Thermodynamic Quantities (all values at 25°C)

Substance	ΔH^o_f(kJ/mol)	ΔG^o_f(kJ/mol)	S^o(J/molK)
Aluminum			
$Al_{(s)}$	0	0	+28.32
$Al^{3+}_{(aq)}$	−538.4	−481.2	−325
$AlCl_{3(s)}$	−705.6	−630.0	+109.3
$Al_2O_{3(s)}$	−1669.8	−1576.5	+51.00
Barium			
$Ba_{(s)}$	0	0	+63.2
$Ba^{2+}_{(aq)}$	−537.6	−560.7	+13
$BaCO_{3(s)}$	−1216.3	−1137.6	+112.1
$BaO_{(s)}$	−553.5	−525.1	+70.42
Beryllium			
$Be_{(s)}$	0	0	+9.44
$BeO_{(s)}$	−608.4	−579.1	+13.77
$Be(OH)_{2(s)}$	−905.8	−817.9	+50.21
Bromine			
$Br_{(g)}$	+111.8	+82.38	+174.9
$Br^-_{(aq)}$	−121.6	−102.8	+80.71
$Br_{2(g)}$	+30.71	+3.14	+245.3
$Br_{2(L)}$	0	0	+152.3
$HBr_{(g)}$	−36.23	−53.22	+198.49
Calcium			
$Ca_{(g)}$	+179.3	+145.5	+154.8
$Ca_{(s)}$	0	0	+41.4
$Ca^{2+}_{(aq)}$	−543.0	−553.0	−55.2
$CaCO_{3(s,\ calcite)}$	−1207.1	−1128.76	+92.88
$CaCl_{2(s)}$	−795.8	−748.1	+104.6
$CaF_{2(s)}$	−1219.6	−1167.3	+68.87
$CaO_{(s)}$	−635.5	−604.17	+39.75
$Ca(OH)_{2(s)}$	−986.2	−898.5	+83.4
$CaSO_{4(s)}$	−1434.0	−1321.8	+106.7
Cadmium			
$Cd^{+2}_{(aq)}$	−75.9	−77.7	−61.1
Carbon			
$C_{(g)}$	+718.4	+672.9	+158.0
$C_{(s,\ diamond)}$	+1.88	+2.84	+2.43
$C_{(s,\ graphite)}$	0	0	+5.69
$CO_3^{2-}{}_{(aq)}$	−677.1	−528.1	−53.1
$HCO_3^-{}_{(aq)}$	−692.0	+587.1	+95.0
$CCl_{4(g)}$	−106.7	−64.0	+309.4
$CCl_{4(L)}$	−139.3	−68.6	+214.4
$CF_{4(g)}$	−679.9	−635.1	+262.3
$CH_{4(g)}$	−74.8	−50.8	+186.3
$C_2H_{2(g)}$	+226.7	+209.2	+200.8
$C_2H_{4(g)}$	+52.30	+68.11	+219.4
$C_2H_{6(g)}$	−84.68	-32.89	+229.5
$C_3H_{8(g)}$	−103.85	-23.47	+269.9
$C_4H_{10(g)}$	−124.73	-15.71	+310.0
$C_4H_{10(L)}$	−147.6	-15.0	+231.0
$C_6H_{6(g)}$	+82.9	+129.7	+269.2
$C_6H_{6(L)}$	+49.0	+124.5	+172.8
$CH_3OH_{(g)}$	−201.2	−161.9	+237.6
$CH_3OH_{(L)}$	−238.6	−166.23	+126.8
$C_2H_5OH_{(g)}$	−235.1	−168.5	+282.7
$C_2H_5OH_{(L)}$	−277.7	−174.76	+160.7
$C_6H_{12}O_{6(s)}$	−1273.02	−910.4	+212.1
$CO_{(g)}$	−110.5	−137.2	+197.9
$CO_{2(g)}$	−393.5	−394.4	+213.6
$HC_2H_3O_{2(L)}$	−487.0	−392.4	+159.8

