

Standard Thermodynamic Values at 25.0°C (298.15 K)

Formula	ΔH_f° (kJ/mol)	ΔG_f° (kJ/mol)	S° (J/K mol)
Ag _(s)	0	0	42.55
Ag _(g)	284.55	245.65	172.997
Ag(NH ₃) ₂ ⁺ _(aq)	-111.29	-17.12	245.2
Ag(S ₂ O ₃) ₂ ³⁻ _(aq)	-1285.7	-1033.65	98.92
Ag ⁺ _(aq)	105.579	77.107	72.68
Ag ⁺ _(g)	1021.73	--	--
Ag ₂ CO _{3(s)}	-505.8	-436.8	167.4
Ag ₂ CrO _{4(s)}	-731.74	-641.76	217.6
Ag ₂ O _(s)	-31.05	-11.2	121.3
Ag ₂ S(s, argentite)	-32.59	-40.67	144.01
Ag ₂ SO _{4(s)}	-715.88	-618.41	200.4
Ag ₃ PO _{4(s)}	--	-879	--
AgBr _(s)	-100.37	-96.9	107.1
AgCl(s, cerargyrite)	-127.068	-109.789	96.2
AgCl ₂ ⁻ _(aq)	-245.2	-215.4	231.4
AgCN _(s)	146	156.9	107.19
AgCNS _(s)	87.9	101.39	131
AgI _(s)	-61.83	-66.19	115.5
AgNO _{3(s)}	-124.39	-33.47	140.92
Al _(s)	0	0	28.33
Al _(g)	326.4	285.7	164.54
Al(OH) _{3(s)}	-1276	--	--
Al ₂ O _{3(s, alumina, alpha)}	-1675.7	-1582.3	50.92
Al ³⁺ _(aq)	-531	-485	-321.7
Al ³⁺ _(g)	5483.17	--	--
AlCl _{3(s)}	-704.2	-628.8	110.67
AlCl _{3(g)}	-583.2	--	--
Ar _(g)	0	0	154.843
As(s, gray, metallic)	0	0	35.1
B _(s)	0	0	5.86
Ba _(s)	0	0	62.8
Ba ²⁺ _(aq)	-537.64	-560.77	9.6
BaC ₂ O _{4(s)}	-1368.6	--	--
BaCO _{3(s, witherite)}	-1216.3	-1137.6	112.1
BaCrO _{4(s)}	-1446	-1345.22	158.6
BaF _{2(s)}	-1207.1	-1156.8	96.36
BaSO _{4(s)}	-1473.2	-1362.2	132.2
Be _(s)	0	0	9.5
BeO _(s)	-609.6	-580.3	14.14
BF _{3(g)}	-1137	-1120.35	254.01
Bi _(s)	0	0	56.74
Bi ₂ S _{3(s)}	-143.1	-140.6	200.4
Bi ³⁺ _(aq)	--	82.8	--
Br ⁻ _(aq)	-121.55	-103.96	82.4
Br _(g)	111.88	82.429	174.91
Br ⁻ _(g)	-219.07	--	--
Br _{2(g)}	30.907	3.11	245.463
Br _{2(l)}	0	0	152.231
Br ₃ ⁻ _(aq)	-130.42	-107.05	215.5
BrO ₃ ⁻ _(aq)	-67.07	18.6	161.71
C(s, diamond)	1.895	2.9	2.377
C(s, graphite)	0	0	5.74
C _(g)	716.682	671.257	158.096
(CH ₃) ₂ O _(g)	-184.05	-112.59	266.38
C ₂ H _{2(g, ethyne)}	226.73	209.2	200.94

C ₂ H ₄ (g,ethene)	52.25	68.12	219.45
C ₂ H ₅ OH(g,ethanol)	-235.1	-168.49	282.7
C ₂ H ₅ OH(l,ethanol)	-277.69	-174.78	160.7
C ₂ H ₆ (g,ethane)	-84.68	-32.82	229.6
C ₂ O ₄ ²⁻ (aq)	-825.1	-673.9	45.6
C ₃ H ₆ (g,propene)	20.2	62.72	266.9
C ₃ H ₈ (g,propane)	-104.5	-23.4	269.9
C ₄ H ₁₀ (g,n-butane)	-126.5	-17.15	310.1
C ₅ H ₁₂ (g,n-pentane)	-146.5	-8.37	348.9
C ₆ H ₁₂ (l,cyclohexane)	-156.3	26.7	204.4
C ₆ H ₆ (g,benzene)	82.9	129.7	269.2
C ₆ H ₆ (l,benzene)	49.0	124.7	172.
