3	42.59	Mg(OH) ₂ (s)	-924.7	-833.7	63.24
Cu ₂ O(s)	-170.7	-147.9	92.36	Manganese			
Fluorine				Mn(g)	280.7	238.5	173.6
F(g)	80.0	61.9	158.7	Mn(s)	0	0	32.0
F(aq)	-332.6	-278.8	-13.8	MnO(s)	-385.2	-362.9	59.7
F ₂ (g)	0	0	202.7	MnO ₂ (s)	-519.6	-464.8	53.14
HF(g)	-268.61	-270.70	173.51	MnO ₄ ⁻ (aq)	-541.4	-447.2	191.2
Hydrogen				Mercury			
H(g)	217.94	203.26	114.60	Hg(g)	60.83	31.76	174.89
H ⁺ (aq)	0	0	0	Hg(l)	0	0	77.40
H ⁺ (g)	1536.2	1517.0	108.9	HgCl ₂ (s)	-230.1	-184.0	144.5
H ₂ (g)	0	0	130.58	Hg ₂ Cl ₂ (s)	-264.9	-210.5	192.5
Iodine				Nickel			
I(g)	106.60	70.16	180.66	Ni(g)	429.7	384.5	182.1
I ⁻ (aq)	-55.19	-51.57	111.3	Ni(s)	0	0	29.9
I ₂ (g)	62.25	19.37	260.57	NiCl ₂ (s)	-305.3	-259.0	97.65
I ₂ (s)	0	0	116.73	NiO(s)	-239.7	-211.7	37.99
HI(g)	25.94	1.30	206.3	Nitrogen			
Iron				N(g)	472.7	455.5	153.3
Fe(g)	415.5	369.8	180.5	N ₂ (g)	0	0	191.50
Fe(s)	0	0	27.15	NH ₃ (aq)	-80.29	-26.50	111.3
Fe ²⁺ (aq)	-87.86	-84.93	113.4	NH ₃ (g)	-46.19	-16.66	192.5
Fe ³⁺ (aq)	-47.69	-10.54	293.3	NH ₄ ⁺ (aq)	-132.5	-79.31	113.4
FeCl ₂ (s)	-341.8	-302.3	117.9	N ₂ H ₄ (g)	95.40	159.4	238.5
FeCl ₃ (s)	-400	-334	142.3	NH ₄ CN(s)	0.0	—	—
FeO(s)	-271.9	-255.2	60.75	NH ₄ Cl(s)	-314.4	-203.0	94.6
Fe ₂ O ₃ (s)	-822.16	-740.98	89.96	NH ₄ NO ₃ (s)	-365.6	-184.0	151
Fe ₃ O ₄ (s)	-1117.1	-1014.2	146.4	NO(g)	90.37	86.71	210.62
FeS ₂ (s)	-171.5	-160.1	52.92	NO ₂ (g)	33.84	51.84	240.45
Lead				N ₂ O(g)	81.6	103.59	220.0
Pb(s)	0	0	68.85	N ₂ O ₄ (g)	9.66	98.28	304.3
PbBr ₂ (s)	-277.4	-260.7	161	NOCl(g)	52.6	66.3	264
PbCO ₃ (s)	-699.1	-625.5	131.0	HNO ₃ (aq)	-206.6	-110.5	146
Pb(NO ₃) ₂ (aq)	-421.3	-246.9	303.3	HNO ₃ (g)	-134.3	-73.94	266.4
Pb(NO ₃) ₂ (s)	-451.9	—	—	Oxygen			
PbO(s)	-217.3	-187.9	68.70	O(g)	247.5	230.1	161.0
Lithium				O ₂ (g)	0	0	205.0
Li(g)	159.3	126.6	138.8	O ₃ (g)	142.3	163.4	237.6
Li(s)	0	0	29.09	OH ⁻ (aq)	-230.0	-157.3	-10.7
Li ⁺ (aq)	-278.5	-273.4	12.2	H ₂ O(g)	-241.82	-228.57	188.83
Li ⁺ (g)	685.7	648.5	133.0	H ₂ O(l)	-285.83	-237.13	69.91
LiCl(s)	-408.3	-384.0	59.30	H ₂ O ₂ (g)	-136.10	-105.48	232.9
Magnesium				H ₂ O ₂ (l)	-187.8	-120.4	109.6
Mg(g)	147.1	112.5	148.6	Phosphorus			
Mg(s)	0	0	32.51	P(g)	316.4	280.0	163.2
MgCl ₂ (s)	-641.6	-592.1	89.6	P ₂ (g)	144.3	103.7	218.1

