There are no translations available.

The Committee on Data for Science and Technology (CODATA) has conducted a project to establish internationally agreed values for the thermodynamic properties of key chemical substances. This table presents the final results of the project. Use of these recommended, internally consistent values is encouraged in the analysis of thermodynamic measurements, data reduction, and preparation of other thermodynamic tables. The table includes the standard enthalpy of formation at 298.15 K, the entropy at 298.15 K, and the quantity H°(298.15 K)-H°(0). A value of 0 in the$D_f H^\circ$ column for an element indicates the reference state for that element. The standard state pressure is 100000 Pa (1 bar). See the reference for information on the dependence of gas-phase entropy on the choice of standard state pressure. Substances are listed in alphabetical order of their chemical formulas when written in the most common form.

Substance	State	DfH°(298.15K)	S°(298.15K)	H°(298
kJmol	-1	JK-1mol	-1	kJmol
Ag	cr	0	42.55±0.20	5.745±0
Ag	g	284.9±0.8	172.997±0.004	6.197±0
Ag+	aq	105.79±0.08	73.45±0.40	
AgCl	cr	-127.01±0.05	96.25±0.20	12.033±
Al	cr	0	28.30±0.10	4.540±0
Al	g	330.0±4.0	164.554±0.004	6.919±0
Al+3	aq	-538.4±1.5	-325±10	
AlF3	cr	-1510.4±1.3	66.5±0.5	11.62±0
Al2O3	cr,corundum	-1675.7±1.3	50.92±0.10	10.016±
Ar	g	0	154.846±0.003	6.197±0
B	cr,rhombic	0	5.90±0.08	1.222±0
B	g	565±5	153.436±0.015	6.316±0
BF3	g	-1136.0±0.8	254.42±0.20	11.650±
B2O3	cr	-1273.5±1.4	53.97±0.30	9.301±0
Be	cr	0	9.50±0.08	1.950±0
Be	g	324±5	136.275±0.003	6.197±0
BeO	cr	-609.4±2.5	13.77±0.04	2.837±0
Br	g	111.87±0.12	175.018±0.004	6.197±0
Br-	aq	-121.41±0.15	82.55±0.20	
Br2	l	0	152.21±0.30	24.52±0
Br2	g	30.91±0.11	245.468±0.005	9.725±0
C	cr,graphite	0	5.74±0.10	1.050±0
C	g	716.68±0.45	158.100±0.003	6.536±0
CO	g	-110.53±0.17	197.660±0.004	8.671±0
CO2	g	-393.51±0.13	213.785±0.010	9.365±0
CO2	aq,undissoc.	-413.26±0.20	119.36±0.60	
CO3-2	aq	-675.23±0.25	-50.0±1.0	

