

Data section

1 Thermodynamic data

Table D1.1 Thermodynamic data for organic compounds (all values relate to 298.15 K)

	<i>M</i> / (g mol ⁻¹)	$\Delta_f H^\circ$ / (kJ mol ⁻¹)	$\Delta_f G^\circ$ / (kJ mol ⁻¹)	S_m° / (J K ⁻¹ mol ⁻¹)	$C_{p,m}$ / (J K ⁻¹ mol ⁻¹)	$\Delta_c H^\circ$ / (kJ mol ⁻¹)
C(s) (graphite)	12.011	0	0	5.740	8.527	-393.51
C(s) (diamond)	12.011	+1.895	+2.900	2.377	6.113	-395.40
CO ₂ (g)	44.010	-393.51	-394.36	213.74	37.11	
Hydrocarbons						
CH ₄ (g), methane	16.04	-74.81	-50.72	186.26	35.31	-890
CH ₃ (g), methyl	15.04	+145.69	+147.92	194.2	38.70	
C ₂ H ₂ (g), ethyne	26.04	+226.73	+209.20	200.94	43.93	-1300
C ₂ H ₄ (g), ethene	28.05	+52.26	+68.15	219.56	43.56	-1411
C ₂ H ₆ (g), ethane	30.07	-84.68	-32.82	229.60	52.63	-1560
C ₃ H ₆ (g), propene	42.08	+20.42	+62.78	267.05	63.89	-2058
C ₃ H ₈ (g), cyclopropane	42.08	+53.30	+104.45	237.55	55.94	-2091
C ₃ H ₈ (g), propane	42.10	-103.85	-23.49	269.91	73.5	-2220
C ₄ H ₈ (g), 1-butene	56.11	-0.13	+71.39	305.71	85.65	-2717
C ₄ H ₈ (g), <i>cis</i> -2-butene	56.11	-6.99	+65.95	300.94	78.91	-2710
C ₄ H ₈ (g), <i>trans</i> -2-butene	56.11	-11.17	+63.06	296.59	87.82	-2707
C ₄ H ₁₀ (g), butane	58.13	-126.15	-17.03	310.23	97.45	-2878
C ₅ H ₁₂ (g), pentane	72.15	-146.44	-8.20	348.40	120.2	-3537
C ₅ H ₁₂ (l)	72.15	-173.1				
C ₆ H ₆ (l), benzene	78.12	+49.0	+124.3	173.3	136.1	-3268
C ₆ H ₆ (g)	78.12	+82.93	+129.72	269.31	81.67	-3320
C ₆ H ₁₂ (l), cyclohexane	84.16	-156	+26.8		156.5	-3902
C ₆ H ₁₄ (l), hexane	86.18	-198.7		204.3		-4163
C ₆ H ₅ CH ₃ (g), methylbenzene (toluene)	92.14	+50.0	+122.0	320.7	103.6	-3953
C ₇ H ₁₆ (l), heptane	100.21	-224.4	+1.0	328.6	224.3	
C ₈ H ₁₈ (l), octane	114.23	-249.9	+6.4	361.1		-5471
C ₈ H ₁₈ (l), iso-octane	114.23	-255.1				-5461
C ₁₀ H ₈ (s), naphthalene	128.18	+78.53				-5157
Alcohols and phenols						
CH ₃ OH(l), methanol	32.04	-238.66	-166.27	126.8	81.6	-726
CH ₃ OH(g)	32.04	-200.66	-161.96	239.81	43.89	-764
C ₂ H ₅ OH(l), ethanol	46.07	-277.69	-174.78	160.7	111.46	-1368
C ₂ H ₅ OH(g)	46.07	-235.10	-168.49	282.70	65.44	-1409
C ₆ H ₅ OH(s), phenol	94.12	-165.0	-50.9	146.0		-3054
Carboxylic acids, hydroxy acids, and esters						
HCOOH(l), formic	46.03	-424.72	-361.35	128.95	99.04	-255
CH ₃ COOH(l), acetic	60.05	-484.5	-389.9	159.8	124.3	-875
CH ₃ COOH(aq)	60.05	-485.76	-396.46	178.7		
CH ₃ CO ₂ (aq)	59.05	-486.01	-369.31	86.6		
(COOH) ₂ (s), oxalic	90.04	-827.2			-6.3	
C ₆ H ₅ COOH(s), benzoic	122.13	-385.1	-245.3	167.6	117	-254
CH ₃ CH(OH)COOH(s), lactic	90.08	-694.0			146.8	-3227
CH ₃ COOC ₂ H ₅ (l), ethyl acetate	88.11	-479.0	-332.7	259.4	170.1	-1344
						-2231