Substance	ΔH_f° (kJ/mol)	ΔG_f° (kJ/mol)	S° (J/mol-K)	Substance	ΔH_f° (kJ/mol)	ΔG_f° (kJ/mol)	S° (J/mol-K)
P ₄ (g)	58.9	24.4	280	AgNO ₃ (s)	-124.4	-33.41	140.9
P ₄ (s, red)	-17.46	-12.03	22.85	Sodium			
P ₄ (s, white)	0	0	41.08	Na(g)	107.7	77.3	153.7
PCl ₃ (g)	-288.07	-269.6	311.7	Na(s)	0	0	51.45
PCl ₃ (l)	-319.6	-272.4	217	Na ⁺ (aq)	-240.1	-261.9	59.0
PF ₅ (g)	-1594.4	-1520.7	300.8	Na ⁺ (g)	609.3	574.3	148.0
PH ₃ (g)	5.4	13.4	210.2	NaBr(aq)	-360.6	-364.7	141.00
P ₄ O ₆ (s)	-1640.1	—	—	NaBr(s)	-361.4	-349.3	86.82
P ₄ O ₁₀ (s)	-2940.1	-2675.2	228.9	Na ₂ CO ₃ (s)	-1130.9	-1047.7	136.0
POCl ₃ (g)	-542.2	-502.5	325	NaCl(aq)	-407.1	-393.0	115.5
POCl ₃ (l)	-597.0	-520.9	222	NaCl(g)	-181.4	-201.3	229.8
H ₃ PO ₄ (aq)	-1288.3	-1142.6	158.2	NaCl(s)	-410.9	-384.0	72.33
Potassium				NaHCO ₃ (s)	-947.7	-851.8	102.1
K(g)	89.99	61.17	160.2	NaNO ₃ (aq)	-446.2	-372.4	207
K(s)	0	0	64.67	NaNO ₃ (s)	-467.9	-367.0	116.5
KCl(s)	-435.9	-408.3	82.7	NaOH(aq)	-469.6	-419.2	49.8
KClO ₃ (s)	-391.2	-289.9	143.0	NaOH(s)	-425.6	-379.5	64.46
KClO ₃ (aq)	-349.5	-284.9	265.7	Na ₂ SO ₄ (s)	-1387.1	-1270.2	149.6
K ₂ CO ₃ (s)	-1150.18	-1064.58	155.44	Strontium			
KNO ₃ (s)	-492.70	-393.13	132.9	SrO(s)	-592.0	-561.9	54.9
K ₂ O(s)	-363.2	-322.1	94.14	Sr(g)	164.4	110.0	164.6
KO ₂ (s)	-284.5	-240.6	122.5	Sulfur			
K ₂ O ₂ (s)	-495.8	-429.8	113.0	S(s, rhombic)	0	0	31.88
KOH(s)	-424.7	-378.9	78.91	S ₈ (g)	102.3	49.7	430.9
KOH(aq)	-482.4	-440.5	91.6	SO ₂ (g)	-296.9	-300.4	248.5
Rubidium				SO ₃ (g)	-395.2	-370.4	256.2
Rb(g)	85.8	55.8	170.0	SO ₄ ²⁻ (aq)	-909.3	-744.5	20.1
Rb(s)	0	0	76.78	SOCl ₂ (l)	-245.6	—	—
RbCl(s)	-430.5	-412.0	92	H ₂ S(g)	-20.17	-33.01	205.6
RbClO ₃ (s)	-392.4	-292.0	152	H ₂ SO ₄ (aq)	-909.3	-744.5	20.1
Scandium				H ₂ SO ₄ (l)	-814.0	-689.9	156.1
Sc(g)	377.8	336.1	174.7	Titanium			
Sc(s)	0	0	34.6	Ti(g)	468	422	180.3
Selenium				Ti(s)	0	0	30.76
H ₂ Se(g)	29.7	15.9	219.0	TiCl ₄ (g)	-763.2	-726.8	354.9
Silicon				TiCl ₄ (l)	-804.2	-728.1	221.9
Si(g)	368.2	323.9	167.8	TiO ₂ (s)	-944.7	-889.4	50.29
Si(s)	0	0	18.7	Vanadium			
SiC(s)	-73.22	-70.85	16.61	V(g)	514.2	453.1	182.2
SiCl ₄ (l)	-640.1	-572.8	239.3	V(s)	0	0	28.9
SiO ₂ (s, quartz)	-910.9	-856.5	41.84	Zinc			
Silver				Zn(g)	130.7	95.2	160.9
