

TABLE A-5 HEAT OF COMBUSTION

Substance	Formula	State	ΔH_c
hydrogen	H ₂	g	-285.8
graphite	C	s	-393.5
carbon monoxide	CO	g	-283.0
methane	CH ₄	g	-890.8
ethane	C ₂ H ₆	g	-1560.7
propane	C ₃ H ₈	g	-2219.2
butane	C ₄ H ₁₀	g	-2877.6
pentane	C ₅ H ₁₂	g	-3535.6
hexane	C ₆ H ₁₄	l	-4163.2
heptane	C ₇ H ₁₆	l	-4817.0
octane	C ₈ H ₁₈	l	-5470.5
ethene (ethylene)	C ₂ H ₄	g	-1411.2
propene (propylene)	C ₃ H ₆	g	-2058.0

Substance	Formula	State	ΔH_c
benzene	C ₆ H ₆	l	-3267.6
toluene	C ₇ H ₈	l	-3910.3
naphthalene	C ₁₀ H ₈	s	-5156.3
anthracene	C ₁₄ H ₁₀	s	-7076.5
methanol	CH ₃ OH	l	-726.1
ethanol	C ₂ H ₅ OH	l	-1366.8
ether	(C ₂ H ₅) ₂ O	l	-2751.1
formaldehyde	CH ₂ O	g	-570.7
glucose	C ₆ H ₁₂ O ₆	s	-2803.0
sucrose	C ₁₂ H ₂₂ O ₁₁	s	-5640.9

ΔH_c = heat of combustion of the given substance. All values of ΔH_c are expressed as kJ/mol of substance oxidized to H₂O(l) and/or CO₂(g) at constant pressure and 25°C.

Substance	State	ΔH_f	Substance	State	ΔH_f
ammonia	g	-45.9	lead(IV) oxide	s	-274.5
ammonium chloride	s	-314.4	lead(II) nitrate	s	-451.9
ammonium sulfate	s	-1180.9	lead(I) sulfate	s	-919.94
barium chloride	s	-858.6	lithium chloride	s	-408.6
barium nitrate	s	-992.1	lithium nitrate	s	-483.1
barium sulfate	s	-1473.2	magnesium chloride	s	-641.5
benzene	g	+82.88	magnesium oxide	s	-601.6
benzene	l	+49.080	magnesium sulfate	s	-1284.9
calcium carbonate	s	-1207.6	manganese(IV) oxide	s	-520.0
calcium chloride	s	-795.4	manganese(II) sulfate	s	-1065.3
calcium hydroxide	s	-983.2	mercury(I) chloride	s	-264.2
calcium nitrate	s	-938.2	mercury(II) chloride	s	-230.0
calcium oxide	s	-634.9	mercury(II) oxide (red)	s	-90.8
calcium sulfate	s	-1434.5	methane	g	-74.9
carbon (diamond)	s	+1.9	nitrogen dioxide	g	+33.2
carbon (graphite)	s	0.00	nitrogen monoxide	g	+90.29
carbon dioxide	g	-393.5	dinitrogen monoxide	g	+82.1
carbon monoxide	g	-110.5	dinitrogen tetroxide	g	+9.2
copper(II) nitrate	s	-302.9	oxygen (O ₂)	g	0.00
copper(II) oxide	s	-157.3	ozone (O ₃)	g	+142.7
copper(II) sulfate	s	-771.4	diphosphorus pentoxide	s	-3009.9
ethane	g	-83.8	potassium bromide	s	-393.8
ethyne (acetylene)	g	+228.2	potassium chloride	s	-436.49
hydrogen (H ₂)	g	0.00	potassium hydroxide	s	-424.58
hydrogen bromide	g	-36.29	potassium nitrate	s	-494.6
hydrogen chloride	g	-92.3	potassium sulfate	s	-1437.8
hydrogen fluoride	g	-273.3	silicon dioxide (quartz)	s	-910.7
hydrogen iodide	g	+26.5	silver chloride	s	-127.01 = 0.5
hydrogen oxide (water)	g	-241.8	silver nitrate	s	-120.5
hydrogen oxide (water)	l	-285.8	silver sulfide	s	-32.59
hydrogen peroxide	g	-136.3	sodium bromide	s	-361.8
hydrogen peroxide	l	-187.8	sodium chloride	s	-385.9
hydrogen sulfide	g	-23.9	sodium hydroxide	s	-425.9
iodine (I ₂)	s	0.00	sodium nitrate	s	-467.9
iodine (I ₂)	g	+62.4	sodium sulfate	l	-1387.1
iron(II) chloride	s	-399.4	sulfur dioxide	g	-296.8
iron(III) oxide	s	-825.5	sulfur trioxide	g	-395.7
iron(III) oxide	s	-825.5	tin(IV) chloride	l	-511.3
iron(II) sulfate	s	-928.4	zinc nitrate	s	-483.7
iron(II) sulfide	s	-100.0	zinc oxide	s	-350.5
lead(II) oxide	s	-217.3	zinc sulfate	s	-980.14

