

Appendix B

Standard state thermodynamic properties of selected minerals and other compounds

Part 1. Inorganic substances

Data from Wagman et al. (1982); with a few additions from other sources – Al species from Drever (1988); silica species and all volume data from SUPCRT92 (Johnson et al., 1992).

Formulas	Form	Mol. wt. g mol ⁻¹	$\Delta_f H^\circ$ kJ mol ⁻¹	$\Delta_f G^\circ$ kJ mol ⁻¹	S° J mol ⁻¹ K ⁻¹	C_p°	V° cm ³ mol ⁻¹
Aluminum							
Al	s	26.9815	0	0	28.33	24.35	
Al ³⁺	aq	26.9815	-531.0	-485.0	-321.7	—	-45.3
Al(OH) ²⁺	aq		-767.0	-693.7	—	—	
Al(OH) ₂ ⁺	aq		-1010.7	-901.4	—	—	
Al(OH) ₃ ^o (aq)	aq		-1250.4	-1100.7	—	—	
Al(OH) ₄ ⁻	aq	95.0111	-1490.0	-1307.0	102.9	—	45.60
Al ₂ O ₃	α , corundum	101.9612	-1675.7	-1582.3	50.92	79.04	25.575
Al ₂ O ₃ · H ₂ O	boehmite	119.9766	-1980.7	-1831.7	96.86	131.25	39.07
Al ₂ O ₃ · H ₂ O	diaspore	119.9766	-1998.91	-1841.78	70.67	106.19	35.52
Al ₂ O ₃ · 3H ₂ O	gibbsite	156.0074	-2586.67	-2310.21	136.90	183.47	63.912
Al ₂ O ₃ · 3H ₂ O	bayerite	156.0074	-2576.5	—	—	—	
Al(OH) ₃	amorphous	78.0037	-1276.0	—	—	—	
Al ₂ SiO ₅	andalusite	162.0460	-2590.27	-2442.66	93.22	122.72	51.53
Al ₂ SiO ₅	kyanite	162.0460	-2594.29	-2443.88	83.81	121.71	44.09
Al ₂ SiO ₅	sillimanite	162.0460	-2587.76	-2440.99	96.11	124.52	49.90
Al ₂ Si ₂ O ₇ · 2H ₂ O	kaolinite	258.1616	-4119.6	-3799.7	205.0	246.14	99.52
Al ₂ Si ₂ O ₇ · 2H ₂ O	halloysite	258.1616	-4101.2	-3780.5	203.3	246.27	99.30
Al ₂ Si ₂ O ₇ · 2H ₂ O	dickite	258.1616	-4118.3	-3795.9	197.1	239.49	99.30
Al ₆ Si ₂ O ₁₃	mullite	426.0532	-6816.2	-6432.7	255.0	326.10	—
Al ₂ Si ₄ O ₁₀ (OH) ₂	pyrophyllite	360.3158	-5642.04	-5268.14	239.41	294.34	126.6

Table (cont.)