Ag(s)	0	0	42.55	Zn(s)	0	0	41.63
Ag ⁺ (aq)	105.90	77.11	73.93	ZnCl ₂ (s)	-415.1	-369.4	111.5
AgCl(s)	-127.0	-109.70	96.11	ZnO(s)	-348.0	-318.2	43.9
Ag ₂ O(s)	-31.05	-11.20	121.3				

AQUEOUS EQUILIBRIUM CONSTANTS

TABLE D.1 • Dissociation Constants for Acids at 25 °C

Name	Formula	K_{a1}	K_{a2}	K_{a3}
Acetic acid	CH ₃ COOH (or HC ₂ H ₃ O ₂)	1.8×10^{-5}		
Arsenic acid	H ₃ AsO ₄	5.6×10^{-3}	1.0×10^{-7}	3.0×10^{-12}
Arsenous acid	H ₃ AsO ₃	5.1×10^{-10}		
Ascorbic acid	H ₂ C ₆ H ₆ O ₆	8.0×10^{-5}	1.6×10^{-12}	
Benzoic acid	C ₆ H ₅ COOH (or HC ₇ H ₅ O ₂)	6.3×10^{-5}		
Boric acid	H ₃ BO ₃	5.8×10^{-10}		
Butanoic acid	C ₃ H ₇ COOH (or HC ₄ H ₇ O ₂)	1.5×10^{-5}		
Carbonic acid	H ₂ CO ₃	4.3×10^{-7}	5.6×10^{-11}	
Chloroacetic acid	CH ₂ ClCOOH (or HC ₂ H ₂ O ₂ Cl)	1.4×10^{-3}		
Chlorous acid	HClO ₂	1.1×10^{-2}		
Citric acid	HOOC(OH)(CH ₂ COOH) ₂ (or H ₃ C ₆ H ₅ O ₇)	7.4×10^{-4}	1.7×10^{-5}	4.0×10^{-7}
Cyanic acid	HCNO	3.5×10^{-4}		
Formic acid	HCOOH (or HCHO ₂)	1.8×10^{-4}		
Hydroazoic acid	HN ₃	1.9×10^{-5}		
Hydrocyanic acid	HCN	4.9×10^{-10}		
Hydrofluoric acid	HF	6.8×10^{-4}		
Hydrogen chromate ion	HCrO ₄ ⁻	3.0×10^{-7}		
Hydrogen peroxide	H ₂ O ₂	2.4×10^{-12}		
Hydrogen selenate ion	HSeO ₄ ⁻	2.2×10^{-2}		
Hydrogen sulfide	H ₂ S	9.5×10^{-8}	1×10^{-19}	
Hypobromous acid	HBrO	2.5×10^{-9}		
Hypochlorous acid	HClO	3.0×10^{-8}		
Hypoiodous acid	HIO	2.3×10^{-11}		
Iodic acid	HIO ₃	1.7×10^{-1}		
Lactic acid	CH ₃ CH(OH)COOH (or HC ₃ H ₅ O ₃)	1.4×10^{-4}		
Malonic acid	CH ₂ (COOH) ₂ (or H ₂ C ₃ H ₂ O ₄)	1.5×10^{-3}	2.0×10^{-6}	
Nitrous acid	HNO ₂	4.5×10^{-4}		
Oxalic acid	(COOH) ₂ (or H ₂ C ₂ O ₄)	5.9×10^{-2}	6.4×10^{-5}	
Paraperiodic acid	H ₅ IO ₆	2.8×10^{-2}	5.3×10^{-9}	
Phenol	C ₆ H ₅ OH (or HC ₆ H ₅ O)	1.3×10^{-10}		
Phosphoric acid	H ₃ PO ₄	7.5×10^{-3}	6.2×10^{-8}	4.2×10^{-13}
Propionic acid	C ₂ H ₅ COOH (or HC ₃ H ₅ O ₂)	1.3×10^{-5}		
Pyrophosphoric acid	H ₄ P ₂ O ₇	3.0×10^{-2}	4.4×10^{-3}	2.1×10^{-7}
Selenous acid	H ₂ SeO ₃	2.3×10^{-3}	5.3×10^{-9}	
Sulfuric acid	H ₂ SO ₄	Strong acid	1.2×10^{-2}	
Sulfurous acid	H ₂ SO ₃	1.7×10^{-2}	6.4×10^{-8}	
Tartaric acid	HOOC(CHOH) ₂ COOH (or H ₂ C ₄ H ₄ O ₆)	1.0×10^{-3}		

TABLE D.2 • Dissociation Constants for Bases at 25 °C