Table D

Alkanals

HCHO(g),
CH₃CHO(l)
CH₃CHO(g)
CH₃COCH

Sugars

C₆H₁₂O₆(s),
C₆H₁₂O₆(s)
C₆H₁₂O₆(s)
C₁₂H₂₂O₁₁(s)

Nitrogen c

CO(NH₂)₂(s)
CH₃NH₂(g),
C₆H₅NH₂(l),
CH₂(NH₂)₂(c)

Table D1.2

Aluminium

Al(s)
Al(l)
Al(g)
Al³⁺(g)
Al³⁺(aq)
Al₂O₃(s, α)
AlCl₃(s)

Argon

Ar(g)

Antimony

Sb(s)
SbH₃(g)

Arsenic

As(s, α)
As(g)
As₄(g)
AsH₃(g)

Barium

Ba(s)
Ba(g)
Ba²⁺(aq)
BaO(s)
BaCl₂(s)

Table D1.1 (continued)

	<i>M</i> / (g mol ⁻¹)	$\Delta_f H^\circ$ / (kJ mol ⁻¹)	$\Delta_f G^\circ$ / (kJ mol ⁻¹)	S_m° / (J K ⁻¹ mol ⁻¹)	$C_{p,m}$ / (J K ⁻¹ mol ⁻¹)	$\Delta_c H^\circ$ / (kJ mol ⁻¹)
<i>Alkanals and alkanones</i>						
HCHO(g), methanal	30.03	-108.57	-102.53	218.77	35.40	-571
CH ₃ CHO(l), ethanal	44.05	-192.30	-128.12	160.2		-1166
CH ₃ CHO(g)	44.05	-166.19	-128.86	250.3	57.3	-1192
CH ₃ COCH ₃ (l), propanone	58.08	-248.1	-155.4	200.4	124.7	-1790
<i>Sugars</i>						
C ₆ H ₁₂ O ₆ (s), α -D-glucose	180.16	-1274				-2808
C ₆ H ₁₂ O ₆ (s), β -D-glucose	180.16	-1268	-910	212		
C ₆ H ₁₂ O ₆ (s), β -D-fructose	180.16	-1266				-2810
C ₁₂ H ₂₂ O ₁₁ (s), sucrose	342.30	-2222	-1543	360.2		-5645
<i>Nitrogen compounds</i>						
CO(NH ₂) ₂ (s), urea	60.06	-333.51	-197.33	104.60	93.14	-632
CH ₃ NH ₂ (g), methylamine	31.06	-22.97	+32.16	243.41	53.1	-1085
C ₆ H ₅ NH ₂ (l), aniline	93.13	+31.1				-3393
CH ₂ (NH ₂)COOH(s), glycine	75.07	-532.9	-373.4	103.5	99.2	-969

Table D1.2 Thermodynamic data (all values relate to 298.15 K)*

	<i>M</i> /(g mol ⁻¹)	$\Delta_f H^\circ$ /(kJ mol ⁻¹)	$\Delta_f G^\circ$ /(kJ mol ⁻¹)	S_m° /(J K ⁻¹ mol ⁻¹)	$C_{p,m}$ /(J K ⁻¹ mol ⁻¹)
<i>Aluminium (aluminum)</i>					
Al(s)	26.98	0	0	28.33	24.35
Al(l)	26.98	+10.56	+7.20	39.55	24.21
Al(g)	26.98	+326.4	+285.7	164.54	21.38
Al ³⁺ (g)	26.98	+5483.17			
Al ³⁺ (aq)	26.98	-531	-485	-321.7	
Al ₂ O ₃ (s, α)	101.96	-1675.7	-1582.3	50.92	79.04
AlCl ₃ (s)	133.24	-704.2	-628.8	110.67	91.84
<i>Argon</i>					
Ar(g)	39.95	0	0	154.84	20.786
<i>Antimony</i>					
Sb(s)	121.75	0	0	45.69	25.23
SbH ₃ (g)	153.24	+145.11	+147.75	232.78	41.05
<i>Arsenic</i>					
As(s, α)	74.92	0	0	35.1	24.64
As(g)	74.92	+302.5	+261.0	174.21	20.79
As ₄ (g)	299.69	+143.9	+92.4	314	
AsH ₃ (g)	77.95	+66.44	+68.93	222.78	38.07
<i>Barium</i>					
Ba(s)	137.34	0	0	62.8	28.07
Ba(g)	137.34	+180	+146	170.24	20.79
Ba ²⁺ (aq)	137.34	-537.64	-560.77	+9.6	
BaO(s)	153.34	-553.5	-525.1	70.43	47.78
BaCl ₂ (s)	208.25	-858.6	-810.4	123.68	75.14

