TABLE 4.11 Bond Dissociation Energies

The bond dissociation energy (enthalpy change) for a bond A—B which is broken through the reaction

$$AB \rightarrow A + B$$

is defined as the standard-state enthalpy change for the reaction at a specified temperature, here at 298 K. That is,

$$\Delta Hf_{298} = \Delta Hf_{298}(A) + \Delta Hf_{298}(B) - \Delta Hf_{298}(AB)$$

All values refer to the gaseous state and are given at 298 K. Values of 0 K are obtained by subtracting $\frac{3}{2}RT$ from the value at 298 K.

To convert the tabulated values to kcal/mol, divide by 4.184.

Bond	ΔHf_{298}, kJ/mol
Aluminum	
Al—Al	186(9)
Al—As	180
Al—Au	326(6)
Al—Br	439(8)
Al—C	255
Al—Cl	494(13)
AlCl—Cl	402(8)
$AlCl_2$—Cl	372(8)
AlO—Cl	515(84)
Al—Cu	216(10)
Al—D	291
Al—F	664(6)
AlF—F	546(42)
AlF_2—F	544(46)
AlO—F	761(42)
Al—H	285(6)
Al—I	368(4)
Al—Li	176(15)
Al—N	297(96)
Al—O	512(4)
AlCl—O	540(41)
AlF—O	582
Al—P	213(13)
Al—Pd	259(12)
Al—S	374(8)
Al—Se	334(10)
Al—Si	251(3)
Al—Te	268(10)
Al—U	326(29)
Antimony	
Sb—Sb	299(6)
Sb—Br	314(59)
Sb—Cl	360(50)
Sb—F	439(96)
Sb—N	301(50)
Sb—O	372(84)
Sb—P	357
Sb—S	379
Sb—Te	277.4(38)
Arsenic	
As—As	382(11)
As—Cl	448
As—Ga	209.6(12)
As—H	272(12)
As—N	582(126)
As—O	481(8)
As—P	534(13)
As—S	(478)
As—Se	96
As—Tl	198(15)
Astatine	
At—At	(115.9)
Barium	
Ba—Br	370(8)
Ba—Cl	444(13)
Ba—F	487(7)
Ba—I	>431(4)
Ba—O	563(42)
Ba—OH	477(42)
Ba—S	400(19)
Beryllium	
Be—Be	59
Be—Br	381(84)
Be—Cl	388(9)

TABLE 4.11 Bond Dissociation Energies (*Continued*)

Bond	ΔHf_{298}, kJ/mol
Beryllium (*continued*)	
BeCl—Cl	540(63)
Be—F	577(42)
Be—H	226(21)
Be—O	448(21)
Be—S	372(59)
Bismuth	
Bi—Bi	197(4)
Bi—Br	267(4)
Bi—Cl	305(8)
Bi—D	284
Bi—F	259(29)
Bi—Ga	159(17)
Bi—H	279
Bi—O	343(6)
Bi—P	280(13)
Bi—Pb	142(15)
Bi—S	316(5)
Bi—Sb	251(4)
Bi—Se	280(6)
Bi—Te	232(11)
Bi—Tl	121(13)
Boron	
B—B	297(21)
$H_3B—BH_3$	146
OB—BO	506(84)
B—Br	435(21)
B—C	448(29)
B—Cl	536(29)
BO—Cl	460(42)
B—D	341(6)
B—F	766(13)
BF—F	523(63)
BF_2—F	557(84)
B—H	330(4)
B—I	384(21)
B—N	389(21)
B—O	806(5)
BCl—O	715(41)
B—P	347(17)
B—S	581(9)
B—Se	462(15)
B—Si	289(29)
B—Te	354(20)