Substance	ΔH^o_f(kJ/mol)	ΔG^o_f(kJ/mol)	S^o(J/molK)
Cesium			
$Cs_{(g)}$	+76.50	+49.53	+175.6
$Cs_{(L)}$	+2.09	+0.03	+92.07
$Cs_{(s)}$	0	0	+85.15
$CsCl_{(s)}$	−442.8	−414.4	+101.2
Chlorine			
$Cl_{(g)}$	+121.7	+105.7	+165.2
$Cl^-_{(aq)}$	−167.2	−131.2	+56.5
$ClO_3^-{}_{(aq)}$	−104.0		
$ClO_4^-{}_{(aq)}$	−129.3		
$Cl_{2(g)}$	0	0	+222.96
$HCl_{(aq)}$	−167.2	−131.2	+56.5
$HCl_{(g)}$	−92.30	−95.27	+186.69
Chromium			
$Cr_{(g)}$	+397.5	+352.6	+174.2
$Cr_{(s)}$	0	0	+23.6
$CrO_4^{2-}{}_{(aq)}$	−881.2	-706.3	+38
$Cr_2O_7^{2-}{}_{(aq)}$	−1490.3	−1257	+214
$Cr_2O_{3(s)}$	−1139.7	−1058.1	+81.2
Cobalt			
$Co_{(g)}$	+439	+393	+179
$Co_{(s)}$	0	0	+28.4
Copper			
$Cu_{(g)}$	+338.4	+298.6	+166.3
$Cu_{(s)}$	0	0	+33.30
$Cu^+_{(aq)}$	+71.7	50.2	−26
$Cu^{2+}_{(aq)}$	+64.8	+65.0	−98.7
$CuCl_{2(s)}$	−205.9	−161.7	+108.1
$CuO_{(s)}$	−156.1	−128.3	+42.59
$Cu(OH)_{2(s)}$	−450.0		+108
$Cu_2O_{(s)}$	−170.7	−147.9	+92.36
Fluorine			
$F_{(g)}$	+80.0	+61.9	+158.7
$F^-_{(aq)}$	−332.6	−278.8	+13.8
$F_{2(g)}$	0	0	+202.7
$HF_{(g)}$	−268.61	−270.70	+173.51
Hydrogen			
$H_{(g)}$	+217.94	+203.26	+114.60
$H^+_{(aq)}$	0	0	0
$H^+_{(g)}$	+1536.2	+1517.0	+108.9
$H_{2(g)}$	0	0	+130.58
Iodine			
$I_{(g)}$	+106.60	+70.16	+180.66
$I^-_{(aq)}$	−55.19	−51.57	+111.3
$I_{2(g)}$	+62.25	+19.37	+260.57
$I_{2(s)}$	0	0	+116.73
$HI_{(g)}$	+25.94	+1.30	+206.3

Thermodynamic Quantities (all values at 25°C)

Substance	ΔH°_f(kJ/mol)	ΔG°_f(kJ/mol)	S°(J/molK)
Iron			
Fe(g)	+415.5	+369.8	+180.66
Fe(s)	0	0	+27.15
$Fe^{2+}_{(aq)}$	−89.1	−84.93	+113.4
$Fe^{3+}_{(aq)}$	−45.8	−10.54	+293.3
$FeCl_{2(s)}$	−341.8	−302.3	+117.9
$FeCl_{3(s)}$	−400	−334	+142.3
$FeO_{(s)}$	−271.9	−255.2	+60.75
$Fe_2O_{3(s)}$	−822.16	−740.98	+89.96
$Fe_3O_{4(s)}$	−1117.1	−1014.2	+146.4
$FeS_{2(s)}$	−171.5	−160.1	+52.92
Lead			
$Pb_{(s)}$	0	0	+68.85
$Pb^{2+}_{(aq)}$	−1.7	−24.3	+18.5
$PbBr_{2(s)}$	−227.4	−260.7	+161
$PbCl_{2(s)}$	−359.4		
$PbCO_{3(s)}$	−699.1	−625.5	+131.0
$Pb(NO_3)_{2(aq)}$	−421.3	−246.9	+303.3
$Pb(NO_3)_{2(aq)}$	−451.9		
$PbO_{(s)}$	−219.0	−187.9	+68.70
$PbO_{2(s)}$	−277.4		
Lithium			
$Li_{(g)}$	+159.3	+126.6	+138.8
$Li_{(s)}$	0	0	+29.09
$Li^+_{(aq)}$	−278.5	−273.4	+12.2
$Li^+_{(g)}$	+685.7	+648.5	+133.0
$LiCl_{(s)}$	−408.3	−384.0	+59.30
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
$Hg_2Cl_{2(s)}$	−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