Name	Formula	K_b
Ammonia	NH ₃	1.8×10^{-5}
Aniline	C ₆ H ₅ NH ₂	4.3×10^{-10}
Dimethylamine	(CH ₃) ₂ NH	5.4×10^{-4}
Ethylamine	C ₂ H ₅ NH ₂	6.4×10^{-4}
Hydrazine	H ₂ NNH ₂	1.3×10^{-6}
Hydroxylamine	HONH ₂	1.1×10^{-8}
Methylamine	CH ₃ NH ₂	4.4×10^{-4}
Pyridine	C ₅ H ₅ N	1.7×10^{-9}
Trimethylamine	(CH ₃) ₃ N	6.4×10^{-5}

TABLE D.3 • Solubility-Product Constants for Compounds at 25 °C

Name	Formula	K_{sp}	Name	Formula	K_{sp}
Barium carbonate	BaCO ₃	5.0×10^{-9}	Lead(II) fluoride	PbF ₂	3.6×10^{-8}
Barium chromate	BaCrO ₄	2.1×10^{-10}	Lead(II) sulfate	PbSO ₄	6.3×10^{-7}
Barium fluoride	BaF ₂	1.7×10^{-6}	Lead(II) sulfide*	PbS	3×10^{-28}
Barium oxalate	BaC ₂ O ₄	1.6×10^{-6}	Magnesium hydroxide	Mg(OH) ₂	1.8×10^{-11}
Barium sulfate	BaSO ₄	1.1×10^{-10}	Magnesium carbonate	MgCO ₃	3.5×10^{-8}
Cadmium carbonate	CdCO ₃	1.8×10^{-14}	Magnesium oxalate	MgC ₂ O ₄	8.6×10^{-5}
Cadmium hydroxide	Cd(OH) ₂	2.5×10^{-14}	Manganese(II) carbonate	MnCO ₃	5.0×10^{-10}
Cadmium sulfide*	CdS	8×10^{-28}	Manganese(II) hydroxide	Mn(OH) ₂	1.6×10^{-13}
Calcium carbonate (calcite)	CaCO ₃	4.5×10^{-9}	Manganese(II) sulfide*	MnS	2×10^{-53}
Calcium chromate	CaCrO ₄	4.5×10^{-9}	Mercury(I) chloride	Hg ₂ Cl ₂	1.2×10^{-18}
Calcium fluoride	CaF ₂	3.9×10^{-11}	Mercury(I) iodide	Hg ₂ I ₂	$1.1 \times 10^{-1.1}$
Calcium hydroxide	Ca(OH) ₂	6.5×10^{-6}	Mercury(II) sulfide*	HgS	2×10^{-53}
Calcium phosphate	Ca ₃ (PO ₄) ₂	2.0×10^{-29}	Nickel(II) carbonate	NiCO ₃	1.3×10^{-7}
Calcium sulfate	CaSO ₄	2.4×10^{-5}	Nickel(II) hydroxide	Ni(OH) ₂	6.0×10^{-16}
Chromium(III) hydroxide	Cr(OH) ₃	1.6×10^{-30}	Nickel(II) sulfide*	NiS	3×10^{-20}
Cobalt(II) carbonate	CoCO ₃	1.0×10^{-10}	Silver bromate	AgBrO ₃	5.5×10^{-13}
Cobalt(II) hydroxide	Co(OH) ₂	1.3×10^{-15}	Silver bromide	AgBr	5.0×10^{-13}
Cobalt(II) sulfide*	CoS	5×10^{-22}	Silver carbonate	Ag ₂ CO ₃	8.1×10^{-12}
Copper(I) bromide	CuBr	5.3×10^{-9}	Silver chloride	AgCl	1.8×10^{-10}
Copper(II) carbonate	CuCO ₃	2.3×10^{-10}	Silver chromate	Ag ₂ CrO ₄	1.2×10^{-12}
Copper(II) hydroxide	Cu(OH) ₂	4.8×10^{-20}	Silver iodide	AgI	8.3×10^{-17}
Copper(II) sulfide*	CuS	6×10^{-37}	Silver sulfate	Ag ₂ SO ₄	1.5×10^{-5}
Iron(II) carbonate	FeCO ₃	2.1×10^{-11}	Silver sulfide*	Ag ₂ S	6×10^{-51}