C ₈ H ₁₈ (g,octane)	-208.5	16.40	466.7
CH ₃ CHO(l)	-192.3	-128.2	160.2
CH ₃ Cl(g)	-80.83	-57.37	234.58
CH ₃ COO ⁻ (aq)	-486.01	-369.31	-6.3
CH ₃ COOH(aq)	-485.76	-396.46	178.7
CH ₃ COOH(l,acetic acid)	-484.51	-389.9	159.8
CH ₃ NH ₂ (aq)	-70.17	20.77	123.4
CH ₃ NH ₃ ⁺ (aq)	-124.93	-39.86	142.7
CH ₃ OCH ₃ (g)	-184.05	-112.59	266.38
CH ₃ OH(g,methanol)	-200.66	-162	239.7
CH ₃ OH(l,methanol)	-238.66	-166.36	126.8
CH ₄ (g,methane)	-74.81	-50.72	186.264
CHCl ₃ (g)	-103.14	-70.34	295.71
CCl ₄ (l)	-135.44	-65.27	216.4
CN ⁻ (aq)	150.6	172.4	94.1
CNS ⁻ (aq)	76.44	92.71	144.3
CO(g)	-110.525	-137.168	197.674
CO ₂ (aq)	-413.8	-385.98	117.6
CO ₂ (g)	-393.509	-394.359	213.74
CO ₃ ²⁻	-677.14	-527.81	-56.9
COCl ₂ (g,phosgene)	-218.8	-204.6	283.53
Ca(OH) ₂ (s)	-986.09	-898.49	83.39
Ca ²⁺ (aq)	-542.83	-553.58	-53.1
Ca ₃ (PO ₄) ₂ (s)	-4109.9	-3884.7	240.91
CaC ₂ O ₄ (s)	-1360.6	--	--
CaCO ₃ (s, aragonite)	-1207.13	-1127.75	88.7
CaCO ₃ (s, calcite)	-1206.92	-1128.79	92.9
CaF ₂ (s)	-1219.6	-1167.3	68.87
CaO(s)	-635.09	-604.03	39.75
CaSO ₄ (s,anhydrite)	-1434.11	-1321.79	106.7
Cd(s)	0	0	51.76
Cd(CN) ₄ ²⁻ (aq)	428	507.6	322
Cd(g)	2623.54	--	--
Cd(NH ₃) ₄ ²⁺ (aq)	-450.2	-226.1	336.4
Cd(OH) ₂ (s)	-560.7	-473.6	96
Cd ²⁺ (aq)	-75.9	-77.612	-73.2
Cd ²⁺ (g)	112.01	77.41	167.746
CdS(s)	-161.9	-156.5	64.9
Ce(s)	0	0	72
Ce ³⁺ (aq)	-696.2	-672	-205
Ce ⁴⁺ (aq)	-537.2	-503.8	-301
Cl ⁻ (aq)	-167.159	-131.228	56.5
Cl(g)	121.679	105.68	165.198
Cl ⁻ (g)	-233.13	--	--
Cl ₂ (g)	0	0	223.066
Cl ₃ ⁻ (aq)	--	-120.4	--
ClO ₂ (g)	102.5	120.5	256.84
ClO ₄ ⁻ (aq)	-129.33	-8.52	182
Co(alpha,hexagonal)	0	0	30.04
Co(NH ₃) ₆ ³⁺ (aq)	-584.9	-157	146
Co ²⁺	-58.2	-54.4	-113
Co ³⁺	92	134	-305
Cr ₂ O ₇ ²⁻ (aq)	-149.03	-1301.1	261.9

CrO_4^{2-} (aq)	-881.15	-727.75	50.21
Cs (s)	0	0	85.23
Cu (s)	0	0	33.15
$\text{Cu}(\text{CN})_3^{2-}$ (aq)	--	403.8	--
$\text{Cu}(\text{CN})_4^{3-}$ (aq)	--	566.6	--
Cu (g)	338.32	298.58	166.38