Formulas	Form	Mol. wt. g mol ⁻¹	$\Delta_f H^\circ$ kJ mol ⁻¹	$\Delta_f G^\circ$ kJ mol ⁻¹	S° J mol ⁻¹ K ⁻¹	C_p° J mol ⁻¹ K ⁻¹	V° cm ³ mol ⁻¹
Barium							
Ba	s	137.3400	0	0	62.8	28.07	
Ba ²⁺	aq	137.3400	-537.64	-560.77	9.6	—	-12.9
BaO	s	153.3394	-553.5	-525.1	70.42	47.78	
BaO ₂	s	169.3388	-634.3	—	—	66.9	
BaF ₂	s	175.3368	-1207.1	-1156.8	96.36	71.21	
BaS	s	169.4040	-460.0	-456.0	78.2	49.37	
BaSO ₄	barite	233.4016	-1473.2	-1362.2	132.2	101.75	52.10
BaCO ₃	witherite	197.3494	-1216.3	-1137.6	112.1	85.35	45.81
BaSiO ₃	s	213.4242	-1623.60	-1540.21	109.6	90.00	
Calcium							
Ca	s	40.0800	0	0	41.42	25.31	
Ca ²⁺	aq	40.0800	-542.83	-553.58	-53.1	—	-18.4
CaO	s	56.0794	-635.09	-604.03	39.75	42.80	
Ca(OH) ₂	portlandite	74.0948	-986.09	-898.49	83.39	87.49	
CaF ₂	fluorite	78.0768	-1219.6	-1167.3	68.87	67.03	24.542
CaS	s	72.1440	-482.4	-477.4	56.5	47.40	
CaSO ₄	anhydrite	136.1416	-1434.11	-1321.79	106.7	99.66	45.94
CaSO ₄ · 2H ₂ O	gypsum	172.1724	-2022.63	-1797.28	194.1	186.02	
Ca ₃ (PO ₄) ₂	β , whitlockite	310.1828	-4120.8	-3884.7	236.0	227.82	
Ca ₃ (PO ₄) ₂	α	310.1828	-4109.9	-3875.5	240.91	231.58	
CaCO ₃	calcite	100.0894	-1206.92	-1128.79	92.9	81.88	36.934
CaCO ₃	aragonite	100.0894	-1207.13	-1127.75	88.7	81.25	34.150
CaSiO ₃	wollastonite	116.1642	-1634.94	-1549.66	81.92	85.27	39.93
CaSiO ₃	pseudowollastonite	116.1642	-1628.4	-1544.7	87.36	86.48	
CaAl ₂ SiO ₆	Ca-Al pyroxene	218.1254	-3298.2	-3122.0	141.4	165.7	
CaAl ₂ Si ₂ O ₈	anorthite	278.2102	-4227.9	-4002.3	199.28	211.42	100.79
CaTiO ₃	perovskite	135.9782	-1660.6	-1575.2	93.64	97.65	
CaTiSiO ₅	sphene	196.0630	-2603.3	-2461.8	129.20	138.95	
CaMg(CO ₃) ₂	dolomite	184.4108	-2326.3	-2163.4	155.18	157.53	64.365
CaMgSi ₂ O ₆	diopside	216.5604	-3206.2	-3032.0	142.93	166.52	66.090
Carbon							
C	graphite	12.0112	0	0	5.740	8.527	5.298
C	diamond	12.0112	1.895	2.900	2.377	6.113	3.417
CO ₃ ²⁻	aq	60.0094	-677.149	-527.81	-56.9	—	-6.1
HCO ₃ ⁻	aq	61.0174	-691.99	-586.77	91.2	—	24.2
CO	g	28.0106	-110.525	-137.168	197.674	29.142	24465.6

Table (cont.)