Substance	ΔH°_f(kJ/mol)	ΔG°_f(kJ/mol)	S°(J/molK)
Nitrogen			
$N_{(g)}$	+472.7	+455.5	+153.3
$N_{2(g)}$	0	0	+191.50
$NH_{3(aq)}$	−80.29	−26.50	+111.3
$NH_{3(g)}$	−46.19	−16.66	+192.5
$NH_4^+{}_{(aq)}$	−132.5	−79.31	+113.4
$N_2H_{4(g)}$	+95.40	+159.4	+238.5
$NH_4CN_{(s)}$	0.0		
$NH_4Cl_{(s)}$	−314.4	−203.0	+94.6
$NH_4NO_{3(s)}$	−365.6	−184.0	+151
$NO_{(g)}$	+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
$N_2O_{4(g)}$	+9.66	+98.28	+304.3
$NOCl_{(g)}$	+52.6	+66.3	+264
$HNO_{3(aq)}$	−206.6	−110.5	+146
$HNO_{3(L)}$	−174.1		
$HNO_{3(g)}$	−134.3	−73.94	+266.4
Oxygen			
$O_{(g)}$	+247.5	+230.1	+161.0
$O_{2(g)}$	0	0	+205.0
$O_{3(g)}$	+142.3	+163.4	+237.6
$OH^-_{(aq)}$	−230.0	−157.3	+10.7
$H_2O_{(g)}$	−241.82	−228.57	+188.83
$H_2O_{(L)}$	−285.83	−237.13	+69.91
$H_2O_{(s)}$	−291.83	−304.0	+41
$H_2O_{2(g)}$	−136.10	−105.48	+232.9
$H_2O_{2(L)}$	−187.8	−120.4	+109.6
Phosphorus			
$P_{(g)}$	+316.4	+280.0	+163.2
$P_{2(g)}$	+144.3	+103.7	+218.1
$P_{4(g)}$	+58.9	+24.4	+280
$P_{4(s,\ red)}$	−17.46	−12.03	+22.85
$P_{4(s,\ white)}$	0	0	+41.08
$PCl_{3(g)}$	−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
$P_4O_{6(s)}$	−1640.1		
$P_4O_{10(s)}$	−2940.1	−2675.2	+228.9
$POCl_{3(g)}$	−542.2	−502.5	+325
$POCl_{3(L)}$	−597.0	−520.9	+222
$H_3PO_{4(aq)}$	−1288.3	−1142.6	+158.2
$PO_4^{3-}{}_{(aq)}$	−1277.4	−1013	−218
$HPO_4^{2-}{}_{(aq)}$	−1292.1	−1082	−36
$H_2PO_4^-{}_{(aq)}$	−1296.3	−1135	+89.1

Thermodynamic Quantities (all values at 25°C)