$\text{Cu}(\text{NH}_3)_4^{2+}$ (aq)	-348.5	-111.07	273.6
$\text{Cu}(\text{OH})_2$ (s)	-449.8	--	--
Cu^+ (aq)	71.67	49.98	40.6
Cu^{2+} (aq)	64.77	65.49	-99.6
Cu_2O (s, cuprite)	-168.6	-146	93.14
Cu_2S (s, chalcocite)	-79.5	-86.2	120.9
CuC_2O_4 (s)	--	-661.8	--
$\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$ (s, malachite)	-1051.4	-893.6	186.2
CuO (s, tenorite)	-157.3	-129.7	42.63
CuS (s, covellite)	-53.1	-53.6	66.5
F^- (aq)	-332.63	-278.79	-13.8
F (g)	78.99	61.91	158.754
F_2 (g)	-255.39	--	--
F_2 (g)	0	0	202.78
Fe (s)	0	0	27.28
$\text{Fe}(\text{CN})_6^{3-}$ (aq)	561.9	729.4	270.3
$\text{Fe}(\text{CN})_6^{4-}$ (aq)	455.6	695.08	95
$\text{Fe}(\text{CNS})_2^{2+}$ (aq)	23.4	71.1	-130
Fe (g)	416.3	370.7	180.49
$\text{Fe}(\text{OH})_3$ (s)	-823	-696.5	106.7
$\text{Fe}_2(\text{SO}_4)_3$ (s)	-2581.5	--	--
Fe^{2+} (aq)	-89.1	-78.9	-137.7
Fe^{2+} (g)	2749.93	--	--
Fe_2O_3 (s, hematite)	-824.2	-742.2	87.4
Fe^{3+} (aq)	-48.5	-4.7	-315.9
Fe^{3+} (g)	5712.8	--	--
Fe_3C (s, cementite)	25.1	20.1	104.6
Fe_3O_4 (s, magnetite)	-1118.4	-1015.4	146.4
FeCO_3 (s, siderite)	-740.57	-666.67	92.9
$\text{FeO}_{0.9470}$ (s, wuestite)	-266.27	-245.12	57.49
FeS (s, pyrrhotite)	-100	-100.4	60.29
FeS_2 (s, pyrite)	-178.2	-166.9	52.93
FeSO_4 (s)	-928.4	-820.8	107.5
Ga (s)	0	0	40.88
Ge (s)	0	0	31.09
H (g)	217.965	203.247	114.713
H^+ (aq)	0	0	0
H^+ (g)	1536.202	--	--
H_2 (aq)	-4.2	17.6	57.7
H_2 (g)	0	0	130.684
H_2O (g)	-241.818	-228.572	188.825
H_2O (l)	-285.83	-237.129	69.91
H_2O_2 (aq)	-191.17	-134.03	143.9
H_2O_2 (g)	-136.31	-105.57	232.7
H_2O_2 (l)	-187.78	-120.35	109.6
H_2S (g)	-20.63	-33.56	205.79
H_2SO_3 (aq)	-608.81	-537.81	232.2
H_2SO_4 (l)	-813.989	-690.003	156.904
H_3AsO_3 (aq)	-742.2	-639.8	195
H_3AsO_4 (aq)	-902.5	-766	184
HBr (g)	-36.4	-53.45	198.695
HCl (g)	-92.307	-95.299	186.908
HCN (g)	135.1	124.7	201.78
He (aq)	-1.7	19.7	54.4
He (g)	0	0	126.15
HF (g)	-271.1	-273.2	173.779

$\text{HI}_{(g)}$	26.48	1.7	206.594
