

Table A-6

Thermodynamic Properties (at standard states)

ΔH_f° in kJ/mol		ΔG_f° in kJ/mol		S° in J/mol·K			
concentration of aqueous solutions is 1 M							
Substance	ΔH_f°	ΔG_f°	S°	Substance	ΔH_f°	ΔG_f°	S°
Ag	0	0	42.7	H ₃ PO ₃	-972	—	—
AgCl	-127	-110	96.1	H ₃ PO ₄	-1280	-1120	110
AgCN	-146	-164	83.7	H ₂ S	-20.1	-33.0	206
Al	0	0	28.3	H ₂ SO ₃ (aq)	-614	-538	232
Al ₂ O ₃	-1670	-1580	51.0	H ₂ SO ₄ (aq)	-908	-742	17.2
BaCl ₂ (aq)	-873	-823	121	HgCl ₂	-230	-177	—
BaSO ₄	-1470	-1350	132	Hg ₂ Cl ₂	-265	-211	196
Be	0	0	9.54	Hg ₂ SO ₄	-742	-624	201
Be ₃ N ₂	-568	-512	—	I ₂	0	0	117
Bi	0	0	56.9	K	0	0	63.6
BiCl ₃	-379	-319	190	KBr	-392	-379	96.4
Bi ₂ S ₃	-183	-164	146	KMnO ₄	-813	-714	172
Br ₂	0	0	152	KOH	-426	—	—
CH ₄	-74.8	-50.8	186	LiBr	-350	—	—
C ₂ H ₄	+52.3	+68.1	219	LiOH	-487	-444	50.2
C ₂ H ₆	-84.7	-32.9	229	Mn	0	0	32.0
C ₄ H ₁₀	-125	-15.7	310	MnCl ₂ (aq)	-555	-491	38.9
CO	-111	-137	198	Mn(NO ₃) ₂ (aq)	-636	-451	218
CO ₂	-393.5	-394.4	214	MnO ₂	-521	-466	53.1
CS ₂	+87.9	+63.6	151	MnS	-214	—	—
Ca	0	0	41.6	N ₂	0	0	192
Ca(OH) ₂	-987	-897	—	NH ₃	-46.2	-16.6	193
Cl ₂	0	0	223	NH ₄ Br	-270	-175	113
CoCO ₃	-723	-650	—	NO	+90.4	—	211
CoO	-239	-213	43.9	NO ₂	+33.8	+51.8	240
Cr ₂ O ₃	-1130	-1050	81.2	Na	0	0	51.0
CsCl(aq)	-415	-371	188	NaBr	-360	—	—
Cs ₂ SO ₄ (aq)	-1400	-1310	283	NaCl	-411	-384	72.4
CuI	-67.8	-69.5	96.7	NaNO ₃ (aq)	-447	—	—
CuS	-53.1	-53.7	66.5	NaOH	-427	—	—
Cu ₂ S	-79.5	-86.2	121	Na ₂ S(aq)	-437	—	—
CuSO ₄	-770	-662	113	Na ₂ SO ₄	-1380	-1270	149
F ₂	0	0	203	O ₂	0	0	205
FeCl ₃	-405	—	—	P ₄ O ₆	-1640	—	—
FeO	-267	—	—	P ₄ O ₁₀	-2980	-2700	229
Fe ₂ O ₃	-822	-741	90.0	PbBr ₂	-277	-260	162
H	+218	—	115	PbCl ₂	-359	-314	136
H ₂	0	0	131	S	0	0	31.9
HBr	-36.2	-53.2	198	SO ₂	-297	-300	249
HCl	-92.3	-95.3	187	SO ₃	-438	-368	95.6
HCl(aq)	-167	-131	56.5	SrO	-590	-560	54.4
HCN(aq)	+151	+172	94.1	Ti	0	0	30.3
HF	-269	-271	174	TiO ₂	—	-853	50.2
HI	+25.9	+1.30	206	TiI	-50.2	-83.3	236
H ₂ O(l)	-286	-237	70.0	UCl ₄	-1050	-962	198
H ₂ O(g)	-242	-229	189	UCl ₅	-1100	-993	259
H ₂ O ₂	—	-118	110	Zn	0	0	41.6
H ₃ PO ₂	-609	—	—	ZnCl ₂ (aq)	-487	-410	3.72
				ZnSO ₄ (aq)	-1063	-892	-92.0