Bond	ΔHf_{298}, kJ/mol
Bromine	
Br—Br	193.870(4)
Br—C	280(21)
$Br—CH_3$	284(8)
$Br—CH_2Br$	255(13)
$Br—CHBr_2$	259(17)
$Br—CBr_3$	209(13)
$Br—CCl_3$	218(13)
$Br—CF_3$	285(13)
$Br—CF_2CF_3$	287.4(63)
$Br—CF_2CF_2CF_3$	278.2(63)
$Br—CHF_2$	289
Br—Cl	218.84(4)
Br—CN	381
$Br—CO—C_6H_5$	268
Br—F	233.8(2)
Br—N	276(21)
$Br—NF_2$	222
Br—NO	120.1(63)
Br—O	235.1(4)
Cadmium	
Cd—Cd	11.3(8)
Cd—Br	159(96)
Cd—Cl	206.7(34)
Cd—F	305(21)
Cd—H	69.0(4)
Cd—I	138(21)
Cd—In	138
Cd—O	142(42)
Cd—S	196
Cd—Se	310
Calcium	
Ca—Ca	14.98(46)
Ca—Br	321(23)
Ca—Cl	398(13)
Ca—F	527(21)
Ca—H	167.8
Ca—I	285(63)
Ca—O	464(84)
Ca—S	314(19)
Carbon	
C—C	607(21)
$H_3C—CH_3$	368

TABLE 4.11 Bond Dissociation Energies (*Continued*)

Bond	ΔHf_{298}, kJ/mol
Carbon (*continued*)	
$(CH_3)_2C—CH_3$	335
$(CH_3)_2C—C(CH_3)_2$	282.4
$CH_3—C_6H_5$	389
$CH_3—CH_2C_6H_5$	301
$(CH_3)_3C—C(C_6H_5)_3$	63
CH_3—allyl	301
CH_3—vinyl	121
$CH_3—C\equiv CH$	490
$CH_2=CH—CH=CH_2$	418
$HC\equiv C—C\equiv CH$	628
$H_2C=CH_2$	682
$HC\equiv CH$	962
$CH_3—CN$	506(21)
$CH_3—CH_2CN$	305(8)
$CH_3—CH(CH_3)CN$	331(8)
$CH_3—C(C_6H_5)CN(CH_3)$	251
$CH_3CH_2—CH_2CN$	321.8(71)
$NC—CN$	603(21)
$C_6H_5—C_6H_5$	418
$CH_3—CF_3$	423.4(46)
$CH_2F—CH_2F$	368(8)
$CF_3—CF_3$	406(13)
$CF_2=CF_2$	318(13)
$CF_3—CN$	501
$CH_3—CHO$	314
$CH_3—CO$	342.7
$CH_3CO—CF_3$	308.8
$CH_3CO—COCH_3$	280(8)
$C_6H_5CO—COC_6H_5$	277.8
Aryl—CH_2COCH_2—aryl	273.6
$C_6H_5CH_2—COOH$	284.9
$(C_6H_5CH_2)_2CH—COOH$	248.5
$C—Cl$	397(29)
$C—F$	536(21)
$C—H$	337.2(8)
$C—I$	209(21)
$C—N$	770(4)
$CF_3—NF_2$	272(13)
$CH_3—NH_2$	331(13)
$C_6H_5CH_2—NH_2$	301(4)
$CH_3—NHC_6H_5$	285
$CH_3—N(CH_3)C_6H_5$	272
$C_6H_5CH_2—NHCH_3$	289(4)
$C_6H_5CH_2—N(CH_3)_2$	255(4)
$CH_3—(N=NCH_3)$	219.7
$C_2H_5—(N=NC_2H_5)$	209.2
$(CH_3)_3C—N=NC(CH_3)_3$	182.0
Aryl—$CH_2N=NCH_2$—aryl	157
$CF_3—(N=NCF_3)$	231.0
$H_2C=NH$	644(21)
$HC\equiv N$	937
$CH_3—NO$	174.9(38)
$C_2H_5—NO$	175.7(54)
$C_3H_7—NO$	167.8(75)
$(CH_3)_2CH—NO$	171.5(54)
n-$C_4H_9—NO$	215.5(42)
$C_6H_5—NO$	215.5(42)
$Cl_3C—NO$	134
$F_3C—NO$	130
$C_6F_5—NO$	211.3(42)
$NC—NO$	121(13)
$CH_3—NO_2$	247(13)
$C_2H_5—NO_2$	259
$C—O$	1076.5(4)
$CH_3—OCH_3$	335
$CH_3—OC_6H_5$	381
$CH_3—OCH_2C_6H_5$	280
$C_2H_5—OC_6H_5$	213
$C_6H_5CH_2—OCOCH_3$	285
$C_6H_5CH_2—OCOC_6H_5$	289
$CH_3CO—OCH_3$	406
$CH_3—OSOCH_3$	280
$CH_2=CHCH_2—OSOCH_3$	209
$C_6H_5CH_2—OSOCH_3$	222
$C=O$	749
$H_2C=O$	732
$OC=O$	532.2(4)
$SC=O$	628
$C\equiv O$	1075
$C—P$	513(8)
$C—S$	699(8)
$CH_3—SH$	305(13)
$CH_3—SC_6H_5$	285(8)
$CH_3—SCH_2C_6H_5$	247(8)
$OC—S$	310.4
$C—Se$	582(96)
Cerium	
$Ce—Ce$	243(21)
$Ce—F$	582(42)
$Ce—N$	519(21)
$Ce—O$	795(13)
$Ce—S$	573(13)
$Ce—Se$	495(15)
$Ce—Te$	389(42)

