

Thermodynamic Quantities (all values at 25°C)

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Substance	ΔH_f° (kJ/mol)	ΔG_f° (kJ/mol)	S(J/molK)	Substance	ΔH_f° (kJ/mol)	ΔG_f° (kJ/mol)	S(J/molK)
Aluminum				Cesium			
Al(s)	0	0	+28.32	Cs(g)	+76.50	+49.53	+175.6
Al ³⁺ (aq)	-538.4	-481.2	-325	Cs(L)	+2.09	+0.03	+92.07
AlCl ₃ (s)	-705.6	-630.0	+109.3	Cs(s)	0	0	+85.15
Al ₂ O ₃ (s)	-1669.8	-1576.5	+51.00	CsCl(s)	-442.8	-414.4	+101.2
Barium				Chlorine			
Ba(s)	0	0	+63.2	Cl(g)	+121.7	+105.7	+165.2
Ba ²⁺ (aq)	-537.6	-560.7	+13	Cl ⁻ (aq)	-167.2	-131.2	+56.5
BaCO ₃ (s)	-1216.3	-1137.6	+112.1	ClO ₃ ⁻ (aq)	-104.0		
BaO(s)	-553.5	-525.1	+70.42	ClO ₄ ⁻ (aq)	-129.3		
Beryllium				Chromium			
Be(s)	0	0	+9.44	Cr(g)	+397.5	+352.6	+174.2
BeO(s)	-608.4	-579.1	+13.77	Cr(s)	0	0	+23.6
Be(OH) ₂ (s)	-905.8	-817.9	+50.21	CrO ₄ ²⁻ (aq)	-881.2	-706.3	+38
Bromine				Cobalt			
Br(g)	+111.8	+82.38	+174.9	Co(g)	+439	+393	+179
Br ⁻ (aq)	-121.6	-102.8	+80.71	Co(s)	0	0	+28.4
Br ₂ (g)	+30.71	+3.14	+245.3	Copper			
Br ₂ (L)	0	0	+152.3	Cu(g)	+338.4	+298.6	+166.3
HBr(g)	-36.23	-53.22	+198.49	Cu(s)	0	0	+33.30
Calcium				Fluorine			
Ca(g)	+179.3	+145.5	+154.8	F(g)	+80.0	+61.9	+158.7
Ca(s)	0	0	+41.4	F ⁻ (aq)	-332.6	-278.8	+13.8
Ca ²⁺ (aq)	-543.0	-553.0	-55.2	F ₂ (g)	0	0	+202.7
CaCO ₃ (s, calcite)	-1207.1	-1128.76	+92.88	HF(g)	-268.61	-270.70	+173.51
CaCl ₂ (s)	-795.8	-748.1	+104.6	Hydrogen			
CaF ₂ (s)	-1219.6	-1167.3	+68.87	H(g)	+217.94	+203.26	+114.60
CaO(s)	-635.5	-604.17	+39.75	H ⁺ (aq)	0	0	0
Ca(OH) ₂ (s)	-986.2	-898.5	+83.4	H ⁺ (g)	+1536.2	+1517.0	+108.9