Formulas	Form	Mol. wt. g mol ⁻¹	$\Delta_f H^\circ$ kJ mol ⁻¹	$\Delta_f G^\circ$ kJ mol ⁻¹	S° J mol ⁻¹ K ⁻¹	C_p°	V° cm ³ mol ⁻¹
CO ₂	g	44.0100	-393.509	-394.359	213.74	37.11	24465.6
CO ₂	aq	44.0100	-413.80	-385.98	117.6	—	32.8
H ₂ CO ₃	aq	62.0254	-699.65	-623.08	187.4	—	
CH ₄	g	16.0432	-74.81	-50.72	186.264	35.309	24465.6
C ₂ H ₆	g	30.0704	-84.68	-32.82	229.60	52.63	24465.6
CN	g	26.0179	437.6	407.5	202.6	29.16	
CN ⁻	aq	26.0179	150.6	172.4	94.1	—	
HCN	g	27.0259	135.1	124.7	201.78	35.86	
HCN	aq	27.0259	107.1	119.7	124.7	—	
Chlorine							
Cl ₂	g	70.9060	0	0	233.066	33.907	24465.6
Cl ⁻	aq	35.4530	-167.159	-131.228	56.5	-136.4	17.3
HCl	aq	36.4610	-167.159	-131.228	56.5	-136.4	17.3
HCl	g	36.4610	-92.307	-95.299	186.908	29.12	24465.6
Copper							
Cu	s	63.5400	0	0	33.15	24.435	
Cu ⁺	aq	63.5400	71.67	49.98	40.6	—	
Cu ²⁺	aq	63.5400	64.77	65.49	-99.6	—	
CuO	tenorite	79.5394	-157.3	-129.7	42.63	42.30	
Cu ₂ O	cuprite	143.0794	-168.6	-146.0	93.14	63.64	
CuSO ₄ · 3H ₂ O	bonattite	213.6478	-1684.31	-1399.36	221.3	205.0	
CuSO ₄ · 5H ₂ O	calcanthite	249.6786	-2279.65	-1879.745	300.4	280.0	
CuS	covellite	96.6040	-53.1	-53.6	66.5	47.82	
Cu ₂ S	chalcocite	159.1440	-79.5	-86.2	120.9	76.32	
Fluorine							
F ₂	g	37.9968	0	0	202.78	31.30	
HF	g	20.0064	-271.1	-273.2	173.779	29.133	
HF	aq	20.0064	-320.08	-296.82	88.7	—	
F ⁻	aq	18.9984	-332.63	-278.79	-13.8	-106.7	
Hydrogen							
H ₂	g	2.0160	0	0	130.684	28.824	24465.6
H ⁺	aq	1.0080	0	0	0	0	0
OH ⁻	aq	17.0074	-229.994	-157.244	-10.75	-148.5	
H ₂ O	l	18.0154	-285.830	-237.129	69.91	75.291	18.068
H ₂ O	g	18.0154	-241.818	-228.572	188.825	33.577	24465.6

Table (cont.)

Formulas	Form	Mol. wt. g mol ⁻¹	$\Delta_f H^\circ$ kJ mol ⁻¹	$\Delta_f G^\circ$ kJ mol ⁻¹	S° J mol ⁻¹ K ⁻¹	C_p° J mol ⁻¹ K ⁻¹	V° cm ³ mol ⁻¹
Iodine							
I ₂	s	253.8088	0	0	116.135	54.438	
I ⁻	aq	126.9044	-55.19	-51.57	111.3	-142.3	
HI	aq	127.9124	-55.19	-51.57	111.3	—	
IO ₃ ⁻	aq	174.9026	-221.3	-128.0	118.4	—	
IO ₄ ⁻	aq	190.9020	-155.5	-58.5	222.0	—	
Iron							
Fe	s	55.8470	0	0	27.28	25.10	
Fe ²⁺	aq	55.8470	-89.1	-78.90	-137.7	—	
Fe ³⁺	aq	55.8470	-48.5	-4.7	-315.9	—	
Fe _{0.947} O	wüstite	68.8865	-266.27	-245.12	57.49	48.12	
Fe ₂ O ₃	hematite	159.6922	-824.2	-742.2	87.40	103.85	
Fe ₃ O ₄	magnetite	231.5386	-1118.4	-1015.4	146.4	143.43	
FeO(OH)	goethite	88.8538	-559.0	(-487.02)	(60.25)	—	
Fe(OH) ₂	s	89.8618	-569.0	-486.5	88.0	—	
Fe(OH) ₃	s	106.8692	-823.0	-696.5	106.7	—	
FeS	troilite	87.9110	-100.0	-100.4	60.29	50.54	
FeS ₂	pyrite	119.9750	-178.2	-166.9	52.93	62.17	
FeCO ₃	siderite	115.8564	-740.57	-666.67	92.9	82.13	
Fe ₂ SiO ₄	fayalite	203.7776	-1479.9	-1379.0	145.2	132.88	
Lead							
Pb	s	207.1900	0	0	64.81	26.44	
Pb ²⁺	aq	207.1900	-1.7	-24.43	10.5	—	
PbO	yellow	223.1894	-217.32	-187.89	68.70	45.77	
PbO	red	223.1894	-218.99	-188.93	66.5	45.81	
PbF ₂	s	245.1868	-664.0	-617.1	110.5	—	
PbCl ₂	s	278.0960	-359.41	-314.10	136.0	—	
PbS	galena	239.2540	-100.42	-98.7	91.2	49.50	
PbSO ₄	anglesite	303.2516	-919.94	-813.14	148.57	103.207	
PbCO ₃	cerussite	267.1994	-699.1	-625.5	131.0	87.40	
PbSiO ₃	s	283.2742	-1145.70	-1062.10	109.6	90.04	
Magnesium							
Mg	s	24.3120	0	0	32.68	24.89	
Mg ²⁺	aq	24.3120	-466.85	-454.8	-138.1	—	
MgO	periclase	40.3114	-601.70	-569.43	26.94	37.15	
Mg(OH) ₂	brucite	58.3268	-924.54	-833.51	63.18	77.03	
MgF ₂	sellaite	62.3088	-1123.4	-1070.2	57.24	61.59	