TABLE 4.11 Bond Dissociation Energies (*Continued*)

Bond	ΔHf_{298}, kJ/mol
Cesium	
Cs—Cs	41.75(93)
Cs—Br	397.5(42)
Cs—Cl	439(21)
Cs—F	514(8)
Cs—H	178.1(38)
Cs—I	339(4)
Cs—O	297(25)
Cs—OH	385(13)
Chlorine	
Cl—Cl	242.580(16)
Cl—C	338(42)
Cl—CH_3	339(21)
Cl—CH_3^+	213
Cl—$C(CH_3)_3$	328.4
Cl—CH_2Cl	310(13)
Cl—CCl_3	293(21)
Cl—CF_3	360(33)
Cl—CCl_2F	305(8)
Cl—$CClF_2$	318(8)
Cl—CF_2CF_2	346.0(71)
Cl—$CH{=}CH_2$	351
Cl—CN	439
Cl—COCl	328
Cl—$COCH_3$	349.4
Cl—COC_6H_5	310(13)
Cl—Cl^+	393
Cl—ClO	143.3(42)
O_3Cl—ClO_4	243
Cl—F	250.54(8)
O_3Cl—F	255
Cl—N	389(50)
Cl—NCl	280
Cl—NCl_2	381
Cl—NF_2	*ca.* 134
Cl—NH_2	251(25)
Cl—NO	159(6)
Cl—NO_2	142(4)
Cl—O	272(4)
OCl—O	243(13)
O_2Cl—O	201(4)
Cl—P	289(42)
Cl—$SiCl_3$	464
Chromium	
Cr—Cr	155(21)
Cr—Br	328(24)
Cr—Cl	366(24)
Cr—Cu	155(21)
Cr—F	437(20)
Cr—Ge	170(29)
Cr—H	280(50)
Cr—I	287(24)
Cr—N	378(19)
Cr—O	427(29)
OCr—O	531(63)
O_2Cr—O	477(84)
Cr—S	339(21)
Cobalt	
Co—Co	167(25)
Co—Br	331(42)
Co—Cl	398(8)
Co—Cu	162(17)
Co—F	435(63)
Co—Ge	239(25)
Co—I	235(81)
Co—O	368(21)
Co—S	343(21)
Copper	
Cu—Cu	202(4)
Cu—Br	331(25)
Cu—Cl	383(21)
Cu—F	431(13)
Cu—Ga	216(15)
Cu—Ge	209(21)
Cu—H	280(8)
Cu—I	197(21)
Cu—Ni	206(17)
Cu—O	343(63)
Cu—S	285(17)
Cu—Se	293(38)
Cu—Sn	177(17)
Cu—Te	176(38)
Curium	
Cm—O	736
Dysprosium	
Dy—F	527(21)
Dy—O	611(42)
Dy—Se	322(42)
Dy—Te	234(42)

TABLE 4.11 Bond Dissociation Energies (*Continued*)

