

APPENDIX V

Chemical Thermodynamic Properties at 298.15 K

Table AV.1

Substance	$\Delta H_f^\circ/\text{kJ mol}^{-1}$	$\Delta G_f^\circ/\text{kJ mol}^{-1}$	$S^\circ/\text{J K}^{-1} \text{mol}^{-1}$	$C_p^\circ/\text{J K}^{-1} \text{mol}^{-1}$
O(g)	249.17	231.75	160.946	21.91
O ₂ (g)	0	0	205.037	29.35
O ₃ (g)	142.7	163.2	238.82	39.20
H(g)	217.997	203.26	114.604	20.786
H ₂ (g)	0	0	130.570	28.82
OH(g)	38.95	34.23	183.64	29.89
H ₂ O(l)	-285.830	-237.178	69.950	75.291
H ₂ O(g)	-241.814	-228.589	188.724	33.577
H ₂ O ₂ (l)	-187.78	-120.42	109.6	89.1
F(g)	79.39	61.92	158.640	22.74
F ₂ (g)	0	0	202.685	31.30
HF(g)	-273.30	-275.40	173.665	29.13
Cl(g)	121.302	105.70	165.076	21.84
Cl ₂ (g)	0	0	222.965	33.91
HCl(g)	-92.31	-95.299	186.786	29.1
Br(g)	111.86	82.429	174.904	20.79
Br ₂ (l)	0	0	152.210	75.69
Br ₂ (g)	30.91	3.14	245.350	36.02
HBr(g)	-36.38	-53.43	198.585	29.14
I(g)	106.762	70.28	180.673	20.79
I ₂ (c)	0	0	116.139	54.44
I ₂ (g)	62.421	19.36	260.567	36.9
HI(g)	26.36	1.72	206.480	29.16
S(c, rhombic)	0	0	32.054	22.6
S(c, monoclinic)	0.33			
S(g)	276.98	238.27	167.715	23.67

Table AV.1 (Continued)

Substance	$\Delta H_f^\circ/\text{kJ mol}^{-1}$	$\Delta G_f^\circ/\text{kJ mol}^{-1}$	$S^\circ/\text{J K}^{-1} \text{mol}^{-1}$	$C_p^\circ/\text{J K}^{-1} \text{mol}^{-1}$
SO ₂ (g)	-296.81	-300.19	248.11	39.9
SO ₃ (g)	-395.7	-371.1	256.6	50.7
H ₂ S(g)	-20.6	-33.6	205.7	34.2
H ₂ SO ₄ (l)	-813.99	-690.10	156.90	138.9
N(g)	472.68	455.57	153.189	20.79
N ₂ (g)	0	0	191.502	29.12
NO(g)	90.25	86.57	210.65	29.84
NO ₂ (g)	33.18	51.30	240.0	37.2
N ₂ O(g)	82.0	104.2	219.7	38.45
N ₂ O ₃ (g)	83.7	139.4	312.2	65.6
N ₂ O ₄ (g)	9.16	97.8	304.2	77.3
N ₂ O ₅ (g)	11	115	356	85
NH ₃ (g)	-45.94	-16.5	192.67	35.1
HNO ₃ (l)	-174.1	-80.8	155.6	109.9
NOCl(g)	51.7	66.1	261.6	44.69
NH ₄ Cl(c)	-314.4	-203.0	94.6	84.1
P(g)	316.5	278.3	163.085	20.79
P ₂ (g)	144.0	104	218.01	32.0
P ₄ (c, α , white)	0	0	164.4	95.36
P ₄ (g)	58.9	24.5	279.9	67.15
PCl ₃ (g)	-287	-268	311.7	71.8
PCl ₅ (g)	-375	-305	364.5	112.8
C(c, graphite)	0	0	5.74	8.53
C(c, diamond)	1.897	2.900	2.38	6.12
C(g)	716.67	671.29	157.988	20.84
CO(g)	-110.53	-137.15	197.556	29.12
CO ₂ (g)	-393.51	-394.36	213.677	37.11
CH ₄ (g)	-74.8	-50.8	186.15	35.31
HCHO(g)	-117	-113	218.7	35.4
CH ₃ OH(l)	-238.7	-166.4	127	82
C ₂ H ₂ (g)	226.7	209.2	200.8	43.9
C ₂ H ₄ (g)	52.3	68.1	219.5	43.6
C ₂ H ₆ (g)	-84.7	-32.9	229.5	52.6
CH ₃ COOH(l)	-485	-390	160	124
C ₂ H ₅ OH(l)	-277.7	-174.9	161	111.5
C ₆ H ₆ (g)	82.93	129.66	26.92	85.29
Si(c)	0	0	18.81	20
Si(g)	450	411	167.870	22.25
SiO ₂ (c, α -quartz)	-910.7	-856.7	41.46	44.4
SiH ₄ (g)	34	57	204.5	42.8
SiF ₄ (g)	-1614.95	-1572.7	282.65	73.6
Pb(c)	0	0	64.80	26.4
PbO(c, red)	-219.0	-188.9	66.5	45.8
PbO ₂ (c)	-277	-217.4	68.6	64.6
PbS(c)	-100	-99	91	49.5
PbSO ₄ (c)	-919.94	-813.2	148.49	103.21
Al(c)	0	0	28.35	24.4
Al ₂ O ₃ (c, α -corundum)	-1675.7	-1582	50.92	79.0
Zn(c)	0	0	41.63	25.4
Zn(g)	130.42	95.18	160.875	20.79
ZnO(c)	-350.46	-318.3	43.64	40.3