Ca	cr	0	41.59±0.40	5.736±0
Ca	g	177.8±0.8	154.887±0.004	6.197±0
Ca+2	aq	-543.0±1.0	-56.2±1.0	
CaO	cr	-634.92±0.90	38.1±0.4	6.75±0.
Cd	cr	0	51.80±0.15	6.247±0
Cd	g	111.80±0.20	167.749±0.004	6.197±0
Cd+2	aq	-75.92±0.60	-72.8±1.5	
CdO	cr	-258.35±0.40	54.8±1.5	8.41±0.
CdSO48/3H2O	cr	-1729.30±0.80	229.65±0.40	35.56±0
Cl	g	121.301±0.008	165.190±0.004	6.272±0
Cl-	aq	-167.080±0.10	56.60±0.20	
ClO4-	aq	-128.10±0.40	184.0±1.5	
Cl2	g	0	223.081±0.010	9.181±0
Cs	cr	0	85.23±0.40	7.711±0
Cs	g	76.5±1.0	175.601±0.003	6.197±0
Cs+	aq	-258.00±0.50	132.1±0.5	
Cu	cr	0	33.15±0.08	5.004±0
Cu	g	337.4±1.2	166.398±0.004	6.197±0
Cu+2	aq	64.9±1.0	-98±4	
CuSO4	cr	-771.4±1.2	109.2±0.4	16.86±0
F	g	79.38±0.30	158.751±0.004	6.518±0
F-	aq	-335.35±0.65	-13.8±0.8	
F2	g	0	202.791±0.005	8.825±0
Ge	cr	0	31.09±0.15	4.636±0
Ge	g	372±3	167.904±0.005	7.398±0
GeF4	g	-1190.20±0.50	301.9±1.0	17.29±0
GeO2	cr,tetragonal	-580.0±1.0	39.71±0.15	7.230±0
H	g	217.998±0.006	114.717±0.002	6.197±0
H+	aq	0	0	
HBr	g	-36.29±0.16	198.700±0.004	8.648±0
HCO3-	aq	-689.93±2.0	98.4±0.5	
HCl	g	-92.31±0.10	186.902±0.005	8.640±0
HF	g	-273.30±0.70	173.779±0.003	8.599±0
HI	g	26.50±0.10	206.590±0.004	8.657±0
HPO4-2	aq	-1299.0±1.5	-33.5±1.5	
HS-	aq	-16.3±1.5	67±5	
HSO4-	aq	-886.9±1.0	131.7±3.0	
H2	g	0	130.680±0.003	8.468±0
H2O	l	-285.830±0.040	69.95±0.03	13.273±
H2O	g	-241.826±0.040	188.835±0.010	9.905±0
H2PO4-	aq	-1302.6±1.5	92.5±1.5	
H2S	g	-20.6±0.5	205.81±0.05	9.957±0
H2S	aq,undissoc.	-38.6±1.5	126±5	
H3BO3	cr	-1094.8±0.8	89.95±0.60	13.52±0
H3BO3	aq,undissoc.	-1072.8±0.8	162.4±0.6	
He	g	0	126.153±0.002	6.197±0

Hg	l	0	75.90±0.12	9.342±0
Hg	g	61.38±0.04	174.971±0.005	6.197±0
Hg+2	aq	170.21±0.20	-36.19±0.80	
HgO	cr,red	-90.79±0.12	70.25±0.30	9.117±0
Hg2+2	aq	166.87±0.50	65.74±0.80	
Hg2Cl2	cr	-265.37±0.40	191.6±0.8	23.35±0
Hg2SO4	cr	-743.09±0.40	200.70±0.20	26.070±
I	g	106.76±0.04	180.787±0.004	6.197±0
I-	aq	-56.78±0.05	106.45±0.30	
I2	cr	0	116.14±0.30	13.196±
I2	g	62.42±0.08	260.687±0.005	10.116±
K	cr	0	64.68±0.20	7.088±0
K	g	89.0±0.8	160.341±0.003	6.197±0
K+	aq	-252.14±0.08	101.20±0.20	
Kr	g	0	164.085±0.003	6.197±0
Li	cr	0	29.12±0.20	4.632±0
Li	g	159.3±1.0	138.782±0.010	6.197±0
Li+	aq	-278.47±0.08	12.24±0.15	
Mg	cr	0	32.67±0.10	4.998±0
Mg	g	147.1±0.8	148.648±0.003	6.197±0
Mg+2	aq	-467.0±0.6	-137±4	
MgF2	cr	-1124.2±1.2	57.2±0.5	9.91±0.
MgO	cr	-601.60±0.30	26.95±0.15	5.160±0
N	g	472.68±0.40	153.301±0.003	6.197±0
NH3	g	-45.94±0.35	192.77±0.05	10.043±
NH4+	aq	-133.26±0.25	111.17±0.40	
NO3-	aq	-206.85±0.40	146.70±0.40	
N2	g	0	191.609±0.004	8.670±0
Na	cr	0	51.30±0.20	6.460±0
Na	g	107.5±0.7	153.718±0.003	6.197±0
Na+	aq	-240.34±0.06	58.45±0.15	
Ne	g	0	146.328±0.003	6.197±0
O	g	249.18±0.10	161.059±0.003	6.725±0
OH-	aq	-230.015±0.040	-10.90±0.20	
O2	g	0	205.152±0.005	8.680±0
P	cr,white	0	41.09±0.25	5.360±0
P	g	316.5±1.0	163.199±0.003	6.197±0
P2	g	144.0±2.0	218.123±0.004	8.904±0
P4	g	58.9±0.3	280.01±0.50	14.10±0
Pb	cr	0	64.80±0.30	6.870±0
Pb	g	195.2±0.8	175.375±0.005	6.197±0
Pb+2	aq	0.92±0.25	18.5±1.0	
PbSO4	cr	-919.97±0.40	148.50±0.60	20.050±
Rb	cr	0	76.78±0.30	7.489±0
Rb	g	80.9±0.8	170.094±0.003	6.197±0
Rb+	aq	-251.12±0.10	121.75±0.25	