Iron(II) hydroxide	Fe(OH) ₂	7.9×10^{-16}	Strontium carbonate	SrCO ₃	9.3×10^{-10}
Lanthanum fluoride	LaF ₃	2×10^{-19}	Tin(II) sulfide*	SnS	1×10^{-26}
Lanthanum iodate	La(IO ₃) ₃	7.4×10^{-14}	Zinc carbonate	ZnCO ₃	1.0×10^{-10}
Lead(II) carbonate	PbCO ₃	7.4×10^{-14}	Zinc hydroxide	Zn(OH) ₂	3.0×10^{-16}
Lead(II) chloride	PbCl ₂	1.7×10^{-5}	Zinc oxalate	ZnC ₂ O ₄	2.7×10^{-8}
Lead(II) chromate	PbCrO ₄	2.8×10^{-13}	Zinc sulfide*	ZnS	2×10^{-25}

*For a solubility equilibrium of the type $MS(s) + H_2O(l) \rightleftharpoons M^{2+}(aq) + HS^-(aq) + OH^-(aq)$

STANDARD REDUCTION POTENTIALS AT 25 °C

Half-Reaction	$E^\circ(\text{V})$	Half-Reaction	$E^\circ(\text{V})$
$\text{Ag}^+(\text{aq}) + \text{e}^- \longrightarrow \text{Ag}(\text{s})$	+0.799	$2 \text{H}_2\text{O}(\text{l}) + 2 \text{e}^- \longrightarrow \text{H}_2(\text{g}) + 2 \text{OH}^-(\text{aq})$	-0.83
$\text{AgBr}(\text{s}) + \text{e}^- \longrightarrow \text{Ag}(\text{s}) + \text{Br}^-(\text{aq})$	+0.095	$\text{HO}_2^-(\text{aq}) + \text{H}_2\text{O}(\text{l}) + 2 \text{e}^- \longrightarrow 3 \text{OH}^-(\text{aq})$	+0.88
$\text{AgCl}(\text{s}) + \text{e}^- \longrightarrow \text{Ag}(\text{s}) + \text{Cl}^-(\text{aq})$	+0.222	$\text{H}_2\text{O}_2(\text{aq}) + 2 \text{H}^+(\text{aq}) + 2 \text{e}^- \longrightarrow 2 \text{H}_2\text{O}(\text{l})$	+1.776
$\text{Ag}(\text{CN})_2^-(\text{aq}) + \text{e}^- \longrightarrow \text{Ag}(\text{s}) + 2 \text{CN}^-(\text{aq})$	-0.31	$\text{Hg}_2^{2+}(\text{aq}) + 2 \text{e}^- \longrightarrow 2 \text{Hg}(\text{l})$	+0.789
$\text{Ag}_2\text{CrO}_4(\text{s}) + 2 \text{e}^- \longrightarrow 2 \text{Ag}(\text{s}) + \text{CrO}_4^{2-}(\text{aq})$	+0.446	$2 \text{Hg}_2^{2+}(\text{aq}) + 2 \text{e}^- \longrightarrow \text{Hg}_2^{2+}(\text{aq})$	+0.920
$\text{AgI}(\text{s}) + \text{e}^- \longrightarrow \text{Ag}(\text{s}) + \text{I}^-(\text{aq})$	-0.151	$\text{Hg}^{2+}(\text{aq}) + 2 \text{e}^- \longrightarrow \text{Hg}(\text{l})$	+0.854
$\text{Ag}(\text{S}_2\text{O}_3)_2^{3-}(\text{aq}) + \text{e}^- \longrightarrow \text{Ag}(\text{s}) + 2 \text{S}_2\text{O}_3^{2-}(\text{aq})$	+0.01	$\text{I}_2(\text{s}) + 2 \text{e}^- \longrightarrow 2 \text{I}^-(\text{aq})$	+0.536