Table (cont.)

Formulas	Form	Mol. wt. g mol ⁻¹	$\Delta_f H^\circ$ kJ mol ⁻¹	$\Delta_f G^\circ$ kJ mol ⁻¹	S° J mol ⁻¹ K ⁻¹	C_p°	V° cm ³ mol ⁻¹
MgS	s	56.3760	-346.0	-341.8	50.33	45.56	
MgCO ₃	magnesite	84.3214	-1095.8	-1012.1	65.7	75.52	28.018
MgCO ₃ · 3H ₂ O	nesquehonite	138.3676	—	-1726.1	—	—	
MgSiO ₃	enstatite	100.3962	-1549.00	-1462.09	67.74	81.38	
Mg ₂ SiO ₄	forsterite	140.7076	-2174.0	-2055.1	95.14	118.49	
Manganese							
Mn	s	54.9380	0	0	32.01	26.32	
Mn ²⁺	aq	54.9380	-220.75	-228.1	-73.6	50.0	
MnO ₄ ⁻	aq	118.9356	-541.4	-447.2	191.2	-82.0	
MnO ₄ ²⁻	aq	118.9356	-653.0	-500.7	59.0	—	
MnO	manganosite	70.9374	-385.22	-362.90	59.71	45.44	
Mn ₃ O ₄	hausmannite	228.8116	-1387.8	-1283.2	155.6	139.66	
Mn ₂ O ₃	s	157.8742	-959.0	-881.1	110.5	107.65	
MnO ₂	pyrolusite	86.9368	-520.03	-465.14	53.05	54.14	
Mn(OH) ₂	amorphous	88.9528	-695.4	-615.0	99.2	—	
MnS	alabandite	87.0020	-214.2	-218.4	78.2	49.96	
MnCO ₃	rhodochrosite	114.9474	-894.1	-816.7	85.8	81.50	
MnSiO ₃	rhodonite	131.0222	-1320.9	-1240.5	89.1	86.44	
Mn ₂ SiO ₄	tephroite	201.9596	-1730.5	-1632.1	163.2	129.87	
Mercury							
Hg	l	200.5900	0	0	76.02	27.983	
Hg	g	200.5900	61.317	31.820	174.96	20.786	
Hg ²⁺	aq	200.5900	171.1	164.4	-32.2	—	
Hg ₂ ²⁺	aq	401.1800	172.4	153.52	84.5	—	
HgS ₂ ²⁻	aq	264.7180	—	41.9	—	—	
HgCl ₄ ²⁻	aq	342.4020	-554.0	-446.8	293.0	—	
Hg ₂ Cl ₂	s	472.0860	-265.22	-210.745	192.5	—	
HgO	s, red	216.5894	-90.83	-58.539	70.29	44.06	
HgO	s, yellow	216.5894	-90.46	-58.409	71.1	—	
HgS	cinnabar	232.6540	-58.2	-50.6	82.4	48.41	
HgS	metacinnabar	232.6540	-53.6	-47.7	88.3	—	
Molybdenum							
Mo	s	95.9400	0	0	28.66	24.06	
MoO ₃	s	127.9388	-745.09	-667.97	77.74	74.98	
MoS ₂	molybdenite	160.0680	-235.1	-225.9	62.59	63.55	

Table (cont.)