Thermodynamic Values (25 °C)							
Substance and State	ΔH°_f ($\frac{\text{kJ}}{\text{mol}}$)	ΔG°_f ($\frac{\text{kJ}}{\text{mol}}$)	S° ($\frac{\text{J}}{\text{K}\cdot\text{mol}}$)	Substance and State	ΔH°_f ($\frac{\text{kJ}}{\text{mol}}$)	ΔG°_f ($\frac{\text{kJ}}{\text{mol}}$)	S° ($\frac{\text{J}}{\text{K}\cdot\text{mol}}$)
Carbon				Nitrogen			
C(s) (graphite)	0	0	6	N ₂ (g)	0	0	192
C(s) (diamond)	2	3	2	NCl ₃ (g)	230	271	-137
CO(g)	-110.5	-137	198	NF ₃ (g)	-125	-83.6	-139
CO ₂ (g)	-393.5	-394	214	NH ₃ (g)	-46	-17	193
CH ₄ (g)	-75	-51	186	NH ₃ (aq)	-80	-27	111
CH ₃ OH(g)	-201	-163	240	NH ₂ CONH ₂ (aq)	?	?	174
CH ₃ OH(l)	-239	-166	127	NO(g)	90	87	211
H ₂ CO(g)	-116	-110	219	NO ₂ (g)	32	52	240
HCOOH(g)	-363	-351	249	N ₂ O(g)	82	104	220
HCN(g)	135.1	125	202	N ₂ O ₄ (g)	10	98	304
C ₂ H ₂ (g)	227	209	201	N ₂ O ₅ (g)	-42	134	178
C ₂ H ₄ (g)	52	68	219	N ₂ H ₃ CH ₃ (l)	54	180	166
CH ₃ CHO(g)	-166	-129	250	HNO ₃ (aq)	-207	-111	146
C ₂ H ₅ OH(l)	-278	-175	161	HNO ₃ (l)	-174	-81	156
C ₂ H ₆ (g)	-84.7	-32.9	229.5	NH ₄ Cl(s)	-314	-201	95
C ₃ H ₆ (g)	20.9	62.7	266.9	NH ₄ ClO ₄ (s)	-295	-89	186
C ₃ H ₈ (g)	-104	-24	270	Silver			
Bromine				Ag(s)	0	0	42.6
Br ₂ (l)	0	0	152	Ag ⁺ (aq)	105.6	77.1	72.7
BrCl(g)	14.64	-0.96	240	Ag(S ₂ O ₃) ³⁻ (aq)	-1285.7	--	--
Chlorine				AgBr(s)	-100.4	-96.9	107.1
Cl ₂ (g)	0	0	223	AgCl(s)	-127.1	-109.8	96.2
Cl ₂ (aq)	-23	7	121	Sulfur			
Cl ⁻ (aq)	-167	-131	57	S(rhombic)	0	0	31.8
HCl(g)	-92	-95	187	SO ₂ (g)	-296.8	-300.2	248.8
Fluorine				SO ₃ (g)	-395.7	-371.1	256.3
F ₂ (g)	0	0	203	H ₂ S(g)	-20.17	-33.0	205.6
F ⁻ (aq)	-333	-279	-14	Titanium			
HF(g)	-271	-273	174	TiCl ₄ (g)	-763	-727	355
Hydrogen				TiO ₂ (s)	-945	-890	50
H ₂ (g)	0	0	131	Aluminum			
H(g)	217	203	115	AlCl ₃ (s)	-526	-505	184
H ⁺ (aq)	0	0	0	Barium			
OH ⁻ (aq)	-230	-157	-11	BaCl ₂ (aq)	-872	-823	123
H ₂ O(l)	-286	-237	70	Ba(OH) ₂ ·8H ₂ O(s)	-3342	-2793	427
H ₂ O(g)	-242	-229	189	Iodine			
Magnesium				I ₂ (s)	0	0	116.7
Mg(s)	0	0	33	HI(g)	25.94	1.30	206.3
Mg(aq)	-492	-456	-118				
MgO(s)	-601	-569	26.9				
Oxygen							
O ₂ (g)	0	0	205				
O(g)	249	232	161				