$\text{Al}^{3+}(\text{aq}) + 3 \text{e}^- \longrightarrow \text{Al}(\text{s})$	-1.66	$2 \text{IO}_3^-(\text{aq}) + 12 \text{H}^+(\text{aq}) + 10 \text{e}^- \longrightarrow$	+1.195
$\text{H}_3\text{AsO}_4(\text{aq}) + 2 \text{H}^+(\text{aq}) + 2 \text{e}^- \longrightarrow$	+0.559	$\text{I}_2(\text{s}) + 6 \text{H}_2\text{O}(\text{l})$	
$\text{H}_3\text{AsO}_3(\text{aq}) + \text{H}_2\text{O}(\text{l})$			
$\text{Ba}^{2+}(\text{aq}) + 2 \text{e}^- \longrightarrow \text{Ba}(\text{s})$	-2.90	$\text{K}^+(\text{aq}) + \text{e}^- \longrightarrow \text{K}(\text{s})$	-2.925
$\text{BiO}^+(\text{aq}) + 2 \text{H}^+(\text{aq}) + 3 \text{e}^- \longrightarrow \text{Bi}(\text{s}) + \text{H}_2\text{O}(\text{l})$	+0.32	$\text{Li}^+(\text{aq}) + \text{e}^- \longrightarrow \text{Li}(\text{s})$	-3.05
$\text{Br}_2(\text{l}) + 2 \text{e}^- \longrightarrow 2 \text{Br}^-(\text{aq})$	+1.065	$\text{Mg}^{2+}(\text{aq}) + 2 \text{e}^- \longrightarrow \text{Mg}(\text{s})$	-2.37
$2 \text{BrO}_3^-(\text{aq}) + 12 \text{H}^+(\text{aq}) + 10 \text{e}^- \longrightarrow$	+1.52	$\text{Mn}^{2+}(\text{aq}) + 2 \text{e}^- \longrightarrow \text{Mn}(\text{s})$	-1.18
$\text{Br}_2(\text{l}) + 6 \text{H}_2\text{O}(\text{l})$		$\text{MnO}_2(\text{s}) + 4 \text{H}^+(\text{aq}) + 2 \text{e}^- \longrightarrow$	+1.23
$2 \text{CO}_2(\text{g}) + 2 \text{H}^+(\text{aq}) + 2 \text{e}^- \longrightarrow \text{H}_2\text{C}_2\text{O}_4(\text{aq})$	-0.49	$\text{Mn}^{2+}(\text{aq}) + 2 \text{H}_2\text{O}(\text{l})$	
$\text{Ca}^{2+}(\text{aq}) + 2 \text{e}^- \longrightarrow \text{Ca}(\text{s})$	-2.87	$\text{MnO}_4^-(\text{aq}) + 8 \text{H}^+(\text{aq}) + 5 \text{e}^- \longrightarrow$	+1.51
$\text{Cd}^{2+}(\text{aq}) + 2 \text{e}^- \longrightarrow \text{Cd}(\text{s})$	-0.403	$\text{Mn}^{2+}(\text{aq}) + 4 \text{H}_2\text{O}(\text{l})$	
$\text{Ce}^{4+}(\text{aq}) + \text{e}^- \longrightarrow \text{Ce}^{3+}(\text{aq})$	+1.61	$\text{MnO}_4^-(\text{aq}) + 2 \text{H}_2\text{O}(\text{l}) + 3 \text{e}^- \longrightarrow$	+0.59
$\text{Cl}_2(\text{g}) + 2 \text{e}^- \longrightarrow 2 \text{Cl}^-(\text{aq})$	+1.359	$\text{MnO}_2(\text{s}) + 4 \text{OH}^-(\text{aq})$	