Formulas	Form	Mol. wt. g mol ⁻¹	$\Delta_f H^\circ$	$\Delta_f G^\circ$	S°	C_p°	V°
				kJ mol ⁻¹		J mol ⁻¹ K ⁻¹	cm ³ mol ⁻¹
Nickel							
Ni	s	58.7100	0	0	29.87	26.07	
Ni ²⁺	aq	58.7100	-54.0	-45.6	-128.9	—	
NiO	bunsenite	74.7094	-239.7	-211.7	37.99	44.31	
NiS	s	90.7740	-82.0	-79.5	52.97	47.11	
Nitrogen							
N ₂	g	28.0134	0	0	191.61	29.125	
NO	g	30.0061	90.25	86.55	210.761	29.844	
NO ₂	g	46.0055	33.18	51.31	240.06	37.20	
N ₂ O	g	44.0128	82.05	104.2	219.85	38.45	
N ₂ O ₄	l	92.0110	-19.50	97.54	209.2	142.7	
N ₂ O ₄	g	92.0110	9.16	97.89	304.29	77.28	
N ₂ O ₅	s	108.0104	-43.1	113.9	178.2	143.1	
N ₂ O ₅	g	108.0104	11.3	115.1	355.7	84.5	
NH ₃	g	17.0307	-46.11	-16.45	192.45	35.06	
NO ₃ ⁻	aq	62.0049	-205.0	-108.74	146.45	-86.6	
NH ₄ ⁺	aq	18.0837	-132.51	-79.31	113.4	79.9	
NH ₄ OH	aq	35.0461	-366.12	-263.63	181.21	—	
Oxygen							
O ₂	g	31.9988	0	0	205.138	29.355	
O ₂	aq	31.9988	-11.7	16.4	110.9	—	
OH ⁻	aq	17.0074	-229.994	-157.244	-10.75	-148.5	
H ₂ O	l	18.0154	-285.830	-237.129	69.91	75.291	18.068
H ₂ O	g	18.0154	-241.818	-228.572	188.825	33.577	24465.6
Potassium							
K	s	39.1020	0	0	64.18	29.58	
K ⁺	aq	39.1020	-252.38	-283.27	102.5	21.8	9.0
KCl	sylvite	74.5550	-436.747	-409.14	82.59	51.30	
KAlSi ₃ O ₈	sanidine	278.3367	-3959.7	-3739.9	232.88	204.51	
KAlSi ₃ O ₈	microcline	278.3367	-3968.1	-3742.9	214.22	202.38	108.741
KAlSiO ₄	kaliophilite	158.1671	-2121.3	-2005.3	133.1	119.79	
KAlSi ₂ O ₆	leucite	218.2519	-3034.2	-2871.4	200.08	164.14	
KAl ₃ Si ₃ O ₁₀ OH ₂	muscovite	398.3133	-5984.4	-5608.4	306.3	—	14.087
Silicon							
Si	s	28.0860	0	0	18.83	20.00	
SiO ₂	α -quartz	60.0848	-910.94	-856.64	41.84	44.43	22.688

Table (cont.)