$\text{HNO}_{2(aq)}$	-119.2	-50.6	135.6
$\text{HS}^{-}_{(aq)}$	-17.6	12.08	62.8
$\text{Hg}(\text{CN})_{4}^{2-}_{(aq)}$	526.3	618.5	305
$\text{Hg}(\text{CNS})_{4}^{2-}_{(aq)}$	326.4	411.4	456
$\text{Hg}_{(l)}$	0	0	76.02
$\text{Hg}^{2+}_{(aq)}$	171.1	164.4	-32.2
$\text{Hg}_2^{2+}_{(aq)}$	172.4	153.52	84.5
$\text{Hg}_2\text{Br}_{2(s)}$	-206.9	-181.075	218
$\text{Hg}_2\text{Cl}_{2(s)}$	-265.22	-210.745	192.5
$\text{Hg}_2\text{SO}_{4(s)}$	-743.12	-625.815	200.66
$\text{HgCl}_{2(s)}$	-224.3	-178.6	146
$\text{HgCl}_4^{2-}_{(aq)}$	-554	-446.8	293
$\text{HgI}_4^{2-}_{(aq)}$	-235.1	-211.7	360
HgS(s, black)	-53.6	-47.7	88.3
HgS(s, red)	-58.2	-50.6	82.4
$\text{I}^{-}_{(aq)}$	-55.19	-51.57	111.3
$\text{I}_{(s)}$	106.838	70.25	180.791
$\text{I}^{-}_{(g)}$	-197	--	--
$\text{I}_{2(aq)}$	22.6	16.4	137.2
$\text{I}_{2(s)}$	0	0	116.135
$\text{I}_{2(g)}$	62.438	19.327	260.69
$\text{I}_3^{-}_{(aq)}$	-51.5	-51.4	239.3
$\text{ICl}_{(g)}$	17.78	-5.46	247.551
$\text{IO}_3^{-}_{(aq)}$	-221.3	-128	118.4
$\text{In}_{(s)}$	0	0	57.82
$\text{Ir}_{(s)}$	0	0	35.48
$\text{K}_{(s)}$	0	0	64.18
$\text{K}_{(g)}$	89.24	60.59	160.336
$\text{K}^{+}_{(aq)}$	-252.38	-283.27	102.5
$\text{K}^{+}_{(g)}$	514.26	--	--
$\text{K}_2\text{O}_{2(s)}$	-494.1	-425.1	102.1
$\text{KBr}_{(s)}$	-393.798	-380.66	95.9
$\text{KCl}_{(s)}$	-436.747	-409.14	82.59
$\text{KClO}_{4(s)}$	-432.75	-303.09	151
$\text{KF}_{(s)}$	-567.27	-537.75	66.57
$\text{KI}_{(s)}$	-327.9	-324.892	106.32
$\text{KNO}_{3(s)}$	-494.63	-394.86	133.05
$\text{KO}_{2(s)}$	-284.93	-239.4	116.7
$\text{KOH}_{(s)}$	-424.764	-379.08	78.7
$\text{Kr}_{(g)}$	0	0	164.082
$\text{Mg}_{(s)}$	0	0	32.68
$\text{Mg}(\text{OH})_{2(s)}$	-924.54	-833.51	63.18
$\text{Mg}^{2+}_{(aq)}$	-466.85	-454.8	-138.1
$\text{Mg}^{2+}_{(g)}$	2348.504	--	--
$\text{MgCO}_{3(s, magnesite)}$	-1095.8	-1012.1	65.7
$\text{MgF}_{2(s)}$	-1123.4	-1070.2	57.24
$\text{MgO}_{(s)}$	-601.7	-569.43	26.94
Mn(s, alpha)	0	0	32.01