$2 \text{HClO}(\text{aq}) + 2 \text{H}^+(\text{aq}) + 2 \text{e}^- \longrightarrow$	+1.63	$\text{HNO}_2(\text{aq}) + \text{H}^+(\text{aq}) + \text{e}^- \longrightarrow \text{NO}(\text{g}) + \text{H}_2\text{O}(\text{l})$	+1.00
$\text{Cl}_2(\text{g}) + 2 \text{H}_2\text{O}(\text{l})$		$\text{N}_2(\text{g}) + 4 \text{H}_2\text{O}(\text{l}) + 4 \text{e}^- \longrightarrow 4 \text{OH}^-(\text{aq}) + \text{N}_2\text{H}_4(\text{aq})$	-1.16
$\text{ClO}^-(\text{aq}) + \text{H}_2\text{O}(\text{l}) + 2 \text{e}^- \longrightarrow$	+0.89	$\text{N}_2(\text{g}) + 5 \text{H}^+(\text{aq}) + 4 \text{e}^- \longrightarrow \text{N}_2\text{H}_5^+(\text{aq})$	-0.23
$\text{Cl}^-(\text{aq}) + 2 \text{OH}^-(\text{aq})$		$\text{NO}_3^-(\text{aq}) + 4 \text{H}^+(\text{aq}) + 3 \text{e}^- \longrightarrow \text{NO}(\text{g}) + 2 \text{H}_2\text{O}(\text{l})$	+0.96
$2 \text{ClO}_3^-(\text{aq}) + 12 \text{H}^+(\text{aq}) + 10 \text{e}^- \longrightarrow$	+1.47	$\text{Na}^+(\text{aq}) + \text{e}^- \longrightarrow \text{Na}(\text{s})$	-2.71
$\text{Cl}_2(\text{g}) + 6 \text{H}_2\text{O}(\text{l})$		$\text{Ni}^{2+}(\text{aq}) + 2 \text{e}^- \longrightarrow \text{Ni}(\text{s})$	-0.28
$\text{Co}^{2+}(\text{aq}) + 2 \text{e}^- \longrightarrow \text{Co}(\text{s})$	-0.277	$\text{O}_2(\text{g}) + 4 \text{H}^+(\text{aq}) + 4 \text{e}^- \longrightarrow 2 \text{H}_2\text{O}(\text{l})$	+1.23
$\text{Co}^{3+}(\text{aq}) + \text{e}^- \longrightarrow \text{Co}^{2+}(\text{aq})$	+1.842	$\text{O}_2(\text{g}) + 2 \text{H}_2\text{O}(\text{l}) + 4 \text{e}^- \longrightarrow 4 \text{OH}^-(\text{aq})$	+0.40
$\text{Cr}^{3+}(\text{aq}) + 3 \text{e}^- \longrightarrow \text{Cr}(\text{s})$	-0.74	$\text{O}_2(\text{g}) + 2 \text{H}^+(\text{aq}) + 2 \text{e}^- \longrightarrow \text{H}_2\text{O}_2(\text{aq})$	+0.68
$\text{Cr}^{3+}(\text{aq}) + \text{e}^- \longrightarrow \text{Cr}^{2+}(\text{aq})$	-0.41	$\text{O}_3(\text{g}) + 2 \text{H}^+(\text{aq}) + 2 \text{e}^- \longrightarrow \text{O}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$	+2.07
$\text{CrO}_7^{2-}(\text{aq}) + 14 \text{H}^+(\text{aq}) + 6 \text{e}^- \longrightarrow$	+1.33	$\text{Pb}^{2+}(\text{aq}) + 2 \text{e}^- \longrightarrow \text{Pb}(\text{s})$	-0.126
$2 \text{Cr}^{3+}(\text{aq}) + 7 \text{H}_2\text{O}(\text{l})$		$\text{PbO}_2(\text{s}) + \text{HSO}_4^-(\text{aq}) + 3 \text{H}^+(\text{aq}) + 2 \text{e}^- \longrightarrow$	+1.685