Table D1.2 (continued)

	$M/(\text{g mol}^{-1})$	$\Delta_f H^\circ/(\text{kJ mol}^{-1})$	$\Delta_f G^\circ/(\text{kJ mol}^{-1})$	$S_m^\circ/(\text{J K}^{-1} \text{mol}^{-1})$	$C_{p,m}/(\text{J K}^{-1} \text{mol}^{-1})$
Beryllium					
Be(s)	9.01	0	0	9.50	16.44
Be(g)	9.01	+324.3	+286.6	136.27	20.79
Bismuth					
Bi(s)	208.98	0	0	56.74	25.52
Bi(g)	208.98	+207.1	+168.2	187.00	20.79
Bromine					
Br ₂ (l)	159.82	0	0	152.23	75.689
Br ₂ (g)	159.82	+30.907	+3.110	245.46	36.02
Br(g)	79.91	+111.88	+82.396	175.02	20.786
Br ⁻ (g)	79.91	-219.07			
Br ⁻ (aq)	79.91	-121.55	-103.96	+82.4	-141.8
HBr(g)	90.92	-36.40	-53.45	198.70	29.142
Cadmium					
Cd(s, γ)	112.40	0	0	51.76	25.98
Cd(g)	112.40	+112.01	+77.41	167.75	20.79
Cd ²⁺ (aq)	112.40	-75.90	-77.612	-73.2	
CdO(s)	128.40	-258.2	-228.4	54.8	43.43
CdCO ₃ (s)	172.41	-750.6	-669.4	92.5	
Caesium (cesium)					
Cs(s)	132.91	0	0	85.23	32.17
Cs(g)	132.91	+76.06	+49.12	175.60	20.79
Cs ⁺ (aq)	132.91	-258.28	-292.02	+133.05	-10.5
Calcium					
Ca(s)	40.08	0	0	41.42	25.31
Ca(g)	40.08	+178.2	+144.3	154.88	20.786
Ca ²⁺ (aq)	40.08	-542.83	-553.58	-53.1	
CaO(s)	56.08	-635.09	-604.03	39.75	42.80
CaCO ₃ (s) (calcite)	100.09	-1206.9	-1128.8	92.9	81.88
CaCO ₃ (s) (aragonite)	100.09	-1207.1	-1127.8	88.7	81.25
CaF ₂ (s)	78.08	1219.6	-1167.3	68.87	67.03
CaCl ₂ (s)	110.99	-795.8	-748.1	104.6	72.59
CaBr ₂ (s)	199.90	-682.8	-663.6	130	
Carbon (for 'organic' compounds of carbon, see Table D1.1)					
C(s) (graphite)	12.011	0	0	5.740	8.527
C(s) (diamond)	12.011	+1.895	+2.900	2.377	6.133
C(g)	12.011	+716.68	+671.26	158.10	20.838
C ₂ (g)	24.022	+831.90	+775.89	199.42	43.21
CO(g)	28.011	-110.53	-137.17	197.67	29.14
CO ₂ (g)	44.010	-393.51	-394.36	213.74	37.11
CO ₂ (aq)	44.010	-413.80	-385.98	117.6	
H ₂ CO ₃ (aq)	62.03	-699.65	-623.08	187.4	
HCO ₃ ⁻ (aq)	61.02	-691.99	-586.77	+91.2	
CO ₃ ²⁻ (aq)	60.01	-677.14	-527.81	-56.9	
CCl ₄ (l)	153.82	-135.44	-65.21	216.40	131.75
CS ₂ (l)	76.14	+89.70	+65.27	151.34	75.7
HCN(g)	27.03	+135.1	+124.7	201.78	35.86
HCN(l)	27.03	+108.87	+124.97	112.84	70.63
CN ⁻ (aq)	26.02	+150.6	+172.4	+94.1	

Table

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ChloriCl₂(g)

Cl(g)

Cl⁻(g)Cl⁻(aq)

HCl(g)

HCl(aq)

.....