SiO ₂	α -cristobalite	60.0848	-909.48	-855.43	42.68	44.18	
SiO ₂	α -tridymite	60.0848	-909.06	-855.26	43.5	44.60	25.740
SiO ₂	coesite	60.0848	-906.31	-851.62	40.376	43.51	20.641
SiO ₂	amorphous	60.0848	-903.49	-850.70	46.9	44.4	
SiO ₂	aq	60.0848	-877.699	-833.411	75.312	318.40	16.1
H ₄ SiO ₄	aq		-1449.359	-1307.669	215.132	468.98	
HSiO ₃ ⁻	aq		-1125.583	-1013.783	41.84	-137.24	9.5
Silver							
Ag	s	107.8700	0	0	42.55	25.351	
Ag ⁺	aq	107.8700	105.579	77.107	72.68	21.8	
Ag ₂ O	s	231.7394	-31.05	-11.20	121.3	65.86	
AgCl	cerargyrite	143.3230	-127.068	-109.789	96.2	50.79	
Ag ₂ S	acanthite	247.8040	-32.59	-40.67	144.01	76.53	
Ag ₂ S	argentite	247.8040	-29.41	-39.46	150.6	—	
Sodium							
Na	s	22.9898	0	0	51.21	28.24	
Na ⁺	aq	22.9898	-240.12	-261.905	59.0	46.4	-1.2
NaCl	halite	58.4428	-411.153	-384.138	72.13	50.50	27.015
Na ₂ SiO ₃	s	122.0638	-1554.90	-1462.80	113.85	—	
NaAlSiO ₄	nepheline	142.0549	-2092.8	-1978.1	124.3	—	54.16
NaAlSi ₃ O ₈	low albite	262.2245	-3935.1	-3711.5	207.40	205.10	100.07
NaAlSi ₂ O ₆	jadeite	202.1397	-3030.9	-2852.1	133.5	—	60.40
Sulfur							
S	orthorhombic	32.0640	0	0	31.80	22.64	
S ²⁻	aq	32.0640	33.1	85.8	-14.6	—	
HS ⁻	aq	33.0720	-17.6	12.08	62.8	—	
SO ₄ ²⁻	aq	96.0616	-909.27	-744.53	20.1	-293.0	
HSO ₄ ⁻	aq	97.0696	-887.34	-755.91	131.8	-84.0	
S ₂	g	64.1280	128.37	79.30	228.18	32.47	
H ₂ S	g	34.0800	-20.63	-33.56	205.79	34.23	
H ₂ S	aq	34.0800	-39.7	-27.83	121.0	—	
SO ₂	g	64.0628	-296.830	-300.194	248.22	39.87	
SO ₃	g	80.0622	-395.72	-371.06	256.76	50.67	
Titanium							
Ti	s	47.9000	0	0	30.63	25.02	
TiO	s	63.8994	-519.7	-495.0	50.0	39.96	
TiO ₂	anatase	79.8988	-939.7	-884.5	49.92	55.48	
TiO ₂	brookite	79.8988	-941.8	—	—	—	
TiO ₂	rutile	79.8988	-944.7	-889.5	50.33	55.02	

Table (cont.)

Uranium						
U	s	238.0290	0	0	50.21	27.665
UO ₂	uraninite	270.0278	-1084.9	-1031.7	77.03	63.60
UO ₃	orthorhombic	286.0272	-1223.8	-1145.9	96.11	81.67
U ³⁺	aq	238.0290	-489.1	-475.4	192.0	—
U ⁴⁺	aq	238.0290	-591.2	-531.0	410.0	—
UO ₂ ²⁺	aq	270.0278	-1019.6	-953.5	-97.5	—
Zinc						
Zn	s	65.3700	0	0	41.63	25.40
Zn ²⁺	aq	65.3700	-155.89	-147.06	-112.1	46.0
ZnO	zincite	81.3694	-348.28	-318.30	43.64	40.25
ZnS	wurtzite	97.4340	-192.63	—	—	—
ZnS	sphalerite	97.4340	-205.98	-201.29	57.7	46.0
ZnCO ₃	smithsonite	125.3794	-812.78	-731.52	82.4	79.71
Zn ₂ SiO ₄	willemitte	222.8236	-1636.74	-1523.16	131.4	123.34

Part 2. Organic substances

N.B.: columns for $\Delta_f G^\circ$ and $\Delta_f H^\circ$ are reversed from Part 1, and $\Delta_f G^\circ$ and $\Delta_f H^\circ$ are in J rather than kJ. Note that a large database of data on organic compounds is being assembled by Everett Shock, and is freely available at <http://webdocs.asu.edu>. Data from Shock and Helgeson (1990).