Substance	ΔH^o_f(kJ/mol)	ΔG^o_f(kJ/mol)	S^o(J/molK)
Potassium			
$K_{(g)}$	+89.99	+61.17	+160.2
$K_{(s)}$	0	0	+64.67
$K^+_{(aq)}$	−252.4	−282.28	+101.2
$KCl_{(s)}$	−435.9	−408.3	+82.7
$KClO_{3(s)}$	−391.2	−289.9	+143.0
$KClO_{3(aq)}$	−349.5	−284.9	+265.7
$K_2CO_{3(s)}$	−1150.18	−1064.58	+155.44
$KNO_{3(s)}$	−492.70	−393.13	+288.1
$K_2O_{(s)}$	−363.2	−322.1	+94.14
$KO_{2(s)}$	−284.5	−240.6	+122.5
$K_2O_{2(s)}$	−495.8	−429.8	+113.0
$KOH_{(s)}$	−424.7	−378.9	+78.91
$KOH_{(aq)}$	−482.4	-440.5	+91.6
Rubidium			
$Rb_{(g)}$	+85.8	+55.8	+170.0
$Rb_{(s)}$	0	0	+78.78
$RbCl_{(s)}$	−430.5	−412.0	+92
$RbClO_{3(s)}$	−392.4	−292.0	+152
Scandium			
$Sc_{(g)}$	+377.8	+336.1	+74.7
$Sc_{(s)}$	0	0	+34.6
Selenium			
$H_2Se(g)$	+29.7	+15.9	+219.0
Silicon			
$Si_{(g)}$	+368.2	+323.9	+167.8
$Si_{(s)}$	0	0	+18.7
$SiC_{(s)}$	−73.22	−70.85	+16.61
$SiCl_{4(L)}$	−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
$Ag_2O_{(s)}$	−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
$Na_2CO_{3(s)}$	−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

Substance	ΔH^o_f(kJ/mol)	ΔG^o_f(kJ/mol)	S^o(J/molK)
Sulfur			
$S_{(s,\ rhombic)}$	0	0	+31.88
$S^{2-}_{(aq)}$	+41.8	+83.7	+22
$S_{8(g)}$	+102.3	+49.7	+430.9
$SO_{2(g)}$	−296.9	−300.4	+248.5
$SO_{3(g)}$	−395.2	−370.4	+256.2
$SO_4^{2-}{}_{(aq)}$	−909.3	−744.5	+18.5
$SOCl_{2(L)}$	−245.6		
$H_2S_{(g)}$	−20.17	−33.01	+205.6
$H_2SO_{4(aq)}$	−909.3	−744.5	+20.1
$H_2SO_{4(L)}$	−814.0	−689.9	+156.1
$HSO_4^{-2}{}_{(aq)}$	−887.3	−752.9	+126.9
Tin			
$Sn^{2+}{}_{(aq)}$	−8.8		−16.7
Titanium			
$Ti_{(g)}$	+468	+422	+180.3
$Ti_{(s)}$	0	0	+30.76
$TiCl_{4(g)}$	−763.2	−726.8	+354.9
$TiCl_{4(L)}$	−804.2	−728.1	+221.9
$TiO_{2(s)}$	−944.7	−889.4	+50.29
Vanadium			
$V_{(g)}$	+514.2	+453.1	+182.2
$V_{(s)}$	0	0	+28.9
Zinc			
$Zn_{(g)}$	+130.7	+95.2	+160.9
$Zn_{(s)}$	0	0	+41.63
$Zn^{2+}_{(aq)}$	−153.9	−147.21	−106.9
$ZnCl_{2(s)}$	−415.1	−369.4	+111.5
$ZnO_{(s)}$	−348.0	−318.2	+43.9

Thermodynamic Quantities

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	S−O	373	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						

Specific Heat Capacity (J / g ^{o}C)

aluminum	0.900
barium	0.179
cadmium	0.232
chromium	0.448
copper	0.386
gallium	0.374
gold	0.128
iron	0.447
lead	0.138
mercury	0.139
nickel	0.443
platinum	0.134
potassium	0.748
silver	0.236
sodium	1.22
tin	0.220
zinc	0.386

Specific Heat Capacity (J / g ^{o}C)

acetone - liquid	2.17
ethyl alcohol - liquid	2.46
isopropyl alcohol - liquid	2.67
carbon tetrachloride	0.861
p-dichlorobenzene	7.1
gasoline	2.22
glass	0.5
water - solid	2.1
water - liquid	4.18
water - gas	1.7

ΔH Values for Phase Changes of Water

Water ΔH_{fusion} at the melting/freezing point = 6.01 kJ/mole OR 334 J/g

$\Delta H_{vaporization}$ at the boiling temperature = 40.7 kJ/mole OR 2261 J/g