Chrom

Cr(s)

Cr(g)

CrO₂²⁺(g)Cr₂O₇²⁻(l)

.....

Copper

Cu(s)

Cu(g)

Cu⁺(aq)Cu²⁺(aq)Cu₂O(s)

CuO(s)

CuSO₄(s)CuSO₄·t—CuSO₄·E

.....

DeuteriD₂(g)

HD(g)

D₂O(g)D₂O(l)

HDO(g)

HDO(l)

.....

FluorineF₂(g)

F(g)

F⁻(aq)

HF(g)

.....

Gold

Au(s)

Au(g)

.....

Helium

He(g)

.....

HydrogenH₂(g)

H(g)

H⁺(aq)H₂O(l)H₂O(g)H₂O₂(l)

Table D1.2 (continued)

mol ⁻¹	<i>M</i> /(g mol ⁻¹)	$\Delta_f H^\circ$ /(kJ mol ⁻¹)	$\Delta_f G^\circ$ /(kJ mol ⁻¹)	S_m° /(J K ⁻¹ mol ⁻¹)	$C_{p,m}$ /(J K ⁻¹ mol ⁻¹)
<i>Chlorine</i>					
Cl ₂ (g)	70.91	0	0	223.07	33.91
Cl(g)	35.45	+121.68	+105.68	165.20	21.840
Cl ⁻ (g)	35.45	-233.13			
Cl ⁻ (aq)	35.45	-167.16	-131.23	+56.5	-136.4
HCl(g)	36.46	-92.31	-95.30	186.91	29.12
HCl(aq)	36.46	-167.16	-131.23	56.5	-136.4
<i>Chromium</i>					
Cr(s)	52.00	0	0	23.77	23.35
Cr(g)	52.00	+396.6	+351.8	174.50	20.79
CrO ₂ ⁺ (aq)	115.99	-881.15	-727.75	+50.21	
Cr ₂ O ₇ ²⁻ (aq)	215.99	-1490.3	-1301.1	+261.9	
<i>Copper</i>					
Cu(s)	63.54	0	0	33.150	24.44
Cu(g)	63.54	+338.32	+298.58	166.38	20.79
Cu ⁺ (aq)	63.54	+71.67	+49.98	+40.6	
Cu ²⁺ (aq)	63.54	+64.77	+65.49	-99.6	
Cu ₂ O(s)	143.08	-168.6	-146.0	93.14	63.64
CuO(s)	79.54	-157.3	-129.7	42.63	42.30
CuSO ₄ (s)	159.60	-771.36	-661.8	109	100.0
CuSO ₄ ·H ₂ O(s)	177.62	-1085.8	-918.11	146.0	134
CuSO ₄ ·5H ₂ O(s)	249.68	-2279.7	-1879.7	300.4	280
<i>Deuterium</i>					
D ₂ (g)	4.028	0	0	144.96	29.20
HD(g)	3.022	+0.318	-1.464	143.80	29.196
D ₂ O(g)	20.028	-249.20	-234.54	198.34	34.27
D ₂ O(l)	20.028	-294.60	-243.44	75.94	84.35
HDO(g)	19.022	-245.30	-233.11	199.51	33.81
HDO(l)	19.022	-289.89	-241.86	79.29	
<i>Fluorine</i>					
F ₂ (g)	38.00	0	0	202.78	31.30
F(g)	19.00	+78.99	+61.91	158.75	22.74
F ⁻ (aq)	19.00	-332.63	-278.79	-13.8	-106.7
HF(g)	20.01	-271.1	-273.2	173.78	29.13
<i>Gold</i>					
Au(s)	196.97	0	0	47.40	25.42
Au(g)	196.97	+366.1	+326.3	180.50	20.79
<i>Helium</i>					
He(g)	4.003	0	0	126.15	20.786
<i>Hydrogen (see also deuterium)</i>					
H ₂ (g)	2.016	0	0	130.684	28.824
H(g)	1.008	+217.97	+203.25	114.71	20.784
H ⁺ (aq)	1.008	0	0	0	0
H ₂ O(l)	18.015	-285.83	-237.13	69.91	75.291
H ₂ O(g)	18.015	-241.82	-228.57	188.83	33.58
H ₂ O ₂ (l)	34.015	-187.78	-120.35	109.6	89.1