Formulas	Form	Name	$\Delta_f G^\circ$ J mol ⁻¹	$\Delta_f H^\circ$ J mol ⁻¹	S° J mol ⁻¹ K ⁻¹	C_p° J mol ⁻¹ K ⁻¹	V° cm ³ mol ⁻¹
n-Alkanes							
CH ₄	aq	methane	-34451	-87906	87.82	277.4	37.30
CH ₄	g	methane	-50720	-74810	186.26	35.31	24465.6
C ₂ H ₆	aq	ethane	-16259	-103136	112.17	369.4	51.20
C ₃ H ₈	aq	propane	-8213	-127570	141.00	462.8	67.00
C ₄ H ₁₀	aq	<i>n</i> -butane	151	-151586	167.44	560.2	82.80
C ₅ H ₁₂	aq	<i>n</i> -pentane	8912	-173887	198.74	640.2	98.60
C ₆ H ₁₄	aq	<i>n</i> -hexane	18493	-198322	221.33	733.0	114.40
C ₇ H ₁₆	aq	<i>n</i> -heptane	27070	-221543	251.04	821.7	130.20
C ₈ H ₁₈	aq	<i>n</i> -octane	35899	-248571	266.94	910.4	146.00
1-Alkenes							
C ₂ H ₄	aq	ethylene	81379	35857	120.08	261.5	45.50
C ₃ H ₆	aq	1-propene	74935	-1213	153.55	350.2	61.30
C ₄ H ₈	aq	1-butene	84977	-23577	181.59	438.9	77.10
C ₅ H ₁₀	aq	1-pentene	94014	-46861	209.62	527.6	92.90
C ₆ H ₁₂	aq	1-hexene	101964	-71233	237.65	616.3	108.70
C ₇ H ₁₄	aq	1-heptene	110667	-94851	265.68	705.0	124.50
C ₈ H ₁₆	aq	1-octene	120164	-117654	293.72	793.7	140.30
Alkylbenzenes							
C ₆ H ₆	aq	benzene	133888	51170	148.53	361.1	83.50
C ₆ H ₅ CH ₃	aq	toluene	126608	13724	183.68	430.1	97.71
C ₆ H ₅ C ₂ H ₅	aq	ethylbenzene	135729	-10460	208.36	504.2	113.80
Alcohols							
CH ₃ OH	aq	methanol	-175937	-246312	134.72	158.2	38.17
C ₂ H ₅ OH	aq	ethanol	-181293	-287232	150.21	260.2	55.08
C ₆ H ₅ OH	aq	phenol	-52656	-153302	191.63	315.1	86.17
Ketones							
C ₃ H ₆ O	aq	acetone	-161084	-258236	185.77	241.4	66.92
Carboxylic acids							
HCOOH	aq	formic acid	-372301	-425429	162.76	79.5	34.69
CH ₃ COOH	aq	acetic acid	-396476	-485762	178.66	169.7	52.01

Table (cont.)