ΔH_f is heat of formation of the given substance from its elements. All values of ΔH_f are expressed as kJ/mol at 25°C. Negative values of ΔH_f indicate exothermic reactions. s = solid, l = liquid, g = gas

Table 18.1 Standard Entropies (at 25°C)

Formula	S°, J/(mol · K)	Formula	S°, J/(mol · K)	Formula	S°, J/(mol · K)
Hydrogen					
H ⁺ (aq)	0	Carbon (continued)		S ₂ (g)	228.1
H ₂ (g)	130.6	CS ₂ (l)	151.0	S(rhombic)	31.9
Sodium					
Na ⁺ (aq)	60.2	HCN(g)	201.7	S(monoclinic)	32.6
Na(s)	51.4	HCN(l)	112.8	SO ₂ (g)	248.1
NaCl(s)	72.1	CCl ₄ (g)	309.7	H ₂ S(g)	205.6
NaHCO ₃ (s)	102	CCl ₄ (l)	214.4	Fluorine	
Na ₂ CO ₃ (s)	139	CH ₃ CHO(g)	266	F ⁻ (aq)	-9.6
Calcium					
Ca ²⁺ (aq)	-55.2	C ₂ H ₅ OH(l)	161	F ₂ (g)	202.7
Ca(s)	41.6	Silicon		HF(g)	173.7
CaO(s)	38.2	Si(s)	18.0	Chlorine	
CaCO ₃ (s)	92.9	SiO ₂ (s)	41.5	Cl ⁻ (aq)	55.1
Carbon					
C(graphite)	5.7	SiF ₄ (g)	285	Cl ₂ (g)	223.0
C(diamond)	2.4	Lead		HCl(g)	186.8
CO(g)	197.5	Pb(s)	64.8	Bromine	
CO ₂ (g)	213.7	PbO(s)	66.3	Br ⁻ (aq)	80.7
HCO ₃ ⁻ (aq)	95.0	PbS(s)	91.3	Br ₂ (l)	152.2
CH ₄ (g)	186.1	Nitrogen		Iodine	
C ₂ H ₄ (g)	219.2	N ₂ (g)	191.5	I ⁻ (aq)	109.4
C ₂ H ₆ (g)	229.5	CO ₂ (g)	193	I ₂ (s)	116.1
C ₆ H ₆ (l)	172.8	NO(g)	210.6	Silver	
HCHO(g)	219	NO ₂ (g)	239.9	Ag ⁺ (aq)	73.9
CH ₃ OH(l)	127	HNO ₃ (aq)	146	Ag(s)	42.7
CS ₂ (g)	237.8	Oxygen		AgF(s)	84
		O ₂ (g)	205.0	AgCl(s)	96.1
		O ₃ (g)	238.8	AgBr(s)	107.1
		OH ⁻ (aq)	-10.5	AgI(s)	114
		H ₂ O(g)	188.7		
		H ₂ O(l)	69.9		