S	cr,rhombic	0	32.054±0.050	4.412±0
S	g	277.17±0.15	167.829±0.006	6.657±0
SO2	g	-296.81±0.20	248.223±0.050	10.549±
SO4-2	aq	-909.34±0.40	18.50±0.40	
S2	g	128.60±0.30	228.167±0.010	9.132±0
Si	cr	0	18.81±0.08	3.217±0
Si	g	450±8	167.981±0.004	7.550±0
SiF4	g	-1615.0±0.8	282.76±0.50	15.36±0
SiO2	cr,alphaquartz	-910.7±1.0	41.46±0.20	6.916±0
Sn	cr,white	0	51.18±0.08	6.323±0
Sn	g	301.2±1.5	168.492±0.004	6.215±0
Sn+2	aq	-8.9±1.0	-16.7±4.0	
SnO	cr,tetragonal	-280.71±0.20	57.17±0.30	8.736±0
SnO2	cr,tetragonal	-577.63±0.20	49.04±0.10	8.384±0
Th	cr	0	51.8±0.5	6.35±0.
Th	g	602±6	190.17±0.05	6.197±0
ThO2	cr	-1226.4±3.5	65.23±0.20	10.560±
Ti	cr	0	30.72±0.10	4.824±0
Ti	g	473±3	180.298±0.010	7.539±0
TiCl4	g	-763.2±3.0	353.2±4.0	21.5±0.
TiO2	cr,rutile	-944.0±0.8	50.62±0.30	8.68±0.
U	cr	0	50.20±0.20	6.364±0
U	g	533±8	199.79±0.10	6.499±0
UO2	cr	-1085.0±1.0	77.03±0.20	11.280±
UO2+2	aq	-1019.0±1.5	-98.2±3.0	
UO3	cr,gamma	-1223.8±1.2	96.11±0.40	14.585±
U3O8	cr	-3574.8±2.5	282.55±0.50	42.74±0
Xe	g	0	169.685±0.003	6.197±0
Zn	cr	0	41.63±0.15	5.657±0
Zn	g	130.40±0.40	160.990±0.004	6.197±0
Zn+2	aq	-153.39±0.20	-109.8±0.5	
ZnO	cr	-350.46±0.27	43.65±0.40	6.933±0

REFERENCE

Cox, J. D., Wagman, D. D., and Medvedev, V. A., CODATA Key Values for Thermodynamics, Hemisphere Publishing Corp., New York, 1989.

The values given in this table represent the consensus judgement of an international group of experts. While we believe there is a high probability that the true values fall within he stated uncertainty limits, CODATA cannot assume responsibility for any consequences of the use of these data.

(*Note: All the numerical values have precisions stated alongside them. Browsers using HTML3.2 will show a +- symbol.Earlier versions will only show a space or possibly some code*)