Bond	ΔHf_{298}, kJ/mol
Erbium	
Er—F	565(17)
Er—O	611(13)
Er—S	418(42)
Er—Se	326(42)
Er—Te	239(42)
Europium	
Eu—Eu	33.5(165)
Eu—Cl	*ca.* 326
Eu—F	528(18)
Eu—O	557(13)
Eu—S	364(15)
Eu—Se	301(15)
Eu—Te	243(15)
Fluorine	
F—F	156.9(96)
F—F^+	>251
F—CH_3	452(21)
F—$C(CH_3)_3$	439
F—C_6H_5	485
F—CCl_3	444(21)
F—CCl_2F	460(25)
F—$CClF_2$	490(25)
F—CF_3	523(17)
F—$COCH_3$	498
F—FO	272(13)
F—FO_2	81.0
F—N	301(42)
F—NF	318(25)
F—NF_2	243(8)
F—NO	235.6(42)
F—NO_2	197(25)
Gadolinium	
Gd—F	590(27)
Gd—O	716(17)
Gd—S	525(15)
Gd—Se	431(15)
Gallium	
Ga—Ga	138(21)
Ga—Br	444(17)
$(CH_3)_3Ga—CH_3$	253
Ga—Cl	481(13)
Ga—F	577(15)
Ga—H	<274
Ga—I	339(10)
Gallium (*continued*)	
Ga—O	285(63)
Ga—P	230(13)
Ga—Sb	209(13)
Ga—Te	251(25)
Germanium	
Ge—Ge	274(21)
Ge—Br	255(29)
Ge—Cl	431.8(4)
Ge—F	485(21)
Ge—H	321.3(8)
Ge—O	662(13)
Ge—S	551.0(25)
Ge—Se	490(21)
Ge—Si	301(21)
Ge—Te	402(8)
Gold	
Au—Au	221.3(21)
Au—B	368(11)
Au—Be	285(8)
Au—Bi	293(84)
Au—Cl	343(10)
Au—Co	215(13)
Au—Cr	215(6)
Au—Cu	232(9)
Au—Fe	187(17)
Au—Ga	294(15)
Au—Ge	277(15)
Au—H	314(10)
Au—La	80(5)
Au—Li	68.0(16)
Au—Mg	243(42)
Au—Mn	185(13)
Au—Ni	274(21)
Au—Pb	130(42)
Au—Pd	143(21)
Au—Rh	231(29)
Au—S	418(25)
Au—Si	312(12)
Au—Sn	244(17)
Au—Te	247(67)
Au—U	318(29)
Hafnium	
Hf—C	548(63)
Hf—N	534(29)
Hf—O	791(8)

TABLE 4.11 Bond Dissociation Energies (*Continued*)

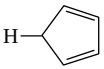
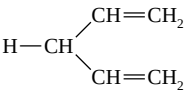
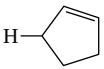
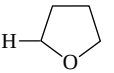
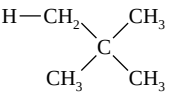
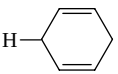
Bond	ΔHf_{298}, kJ/mol	Bond	ΔHf_{298}, kJ/mol
Hydrogen		Hydrogen (*continued*)	
H—H	436.002(4)	H—$CHCl_2$	414.2
H—^{2}H or H—D	439.446(4)	H—CCl_3	377(8)
^{2}H—^{2}H or D—D	443.546(4)	H—CBr_3	377(8)
H—Br	365.7(21)	H—CCl_2CHCl_2	393(8)
H—C	337.2(8)	H—CH_2F	423(8)
H—CH	452(33)	H—CHF_2	423(8)
H—CH_2	473(4)	H—CF_3	444(13)
H—CH_3	431(8)	H—CF_2Cl	435(4)
^{2}H—C^2H_3 or D—CD_3	442.75(25)	H—CH_2CF_3	446(45)
H—C≡CH	523(4)	H—CF_2CH_3	416(4)
H—CH═CH_2	427	H—CF_2CF_3	431(63)
H—CH_2CH_3	410(4)	H—CH_2I	431(8)
H—CH_2C≡CH	392.9(50)	H—CHI_2	431(8)
H—CH_2CH═CH_2	356	H—CN	540(25)
H—cyclopropyl	423(13)	H—CH_2CN	*ca.* 389
H—$CH_2CH_2CH_3$	410(8)	H—$CH(CH_3)CN$	377(8)
H—$CH(CH_3)_2$	395.4	H—$C(CH_3)_2CN$	364(8)
H—cyclobutyl	397(13)	H—CH_2NH_2	397(8)
H—$CH_2CH(CH_3)_2$	360	H—$CH_2Si(CH_3)_3$	414(4)
H—$CH(CH_3)CH_2CH_3$	397(4)	H—CH_2COCH_3	393(75)
H—$C(CH_3)_3$	381	H—Cl	431.8(4)
	339(4)	H—CO	126(8)
		H—CHO	364(4)
		H—COOH	377
		H—$COCH_3$	364(4)
	335(4)	H—$COCH_2CH_3$	364(4)
	343(4)		385
		H—COC_6H_5	364(4)
		H—$COCF_3$	381(8)
	414(4)	H—F	568.6(13)
		H—I	298.7(8)
		H—N	314(17)
		H—NH	377(8)
H—$C(CH_3)_2CH$═CH_2	331	H—NH_2	435(8)
H—cyclopentyl	395(42)	H—$NHCH_3$	431(8)
H—$CH_2C(CH_3)_3$	418(4)	H—$N(CH_3)_2$	397(8)
H—C_6H_5	431	H—NHC_6H_5	335(13)
H—$CH_2C_6H_5$	356(4)	H—$N(CH_3)C_6H_5$	310(13)
H—$C(C_6H_5)_3$	314	HNF_2	318(13)
		H—N_3	356
	310	H—NO	<205
		H—O	428.0(21)
		H—OH	498.7(8)
H—cyclohexyl	399.6(42)	H—OCH_3	436.8(42)
H—cycloheptyl	387.0(42)	H—OCH_2CH_3	436.0
H—norbornyl	406(13)	H—$OC(CH_3)_3$	439(4)
H—CH_2Br	410(25)	H—OC_6H_5	368(25)
H—$CHBr_2$	435	H—ONO	327.6(25)
H—CH_2Cl	423		