$\text{Mn}^{2+}_{(aq)}$	-220.75	-228.1	-73.6
$\text{MnO}_{2(s)}$	-520.03	-465.14	53.05
$\text{MnO}_4^{-}_{(aq)}$	-541.4	-447.2	191.2
MnS(s, green)	-214.2	-218.4	78.2
$\text{Mo}_{(s)}$	0	0	28.66
$\text{Na}_{(s)}$	0	0	51.21
$\text{Na}_{(g)}$	107.32	76.761	153.712
$\text{Na}^{+}_{(aq)}$	-240.12	-261.905	59
$\text{Na}^{+}_{(g)}$	609.358	--	--
$\text{Na}_2\text{CO}_{3(s)}$	-1130.68	-1044.44	134.98
$\text{Na}_2\text{O}_{(s)}$	-414.22	-375.46	75.06
$\text{NaBr}_{(s)}$	-361.062	-348.983	86.82

NaCl _(s)	-411.153	-384.138	72.13
NaF _(s)	-573.647	-543.494	51.46
NaI _(s)	-287.78	-286.06	98.53
NaNO _{2(s)}	-358.65	-284.55	103.8
NaNO _{3(s)}	-467.85	-367	116.52
Ne _(g)	0	0	146.328
N _(g)	472.704	455.563	153.298
N _{2(g)}	0	0	191.61
N ₂ O _(g)	82.05	104.2	219.85
N ₂ O _{4(g)}	9.16	97.89	304.29
N ₂ O _{4(l)}	-19.5	97.54	209.2
N ₂ O _{5(s)}	-43.1	113.9	178.2
N ₂ O _{5(g)}	11.3	115.1	355.7
NH _{3(aq)}	-80.29	-26.5	111.3
NH _{3(g)}	-46.11	-16.45	192.45
NH ₄ ⁺ _(aq)	-132.51	-79.31	113.4
NH ₄ Cl _(s)	-314.43	-202.87	94.6
NO _(g)	90.25	86.55	210.761
NO _{2(g)}	33.18	51.31	240.06
NO ₃ ⁻ _(aq)	-205	-108.74	146.4
NOBr _(g)	82.17	82.42	273.66
NOCl _(g)	51.71	66.08	261.69
Ni _(s)	0	0	29.87
Ni(CN) ₄ ²⁻ _(aq)	367.8	472.1	218
Ni(NH ₃) ₄ ²⁺ _(aq)	-438.9	--	258.6
Ni(NH ₃) ₆ ²⁺ _(aq)	-630.1	-255.7	394.6
Ni ²⁺ _(aq)	-54	-45.6	-128.9
NiS _(s)	-82	-79.5	52.97
O _(g)	249.17	231.731	161.055
O _{2(aq)}	-11.7	16.4	110.9
O _{2(g)}	0	0	205.138
O ₃ (ozone)	142.7	163.2	238.93
OH ⁻ _(aq)	-229.994	-157.244	-10.75
Os _(s)	0	0	32.6
P(c,white)	0	0	41.09
P _(g)	314.64	278.25	163.193
PCl _{3(g)}	-287	-267.8	311.78
PCl _{5(g)}	-374.9	-305	364.58
PH _{3(g)}	5.4	13.4	210.23
PO ₄ ³⁻ _(aq)	-1277.4	-1018.7	-222
Pa _(s)	0	0	51.9
Pb _(s)	0	0	64.81
Pb _(g)	195	161.9	175.373
Pb(OH) _{2(s)}	--	-452.2	--
Pb(OH) ₃ ⁻ _(aq)	--	-575.6	--
Pb ²⁺ _(aq)	-1.7	-24.43	10.5
Pb ₃ O _{4(s)}	-718.4	-601.2	211.3
PbBr _{2(s)}	-278.9	-261.92	161.5