Table D1.2 (continued)

	$M/(\text{g mol}^{-1})$	$\Delta_f H^\circ/(\text{kJ mol}^{-1})$	$\Delta_f G^\circ/(\text{kJ mol}^{-1})$	$S_m^\circ/(\text{J K}^{-1} \text{mol}^{-1})$	$C_{p,m}/(\text{J K}^{-1} \text{mol}^{-1})$
<i>Iodine</i>					
$\text{I}_2(\text{s})$	253.81	0	0	116.135	54.44
$\text{I}_2(\text{g})$	253.81	+62.44	+19.33	260.69	36.90
$\text{I}(\text{g})$	126.90	+106.84	+70.25	180.79	20.786
$\text{I}^-(\text{aq})$	126.90	-55.19	-51.57	+111.3	-142.3
$\text{HI}(\text{g})$	127.91	+26.48	+1.70	206.59	29.158
<i>Iron</i>					
$\text{Fe}(\text{s})$	55.85	0	0	27.28	25.10
$\text{Fe}(\text{g})$	55.85	+416.3	+370.7	180.49	25.68
$\text{Fe}^{2+}(\text{aq})$	55.85	-89.1	-78.90	-137.7	
$\text{Fe}^{3+}(\text{aq})$	55.85	-48.5	-4.7	-315.9	
$\text{Fe}_3\text{O}_4(\text{s})$ (magnetite)	231.54	-1184.4	-1015.4	146.4	143.43
$\text{Fe}_2\text{O}_3(\text{s})$ (haematite)	159.69	-824.2	-742.2	87.40	103.85
$\text{FeS}(\text{s}, \alpha)$	87.91	-100.0	-100.4	60.29	50.54
$\text{FeS}_2(\text{s})$	119.98	-178.2	-166.9	52.93	62.17
<i>Krypton</i>					
$\text{Kr}(\text{g})$	83.80	0	0	164.08	20.786
<i>Lead</i>					
$\text{Pb}(\text{s})$	207.19	0	0	64.81	26.44
$\text{Pb}(\text{g})$	207.19	+195.0	+161.9	175.37	20.79
$\text{Pb}^{2+}(\text{aq})$	207.19	-1.7	-24.43	+10.5	
$\text{PbO}(\text{s}, \text{yellow})$	223.19	-217.32	-187.89	68.70	45.77
$\text{PbO}(\text{s}, \text{red})$	223.19	-218.99	-188.93	66.5	45.81
$\text{PbO}_2(\text{s})$	239.19	-277.4	-217.33	68.6	64.64
<i>Lithium</i>					
$\text{Li}(\text{s})$	6.94	0	0	29.12	24.77
$\text{Li}(\text{g})$	6.94	+159.37	+126.66	138.77	20.79
$\text{Li}^+(\text{aq})$	6.94	-278.49	-293.31	+13.4	+68.6
<i>Magnesium</i>					
$\text{Mg}(\text{s})$	24.31	0	0	32.68	24.89
$\text{Mg}(\text{g})$	24.31	+147.70	+113.10	148.65	20.786
$\text{Mg}^{2+}(\text{aq})$	24.31	-466.85	-454.8	-138.1	
$\text{MgO}(\text{s})$	40.31	-601.70	-569.43	26.94	37.15
$\text{MgCO}_3(\text{s})$	84.32	-1095.8	-1012.1	65.7	75.52
$\text{MgCl}_2(\text{s})$	95.22	-641.32	-591.79	89.62	71.38
$\text{MgBr}_2(\text{s})$	184.13	-524.3	-503.8	117.2	
<i>Mercury</i>					
$\text{Hg}(\text{l})$	200.59	0	0	76.02	27.983
$\text{Hg}(\text{g})$	200.59	+61.32	+31.82	174.96	20.786
$\text{Hg}^{2+}(\text{aq})$	200.59	+171.1	+164.40	-32.2	
$\text{Hg}_2^{2+}(\text{aq})$	401.18	+172.4	+153.52	+84.5	
$\text{HgO}(\text{s})$	216.59	-90.83	-58.54	70.29	44.06
$\text{Hg}_2\text{Cl}_2(\text{s})$	472.09	-265.22	-210.75	192.5	102
$\text{HgCl}_2(\text{l})$	271.50	-224.3	-178.6	146.0	
$\text{HgS}(\text{s}, \text{black})$	232.65	-53.6	-47.7	88.3	
<i>Neon</i>					
$\text{Ne}(\text{g})$	20.18	0	0	146.33	20.786