$\text{CrO}_4^{2-}(\text{aq}) + 4 \text{H}_2\text{O}(\text{l}) + 3 \text{e}^- \longrightarrow$	-0.13	$\text{PbSO}_4(\text{s}) + 2 \text{H}_2\text{O}(\text{l})$	
$\text{Cr}(\text{OH})_3(\text{s}) + 5 \text{OH}^-(\text{aq})$		$\text{PbSO}_4(\text{s}) + \text{H}^+(\text{aq}) + 2 \text{e}^- \longrightarrow \text{Pb}(\text{s}) + \text{HSO}_4^-(\text{aq})$	-0.356
$\text{Cu}^{2+}(\text{aq}) + 2 \text{e}^- \longrightarrow \text{Cu}(\text{s})$	+0.337	$\text{PtCl}_4^{2-}(\text{aq}) + 2 \text{e}^- \longrightarrow \text{Pt}(\text{s}) + 4 \text{Cl}^-(\text{aq})$	+0.73
$\text{Cu}^{2+}(\text{aq}) + \text{e}^- \longrightarrow \text{Cu}^+(\text{aq})$	+0.153	$\text{S}(\text{s}) + 2 \text{H}^+(\text{aq}) + 2 \text{e}^- \longrightarrow \text{H}_2\text{S}(\text{g})$	+0.141
$\text{Cu}^+(\text{aq}) + \text{e}^- \longrightarrow \text{Cu}(\text{s})$	+0.521	$\text{H}_2\text{SO}_3(\text{aq}) + 4 \text{H}^+(\text{aq}) + 4 \text{e}^- \longrightarrow \text{S}(\text{s}) + 3 \text{H}_2\text{O}(\text{l})$	+0.45
$\text{CuI}(\text{s}) + \text{e}^- \longrightarrow \text{Cu}(\text{s}) + \text{I}^-(\text{aq})$	-0.185	$\text{HSO}_4^-(\text{aq}) + 3 \text{H}^+(\text{aq}) + 2 \text{e}^- \longrightarrow$	+0.17
$\text{F}_2(\text{g}) + 2 \text{e}^- \longrightarrow 2 \text{F}^-(\text{aq})$	+2.87	$\text{H}_2\text{SO}_3(\text{aq}) + \text{H}_2\text{O}(\text{l})$	
$\text{Fe}^{2+}(\text{aq}) + 2 \text{e}^- \longrightarrow \text{Fe}(\text{s})$	-0.440	$\text{Sn}^{2+}(\text{aq}) + 2 \text{e}^- \longrightarrow \text{Sn}(\text{s})$	-0.136
$\text{Fe}^{3+}(\text{aq}) + \text{e}^- \longrightarrow \text{Fe}^{2+}(\text{aq})$	+0.771	$\text{Sn}^{4+}(\text{aq}) + 2 \text{e}^- \longrightarrow \text{Sn}^{2+}(\text{aq})$	+0.154
$\text{Fe}(\text{CN})_6^{3-}(\text{aq}) + \text{e}^- \longrightarrow \text{Fe}(\text{CN})_6^{4-}(\text{aq})$	+0.36	$\text{VO}_2^+(\text{aq}) + 2 \text{H}^+(\text{aq}) + \text{e}^- \longrightarrow \text{VO}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l})$	+1.00
$2 \text{H}^+(\text{aq}) + 2 \text{e}^- \longrightarrow \text{H}_2(\text{g})$	0.000	$\text{Zn}^{2+}(\text{aq}) + 2 \text{e}^- \longrightarrow \text{Zn}(\text{s})$	-0.763