CaSO ₄ (s)	-1434.0	-1321.8	+106.7	H ₂ (g)	0	0	+130.58
Cadmium				Iodine			
Cd ²⁺ (aq)	-75.9	-77.7	-61.1	I(g)	+106.60	+70.16	+180.66
Carbon				Hydrogen			
C(g)	+718.4	+672.9	+158.0	I ⁻ (aq)	-55.19	-51.57	+111.3
C(s, diamond)	+1.88	+2.84	+2.43	I ₂ (g)	+62.25	+19.37	+260.57
C(s, graphite)	0	0	+5.69	I ₂ (s)	0	0	+116.73
CO ₃ ²⁻ (aq)	-677.1	-528.1	-53.1	HI(g)	+25.94	+1.30	+206.3
HCO ₃ ⁻ (aq)	-692.0	+587.1	+95.0	Hydrogen			
CCl ₄ (g)	-106.7	-64.0	+309.4	H ₂ (g)	+217.94	+203.26	+114.60
CCl ₄ (L)	-139.3	-68.6	+214.4	H ⁺ (aq)	0	0	0
CF ₄ (g)	-679.9	-635.1	+262.3	H ⁺ (g)	+1536.2	+1517.0	+108.9
CH ₄ (g)	-74.8	-50.8	+186.3	H ₂ (g)	0	0	+130.58
C ₂ H ₂ (g)	+226.7	+209.2	+200.8	Iodine			
C ₂ H ₄ (g)	+52.30	+68.11	+219.4	I(g)	+106.60	+70.16	+180.66
C ₂ H ₆ (g)	-84.68	-32.89	+229.5	I ⁻ (aq)	-55.19	-51.57	+111.3
C ₃ H ₈ (g)	-103.85	-23.47	+269.9	I ₂ (g)	+62.25	+19.37	+260.57
C ₄ H ₁₀ (g)	-124.73	-15.71	+310.0	I ₂ (s)	0	0	+116.73
C ₄ H ₁₀ (L)	-147.6	-15.0	+231.0	HI(g)	+25.94	+1.30	+206.3
C ₆ H ₆ (g)	+82.9	+129.7	+269.2	Hydrogen			
C ₆ H ₆ (L)	+49.0	+124.5	+172.8	H ₂ (g)	+217.94	+203.26	+114.60
CH ₃ OH(g)	-201.2	-161.9	+237.6	H ⁺ (aq)	0	0	0
CH ₃ OH(L)	-238.6	-166.23	+126.8	H ⁺ (g)	+1536.2	+1517.0	+108.9
C ₂ H ₅ OH(g)	-235.1	-168.5	+282.7	H ₂ (g)	0	0	+130.58
C ₂ H ₅ OH(L)	-277.7	-174.76	+160.7	Iodine			
C ₆ H ₁₂ O ₆ (s)	-1273.02	-910.4	+212.1	I(g)	+106.60	+70.16	+180.66
CO(g)	-110.5	-137.2	+197.9	I ⁻ (aq)	-55.19	-51.57	+111.3
CO ₂ (g)	-393.5	-394.4	+213.6	I ₂ (g)	+62.25	+19.37	+260.57
HC ₂ H ₃ O ₂ (L)	-487.0	-392.4	+159.8	I ₂ (s)	0	0	+116.73
				HI(g)	+25.94	+1.30	+206.3