Tabl

Nitric

 $\text{N}_2(\text{g})$ $\text{N}(\text{g})$ $\text{NO}(\text{g})$ $\text{N}_2\text{O}(\text{g})$ $\text{NO}_2(\text{g})$ N_2O_4 N_2O_5 N_2O_5 HNO_2 HNO_3 NO_3^- $\text{NH}_3(\text{g})$ $\text{NH}_3(\text{aq})$ $\text{NH}_4^+(\text{aq})$ NH_2O $\text{HN}_3(\text{l})$ $\text{HN}_3(\text{g})$ $\text{N}_2\text{H}_4(\text{l})$ NH_4N NH_4Cl

Oxygen

 $\text{O}_2(\text{g})$ $\text{O}(\text{g})$ $\text{O}_3(\text{g})$ $\text{OH}^-(\text{aq})$

Phosphorus

 $\text{P}(\text{s}, \text{w})$ $\text{P}(\text{g})$ $\text{P}_2(\text{g})$ $\text{P}_4(\text{g})$ $\text{PH}_3(\text{g})$ $\text{PCl}_3(\text{g})$ $\text{PCl}_3(\text{l})$ $\text{PCl}_5(\text{g})$ $\text{PCl}_5(\text{s})$ H_3PO_3 H_3PO_3 H_3PO_4 H_3PO_4 H_3PO_4 $\text{PO}_4^{3-}(\text{aq})$ $\text{P}_4\text{O}_{10}(\text{s})$ $\text{P}_4\text{O}_6(\text{s})$

Potassium

 $\text{K}(\text{s})$ $\text{K}(\text{g})$ $\text{K}^+(\text{aq})$ $\text{K}^+(\text{aq})$ $\text{KOH}(\text{s})$ $\text{KF}(\text{s})$ $\text{KCl}(\text{s})$ $\text{KBr}(\text{s})$ $\text{KI}(\text{s})$

Table D1.2 (continued)