Formulas	Form	Name g mol ⁻¹	$\Delta_f G^\circ$ J mol ⁻¹	$\Delta_f H^\circ$ J mol ⁻¹	S° J mol ⁻¹ K ⁻¹	C_p° J mol ⁻¹ K ⁻¹	V° cm ³ mol ⁻¹
C ₂ H ₅ COOH	aq	propanoic acid	-390 911	-512 414	206.69	234.3	67.90
C ₃ H ₇ COOH	aq	butanoic acid	-381 539	-535 343	234.72	336.8	84.61
C ₄ H ₉ COOH	aq	pentanoic acid	-373 288	-559 359	262.76	432.2	100.50
C ₅ H ₁₁ COOH	aq	hexanoic acid	-364 343	-582 789	292.46	523.8	116.55
C ₆ H ₁₃ COOH	aq	heptanoic acid	-356 268	-607 015	318.82	612.5	132.30
C ₇ H ₁₅ COOH	aq	octanoic acid	-348 946	-631 993	346.85	701.2	148.10
Carboxylate anions							
HCOO ⁻	aq	formate	-350 879	-425 429	90.79	-92.0	26.16
CH ₃ COO ⁻	aq	acetate	-369 322	-486 097	86.19	25.9	40.50
C ₂ H ₅ COO ⁻	aq	propanoate	-363 046	-513 084	110.88	129.3	54.95
C ₃ H ₇ COO ⁻	aq	butanoate	-354 008	-535 259	133.05	186.2	70.30
C ₄ H ₉ COO ⁻	aq	pentanoate	-345 598	-562 371	160.25	329.7	86.31
C ₅ H ₁₁ COO ⁻	aq	hexanoate	-336 603	-585 300	189.54	418.4	102.21
C ₆ H ₁₃ COO ⁻	aq	heptanoate	-327 984	-609 023	217.57	469.4	118.60
C ₇ H ₁₅ COO ⁻	aq	octanoate	-319 407	-632 746	242.67	558.1	134.40
Amino acids							
C ₂ H ₅ NO ₂	aq	glycine	-370 778	-513 988	158.32	39.3	43.25
C ₃ H ₇ NO ₂	aq	alanine	-371 539	-552 832	167.36	141.4	60.45
C ₅ H ₁₁ NO ₂	aq	valine	-356 895	-616 303	178.24	302.1	90.79
C ₆ H ₁₃ NO ₂	aq	leucine	-343 088	-632 077	215.48	397.9	107.57
C ₆ H ₁₃ NO ₂	aq	isoleucine	-343 925	-631 366	220.92	383.3	105.45
C ₃ H ₇ NO ₃	aq	serine	-510 866	-714 627	194.56	117.6	60.62
C ₄ H ₉ NO ₃	aq	threonine	-502 080	-749 354	222.59	210.0	76.86
C ₄ H ₇ NO ₄	aq	aspartic acid	-721 322	-947 132	229.28	127.2	71.79
C ₅ H ₉ NO ₄	aq	glutamic acid	-723 832	-970 688	294.97	177.0	89.36
C ₄ H ₈ N ₂ O ₃	aq	asparagine	-538 272	-780 985	230.96	125.1	77.18
C ₅ H ₁₀ N ₂ O ₃	aq	glutamine	-529 694	-804 709	258.99	187.0	94.36
C ₉ H ₁₁ NO ₂	aq	phenylalanine	-207 108	-460 575	221.33	384.1	121.92
C ₁₁ H ₁₁ N ₂ O ₂	aq	tryptophan	-112 550	-409 195	153.13	420.1	144.00
C ₉ H ₁₁ NO ₃	aq	tyrosine	-365 263	-658 562	190.37	299.2	123.00
C ₅ H ₁₁ NO ₂ S	aq	methionine	-502 917	-743 078	274.89	292.9	105.30
Peptides							
C ₄ H ₈ N ₂ O ₃	aq	diglycine	-489 612	-734 878	226.77	158.99	319.11
C ₅ H ₁₀ N ₂ O ₃	aq	alanylglycine	-488 398	-778 684	212.13	252.30	398.40
C ₈ H ₁₆ N ₂ O ₃	aq	leucylglycine	-462 834	-847 929	303.76	497.06	608.10
C ₄ H ₆ N ₂ O ₂	aq	diketopiperazine	-240 329	-415 471	223.84	71.13	321.04