PbCl _{2(s)}	-359.41	-314.1	-136
PbO(s,red)	-218.99	-189.93	66.5
PbO(s,yellow,litharge)	-217.32	-187.89	68.7
PbO _{2(s)}	-277.4	-217.33	68.6
PbS(s,galena)	-100.4	-98.7	91.2
PbSO _{4(s)}	-919.94	-813.14	148.57
Pd _(s)	0	0	37.57
Pt _(s)	0	0	41.63
Ra _(s)	0	0	71
Rb _(s)	0	0	76.78
Re _(s)	0	0	36.86
Rh _(s)	0	0	31.51
Rn _(g)	0	0	176.21

Ru _(s)	0	0	28.53
S(s,monoclinic)	0.33	--	--
S(s,rhombic)	0	0	31.8
S _(g)	278.805	238.25	167.821
S ²⁻ _(aq)	33.1	85.8	-14.6
S ₂ O ₃ ²⁻ _(aq)	-648.5	-522.5	67
S ₄ O ₆ ²⁻ _(aq)	-1224.2	-1040.4	257.3
SO ₂ _(g)	-296.83	-300.194	248.22
SO ₂ Cl ₂ _(g)	-364	-320	311.94
SO ₃ _(g)	-395.72	-371.06	256.76
SO ₃ _(l)	-441.04	-373.75	113.8
SO ₄ ²⁻ _(aq)	-909.27	-744.53	20.1
SF ₆ _(g)	-1209	-1105.3	291.82
Sb _(s)	0	0	45.69
Sc _(s)	0	0	34.64
Se(s,black)	0	0	42.442
Si _(s)	0	0	18.83
SiO ₂ (s,quartz)	-910.94	-856.64	41.84
Sn(s,grey)	-2.09	0.13	44.14
Sn(s,white)	0	0	51.55
Sn ²⁺ _(aq)	-8.8	-27.2	-17
Sn ⁴⁺ _(aq)	30.5	2.5	-117
SnO _(s)	-285.8	-256.9	56.5
SnO ₂ (s,cassiterite)	-580.7	-519.6	52.3
SnS _(s)	-100	-98.3	77
Sr _(s)	0	0	52.3
Sr ²⁺ _(aq)	-545.8	-559.48	-32.6
Ta _(s)	0	0	41.51
Tc _(s)	0	0	--
Te _(s)	0	0	49.71
Th _(s)	0	0	53.39
ThO ₂ _(s)	-1226.4	-1168.77	65.23
Ti _(s)	0	0	30.63
Ti _(s)	0	0	64.18
Ti ⁺ _(aq)	5.36	-32.4	125.5
Ti ⁺ _(g)	777.764	--	--
Ti ³⁺ _(aq)	196.6	214.6	-192
Ti ³⁺ _(g)	5639.2	--	--
U _(s)	0	0	50.21
U ⁴⁺ _(aq)	-591.2	-531	-410
UO ₂ _(s)	-1084.9	-1031.7	77.08
UO ₂ ²⁺ _(aq)	-1019.6	-953.5	-97.5
V _(s)	0	0	28.91
VO ²⁺ _(aq)	-486.6	-446.4	-133.9
VO ₂ ⁺ _(aq)	-649.8	-587	-42.3
W _(s)	0	0	32.64
WO ₂ _(s)	-589.69	-533.89	50.54
WO ₃ _(s)	-842.87	-764.03	75.9
Xe _(g)	0	0	169.683
Zn _(s)	0	0	41.63
Zn(CN) ₄ ²⁻ _(aq)	342.3	446.9	226
Zn(NH ₃) ₄ ²⁺ _(aq)	-533.5	-301.9	301
Zn(OH) ₄ ²⁻ _(aq)	--	-858.52	--
Zn ²⁺ _(aq)	-153.89	-147.06	-112.1
Zn ²⁺ _(g)	2782.78	--	--
ZnO _(s)	-348.28	-318.3	43.64
ZnS(s, sphalerite)	-205.98	-201.29	57.7
ZnS(s, wurtzite)	-192.63	--	--
Zr _(s)	0	0	53.39