Thermodynamic Quantities (all values at 25°C)

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Substance	ΔH_f° (kJ/mol)	ΔG_f° (kJ/mol)	S (J/molK)	Substance	ΔH_f° (kJ/mol)	ΔG_f° (kJ/mol)	S (J/molK)
Iron				Nitrogen			
Fe(g)	+415.5	+369.8	+180.66	N(g)	+472.7	+455.5	+153.3
Fe(s)	0	0	+27.15	N ₂ (g)	0	0	+191.50
Fe ²⁺ (aq)	-89.1	-84.93	+113.4	NH ₃ (aq)	-80.29	-26.50	+111.3
Fe ³⁺ (aq)	-45.8	-10.54	+293.3	NH ₃ (g)	-46.19	-16.66	+192.5
FeCl ₂ (s)	-341.8	-302.3	+117.9	NH ₄ ⁺ (aq)	-132.5	-79.31	+113.4
FeCl ₃ (s)	-400	-334	+142.3	N ₂ H ₄ (g)	+95.40	+159.4	+238.5
FeO(s)	-271.9	-255.2	+60.75	NH ₄ CN(s)	0.0		
Fe ₂ O ₃ (s)	-822.16	-740.98	+89.96	NH ₄ Cl(s)	-314.4	-203.0	+94.6
Fe ₃ O ₄ (s)	-1117.1	-1014.2	+146.4	NH ₄ NO ₃ (s)	-365.6	-184.0	+151
FeS ₂ (s)	-171.5	-160.1	+52.92	NO(g)	+90.37	+86.71	+210.62
				NO ₂ (g)	+33.84	+51.84	+240.45
				NO ₂ ⁻ (aq)	-104.6		
				NO ₃ ⁻ (aq)	-205.0		+147
Lead				Oxygen			
Pb(s)	0	0	+68.85	O(g)	+247.5	+230.1	+161.0
Pb ²⁺ (aq)	-1.7	-24.3	+18.5	O ₂ (g)	0	0	+205.0
PbBr ₂ (s)	-227.4	-260.7	+161	O ₃ (g)	+142.3	+163.4	+237.6
PbCl ₂ (s)	-359.4			OH ⁻ (aq)	-230.0	-157.3	+10.7
PbCO ₃ (s)	-699.1	-625.5	+131.0	H ₂ O(g)	-241.82	-228.57	+188.83
Pb(NO ₃) ₂ (aq)	-421.3	-246.9	+303.3	H ₂ O(L)	-285.83	-237.13	+69.91
Pb(NO ₃) ₂ (aq)	-451.9			H ₂ O ₂ (g)	-136.10	-105.48	+232.9
PbO(s)	-219.0	-187.9	+68.70	H ₂ O ₂ (L)	-187.8	-120.4	+109.6
PbO ₂ (s)	-277.4						
				Phosphorus			
Lithium				P(g)	+316.4	+280.0	+163.2
Li(g)	+159.3	+126.6	+138.8	P ₂ (g)	+144.3	+103.7	+218.1
Li(s)	0	0	+29.09	P ₄ (g)	+58.9	+24.4	+280
Li ⁺ (aq)	-278.5	-273.4	+12.2	P ₄ (s, red)	-17.46	-12.03	+22.85
Li ⁺ (g)	+685.7	+648.5	+133.0	P ₄ (s, white)	0	0	+41.08
LiCl(s)	-408.3	-384.0	+59.30	PCl ₃ (g)	-288.07	-269.6	+311.4
				PCl ₃ (L)	-319..6	-272.4	+217
				PF ₅ (g)	-1594.4	-1520.7	+300.8
				PH ₃ (g)	+5.4	+13.4	+210.2
				P ₄ O ₆ (s)	-1640.1		
				P ₄ O ₁₀ (s)	-2940.1	-2675.2	+228.9
				POCl ₃ (g)	-542.2	-502.5	+325
				POCl ₃ (L)	-597.0	-520.9	+222
				H ₃ PO ₄ (aq)	-1288.3	-1142.6	+158.2
				PO ₄ ³⁻ (aq)	-1277.4	-1013	-218
				HPO ₄ ²⁻ (aq)	-1292.1	-1082	-36
				H ₂ PO ₄ ⁻ (aq)	-1296.3	-1135	+89.1
Magnesium							
Mg(g)	+147.1	+112.5	+148.6				
Mg(s)	0	0	+32.51				
Mg ²⁺ (aq)	-466.8	-456.0	-137				
MgCl ₂ (s)	-641.6	-592.1	+89.6				
MgO(s)	-601.8	-569.6	+26.8				
Mg(OH) ₂ (s)	-924.7	-833.7	+63.24				
MgSO ₄ (s)	-1284.9	-1170.6	+96.5				
Manganese							
Mn(g)	+280.7	+238.5	+173.6				
Mn(s)	0	0	+32.0				
Mn ²⁺ (aq)	-220.8	-223	-84				
MnO(s)	-385.2	-362.9	+59.7				
MnO ₂ (s)	-519.6	-464.8	+53.14				
MnO ₄ ⁻ (aq)	-541.4	-425.1	+190				
Mg(OH) ₂ (s)	-924.7	-833.7	+63.24				
Mercury							
Hg(g)	+60.83	+31.76	+174.89				
Hg(L)	0	0	+77.40				
Hg ²⁺ (aq)	+167	+164	+65.7				
HgCl ₂ (s)	-230.1	-184.0	+144.5				
Hg ₂ Cl ₂ (s)	-264.9	-210.5	+192.5				
Nickel							
Ni(g)	+429.7	+384.5	+182.1				
Ni(s)	0	0	+29.9				
Ni ²⁺ (aq)	-54.0						
NiCl ₂ (s)	-305.3	-259.0	+97.65				
NiO(s)	-239.7	-211.7	+37.99				

Thermodynamic Quantities (all values at 25°C)