$^{-1} \text{ mol}^{-1}$	$M/(\text{g mol}^{-1})$	$\Delta_f H^\circ/(\text{kJ mol}^{-1})$	$\Delta_f G^\circ/(\text{kJ mol}^{-1})$	$S_m^\circ/(\text{J K}^{-1} \text{ mol}^{-1})$	$C_{p,m}/(\text{J K}^{-1} \text{ mol}^{-1})$
<i>Nitrogen</i>					
$\text{N}_2(\text{g})$	28.013	0	0	191.61	29.125
$\text{N}(\text{g})$	14.007	+472.70	+455.56	153.30	20.786
$\text{NO}(\text{g})$	30.01	+90.25	+86.55	210.76	29.844
$\text{N}_2\text{O}(\text{g})$	44.01	+82.05	+104.20	219.85	38.45
$\text{NO}_2(\text{g})$	46.01	+33.18	+51.31	240.06	37.20
$\text{N}_2\text{O}_4(\text{g})$	92.01	+9.16	+97.89	304.29	77.28
$\text{N}_2\text{O}_5(\text{s})$	108.01	-43.1	+113.9	178.2	143.1
$\text{N}_2\text{O}_5(\text{g})$	108.01	+11.3	+115.1	355.7	84.5
$\text{HNO}_3(\text{l})$	63.01	-174.10	-80.71	155.60	109.87
$\text{HNO}_3(\text{aq})$	63.01	-207.36	-111.25	146.4	-86.6
$\text{NO}_3^-(\text{aq})$	62.01	-205.0	-108.74	+146.4	-86.6
$\text{NH}_3(\text{g})$	17.03	-46.11	-16.45	192.45	35.06
$\text{NH}_3(\text{aq})$	17.03	-80.29	-26.50	113.3	
$\text{NH}_4^+(\text{aq})$	18.04	-132.51	-79.31	+113.4	+79.9
$\text{NH}_2\text{OH}(\text{s})$	33.03	-114.2			
$\text{HN}_3(\text{l})$	43.03	+264.0	+327.3	140.6	43.68
$\text{HN}_3(\text{g})$	43.03	+294.1	+328.1	238.97	98.87
$\text{N}_2\text{H}_4(\text{l})$	32.05	+50.63	+149.43	121.21	139.3
$\text{NH}_4\text{NO}_3(\text{s})$	80.04	-365.56	-183.87	151.08	84.1
$\text{NH}_4\text{Cl}(\text{s})$	53.49	-314.43	-202.87	94.6	
<i>Oxygen</i>					
$\text{O}_2(\text{g})$	31.999	0	0	205.138	29.355
$\text{O}(\text{g})$	15.999	+249.17	+231.73	161.06	21.912
$\text{O}_3(\text{g})$	47.998	+142.7	+163.2	238.93	39.20
$\text{OH}^-(\text{aq})$	17.007	-229.99	-157.24	-10.75	-148.5
<i>Phosphorus</i>					
$\text{P}(\text{s, wh})$	30.97	0	0	41.09	23.840
$\text{P}(\text{g})$	30.97	+314.64	+278.25	163.19	20.786
$\text{P}_2(\text{g})$	61.95	+144.3	+103.7	218.13	32.05
$\text{P}_4(\text{g})$	123.90	+58.91	+24.44	279.98	67.15
$\text{PH}_3(\text{g})$	34.00	+5.4	+13.4	210.23	37.11
$\text{PCl}_3(\text{g})$	137.33	-287.0	-267.8	311.78	71.84
$\text{PCl}_3(\text{l})$	137.33	-319.7	-272.3	217.1	
$\text{PCl}_5(\text{g})$	208.24	-374.9	-305.0	364.6	112.8
$\text{PCl}_5(\text{s})$	208.24	-443.5			
$\text{H}_3\text{PO}_3(\text{s})$	82.00	-964.4			
$\text{H}_3\text{PO}_3(\text{aq})$	82.00	-964.8			
$\text{H}_3\text{PO}_4(\text{s})$	94.97	-1279.0	-1119.1	110.50	106.06
$\text{H}_3\text{PO}_4(\text{l})$	94.97	-1266.9			
$\text{H}_3\text{PO}_4(\text{aq})$	94.97	-1277.4	-1018.7	-222	
$\text{PO}_4^{3-}(\text{aq})$	94.97	-1277.4	-1018.7	-222	
$\text{P}_4\text{O}_{10}(\text{s})$	283.89	-2984.0	-2697.0	228.86	211.71
$\text{P}_4\text{O}_8(\text{s})$	219.89	-1640.1			
<i>Potassium</i>					
$\text{K}(\text{s})$	39.10	0	0	64.18	29.58
$\text{K}(\text{g})$	39.10	+89.24	+60.59	160.336	20.786
$\text{K}^+(\text{g})$	39.10	+514.26			
$\text{K}^+(\text{aq})$	39.10	-252.38	-283.27	+102.5	+21.8
$\text{KOH}(\text{s})$	56.11	-424.76	-379.08	78.9	64.9
$\text{KF}(\text{s})$	58.10	-576.27	-537.75	66.57	49.04
$\text{KCl}(\text{s})$	74.56	-436.75	-409.14	82.59	51.30
$\text{KBr}(\text{s})$	119.01	-393.80	-380.66	95.90	52.30
$\text{KI}(\text{s})$	166.01	-327.90	-324.89	106.32	52.93

Table D1.2 (continued)