Table AV.1 (Continued)

Substance	$\Delta H_f^\circ/\text{kJ mol}^{-1}$	$\Delta G_f^\circ/\text{kJ mol}^{-1}$	$S^\circ/\text{J K}^{-1} \text{mol}^{-1}$	$C_p^\circ/\text{J K}^{-1} \text{mol}^{-1}$
Hg(l)	0	0	75.90	27.98
Hg(g)	61.38	31.85	174.860	20.79
HgO(c, red)	-90.8	-58.56	70.3	44.1
Cu(c)	0	0	33.15	24.43
CuO(c)	-157	-130	42.6	42.3
Cu ₂ O(c)	-169	-146	93.1	63.6
Ag(c)	0	0	42.55	25.35
Ag ₂ O(c)	-31.0	-11.2	121	65.9
AgCl(c)	-127.070	-109.80	96.23	50.8
Ag ₂ S(c, α)	-32.6	-40.7	144.0	76.5
Fe(c, α)	0	0	27.3	25.1
Fe _{0.947} O(c, wustite)	-266.3	-245.1	57.5	48.1
Fe ₂ O ₃ (c, hematite)	-824.2	-742.2	87.4	103.8
Fe ₃ O ₄ (c, magnetite)	-1118	-1015	146	143.4
FeS(c, α)	-100	-100.4	60.3	50.5
FeS ₂ (c, pyrite)	-178	-167	52.9	62.2
Ti(c)	0	0	30.6	25.0
TiO ₂ (c, rutile)	-945	-890	50.3	55.0
TiCl ₄ (l)	-803	-737	252.3	145.2
Mg(c)	0	0	32.68	24.9
MgO(c)	-601.5	-569.4	26.95	37.2
MgCO ₃ (c)	-1096	-1012	66	75.5
Ca(c)	0	0	41.6	25.3
CaO(c)	-635.09	-604.0	38.1	42.8
Ca(OH) ₂ (c)	-986.1	-898.6	83.4	87.5
CaC ₂ (c)	-60	-65	70.0	62.7
CaCO ₃ (c, calcite)	-1206.9	-1128.8	93	81.9
SrO(c)	-592	-562	54	45.0
SrCO ₃ (c)	-1220	-1140	97	81.4
BaO(c)	-554	-525	70.4	47.8
BaCO ₃ (c)	-1216	-1138	112	85.4
Na ₂ O(c)	-414.2	-375.5	75.1	69.1
NaOH(c)	-425.61	-379.53	64.45	59.5
NaF(c)	-573.65	-543.51	51.5	46.9
NaCl(c)	-411.15	-384.15	72.1	50.5
NaBr(c)	-361.06	-348.98	86.8	51.4
NaI(c)	-287.8	-286.1	98.5	52.1
Na ₂ SO ₄ (c)	-1387.1	-1270.2	149.6	128.2
Na ₂ SO ₄ · 10H ₂ O	-4327.3	-3647.4	592	
NaNO ₃ (c)	-467.9	-367.1	116.5	92.9
KF(c)	-567.3	-537.8	66.6	49.0
KCl(c)	-436.75	-409.2	82.6	51.3
KClO ₃ (c)	-397.7	-296.3	143	100.2
KClO ₄ (c)	-432.8	-303.2	151	112.4
KBr(c)	-393.80	-380.7	95.9	52.3
KI(c)	-327.90	-324.89	106.3	52.9

g: gas; l: liquid; c: crystal.