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Substance	ΔH_f° (kJ/mol)	ΔG_f° (kJ/mol)	S (J/molK)	Substance	ΔH_f° (kJ/mol)	ΔG_f° (kJ/mol)	S (J/molK)
Potassium				Sulfur			
K _(g)	+89.99	+61.17	+160.2	S _(s, rhombic)	0	0	+31.88
K _(s)	0	0	+64.67	S ²⁻ _(aq)	+41.8	+83.7	+22
K ⁺ _(aq)	-252.4	-282.28	+101.2	S _{8(g)}	+102.3	+49.7	+430.9
KCl _(s)	-435.9	-408.3	+82.7	SO _{2(g)}	-296.9	-300.4	+248.5
KClO _{3(s)}	-391.2	-289.9	+143.0	SO _{3(g)}	-395.2	-370.4	+256.2
KClO _{3(aq)}	-349.5	-284.9	+265.7	SO ₄ ²⁻ _(aq)	-909.3	-744.5	+18.5
K ₂ CO _{3(s)}	-1150.18	-1064.58	+155.44	SOCl _{2(L)}	-245.6		
KNO _{3(s)}	-492.70	-393.13	+288.1	H ₂ S _(g)	-20.17	-33.01	+205.6
K ₂ O _(s)	-363.2	-322.1	+94.14	H ₂ SO _{4(aq)}	-909.3	-744.5	+20.1
KO _{2(s)}	-284.5	-240.6	+122.5	H ₂ SO _{4(L)}	-814.0	-689.9	+156.1
K ₂ O _{2(s)}	-495.8	-429.8	+113.0	HSO ₄ ²⁻ _(aq)	-887.3	-752.9	+126.9
KOH _(s)	-424.7	-378.9	+78.91	Tin			
KOH _(aq)	-482.4	-440.5	+91.6	Sn ²⁺ _(aq)	-8.8		-16.7
Rubidium				Titanium			
Rb _(g)	+85.8	+55.8	+170.0	Ti _(g)	+468	+422	+180.3
Rb _(s)	0	0	+78.78	Ti _(s)	0	0	+30.76
RbCl _(s)	-430.5	-412.0	+92	TiCl _{4(g)}	-763.2	-726.8	+354.9
RbClO _{3(s)}	-392.4	-292.0	+152	TiCl _{4(L)}	-804.2	-728.1	+221.9
Scandium				Vanadium			
Sc _(g)	+377.8	+336.1	+74.7	V _(g)	+514.2	+453.1	+182.2
Sc _(s)	0	0	+34.6	V _(s)	0	0	+28.9
Selenium				Zinc			
H ₂ Se _(g)	+29.7	+15.9	+219.0	Zn _(g)	+130.7	+95.2	+160.9
Silicon				Zn _(s)	0	0	+41.63
Si _(g)	+368.2	+323.9	+167.8	Zn ²⁺ _(aq)	-153.9	-147.21	-106.9
Si _(s)	0	0	+18.7	ZnCl _{2(s)}	-415.1	-369.4	+111.5
SiC _(s)	-73.22	-70.85	+16.61	ZnO _(s)	-348.0	-318.2	+43.9
SiCl _{4(L)}	-640.1	-572.8	+239.3				
SiO _{2(s, quartz)}	-910.9	-856.5	+41.84				
Silver							
Ag _(s)	0	0	+42.55				
Ag ⁺ _(aq)	+105.90	+77.11	+73.93				
AgCl _(s)	-127.0	-109.70	+96.11				
Ag ₂ O _(s)	-31.05	-11.20	+121.3				
AgNO _{3(s)}	-124.4	-33.41	+140.9				
Sodium							
Na _(g)	107.7	+77.3	+153.7				
Na _(s)	0	0	+51.45				
Na ⁺ _(aq)	-240.1	-261.9	+59.0				
Na ⁺ _(g)	+609.3	+574.3	+148.0				
NaBr _(aq)	-360.6	-364.7	+141.0				
NaBr _(s)	-361.4	-349.3	+86.82				
Na ₂ CO _{3(s)}	-1130.9	-1047.7	+136.0				
NaCl _(aq)	-407.1	-393.0	+115.5				
NaCl _(s)	-410.9	-384.0	+72.33				
NaHCO _{3(s)}	-947.7	-851.8	+102.1				
NaNO _{3(aq)}	-446.2	-372.4	+207				
NaNO _{3(s)}	-467.9	-367.0	+116.5				
NaOH _(aq)	-469.6	-419.2	+49.8				
NaOH _(s)	-425.6	-379.5	+64.46				
Strontium							
SrO _(s)	-592.0	-561.9	+54.9				
Sr _(g)	+164.4	+110.0	+164.6				

Thermodynamic Quantities

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Average Bond Enthalpies (kJ/mole)							
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=O	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						