	$M/(\text{g mol}^{-1})$	$\Delta_f H^\circ/(\text{kJ mol}^{-1})$	$\Delta_f G^\circ/(\text{kJ mol}^{-1})$	$S_m^\circ/(\text{J K}^{-1} \text{mol}^{-1})$	$C_{p,m}/(\text{J K}^{-1} \text{mol}^{-1})$
<i>Silicon</i>					
Si(s)	28.09	0	0	18.83	20.00
Si(g)	28.09	+455.6	+411.3	167.97	22.25
SiO ₂ (s,α)	60.09	-910.93	-856.64	41.84	44.43
<i>Silver</i>					
Ag(s)	107.87	0	0	42.55	25.351
Ag(g)	107.87	+284.55	+245.65	173.00	20.79
Ag ⁺ (aq)	107.87	+105.58	+77.11	+72.68	+21.8
AgBr(s)	187.78	-100.37	-96.90	107.1	52.38
AgCl(s)	143.32	-127.07	-109.79	96.2	50.79
Ag ₂ O(s)	231.74	-31.05	-11.20	121.3	65.86
AgNO ₃ (s)	169.88	-124.39	-33.41	140.92	93.05
<i>Sodium</i>					
Na(s)	22.99	0	0	51.21	28.24
Na(g)	22.99	+107.32	+76.76	153.71	20.79
Na ⁺ (aq)	22.99	-240.12	-261.91	+59.0	+46.4
NaOH(s)	40.00	-425.61	-379.49	64.46	59.54
NaCl(s)	58.44	-411.15	-384.14	72.13	50.50
NaBr(s)	102.90	-361.06	-348.98	86.82	51.38
NaI(s)	149.89	-287.78	-286.06	98.53	52.09
<i>Sulfur</i>					
S(s, α) (rhombic)	32.06	0	0	31.80	22.64
S(s, β) (monoclinic)	32.06	+0.33	+0.1	32.6	23.6
S(g)	32.06	+278.81	+238.25	167.82	23.673
S ₂ (g)	64.13	+128.37	+79.30	228.18	32.47
S ²⁻ (aq)	32.06	+33.1	+85.8	-14.6	
SO ₂ (g)	64.06	-296.83	-300.19	248.22	39.87
SO ₃ (g)	80.06	-395.72	-371.06	256.76	50.67
H ₂ SO ₄ (l)	98.08	-813.99	-690.00	156.90	138.9
H ₂ SO ₄ (aq)	98.08	-909.27	-744.53	20.1	-293
SO ₄ ²⁻ (aq)	96.06	-909.27	-744.53	+20.1	-293
HSO ₄ ⁻ (aq)	97.07	-887.34	-755.91	+131.8	-84
H ₂ S(g)	34.08	-20.63	-33.56	205.79	34.23
H ₂ S(aq)	34.08	-39.7	-27.83	121	
HS ⁻ (aq)	33.072	-17.6	+12.08	+62.08	
SF ₆ (g)	146.05	-1209	-1105.3	291.82	97.28
<i>Tin</i>					
Sn(s,β)	118.69	0	0	51.55	26.99
Sn(g)	118.69	+302.1	+267.3	168.49	20.26
Sn ²⁺ (aq)	118.69	-8.8	-27.2	-17	
SnO(s)	134.69	-285.8	-256.8	56.5	44.31
SnO ₂ (s)	150.69	-580.7	+519.6	52.3	52.59
<i>Xenon</i>					
Xe(g)	131.30	0	0	169.68	20.786
<i>Zinc</i>					
Zn(s)	65.37	0	0	41.63	25.40
Zn(g)	65.37	+130.73	+95.14	160.98	20.79
Zn ²⁺ (aq)	65.37	-153.89	-147.06	-112.1	+46
ZnO(s)	81.37	-348.28	-318.30	43.64	40.25

* Entropies and heat capacities of ions are relative to H⁺(aq) and are given with a sign.

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O₂
Cl
Mn
Br₂
Pu
NO
2H
Cl
Hg²⁺
NO₂
Ag⁺
Hg₂²⁺
Fe³⁺
Ti³⁺
Cd²⁺
In²⁺
Cr³⁺
Fe²⁺
In³⁺
S + 2
In³⁺
U⁴⁺
Cr³⁺
Zn²⁺
Cd(O
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Cr²⁺
Mn²⁺
V²⁺