TABLE 4.11 Bond Dissociation Energies (*Continued*)

Bond	ΔHf_{298}, kJ/mol
Hydrogen (*continued*)	
H—ONO_2	423.4(25)
H—OOH	374(8)
H—$OOCCH_3$	469(17)
H—$OOCCH_2CH_3$	460(17)
H—$OOCC_3H_7$	431(17)
H—P	343(29)
H—S	344(12)
H—SH	381(4)
H—SCH_3	*ca.* 368
H—Se	305(2)
H—Si	298.49(46)
H—SiH_3	393(13)
H—$Si(CH_3)_3$	377(13)
H—Te	268(2)
Indium	
In—In	100(8)
In—Br	418(21)
In—Cl	439(8)
In—F	506(15)
In—O	360(21)
In—P	197.9(85)
In—S	289(17)
In—Sb	152(11)
In—Se	247(17)
In—Te	218(17)
Iodine	
I—I	152.549(8)
I—Br	179.1(4)
I—CH_3	232(13)
I—C_2H_5	223.8
I—$CH(CH_3)_2$	222
I—$C(CH_3)_3$	207.1
I—CH_2CF_3	234(4)
I—CF_2CH_3	216(4)
I—C_3F_7	209(4)
I—CH═$CHCH_3$	172
I—C_6H_5	268(4)
I—C_6F_5	276
I—Cl	213.3(4)
I—$COCH_3$	219.7
I—CN	305(4)
I—F	280(4)
I—N	159(17)
I—NO	71(4)
I—NO_2	75(4)
I—O	184(21)
Iridium	
Ir—O	352(21)
Ir—Si	463(21)
Iron	
Fe—Fe	100(21)
Fe—Br	247(96)
Fe—Cl	*ca.* 352
Fe—O	409(13)
Fe—S	339(21)
Fe—Si	297(25)
Krypton	
Kr—Kr	5.4(8)
Kr—F	54
Lanthanum	
La—La	247(21)
La—C	506(63)
La—F	598(42)
La—N	519(42)
La—O	799(13)
La—S	577(25)
Lead	
Pb—Pb	339(25)
Pb—Br	247(38)
$Pb(CH_3)_3$—CH_3	207(42)
Pb—Cl	301(29)
Pb—F	356(8)
Pb—H	176(21)
Pb—I	197(38)
Pb—O	378(4)
Pb—S	346.0(17)
Pb—Se	303(4)
Pb—Te	251(13)
Lithium	
Li—Li	106(4)
Li—Br	423(21)
Li—Cl	469(13)
Li—F	577(21)
Li—H	247
Li—I	352(13)
Li—Na	88
Li—O	341(6)
Li—OH	427(21)

TABLE 4.11 Bond Dissociation Energies (*Continued*)

Bond	ΔHf_{298}, kJ/mol
Lutetium	
Lu—Lu	142(34)
Lu—F	569(42)
Lu—O	695(13)
Lu—S	507(15)
Lu—Te	326(17)
Magnesium	
Mg—Mg	8.522(4)
Mg—Br	297(63)
Mg—Cl	318(13)
Mg—F	462(21)
MgF—F	569(42)
Mg—H	197(50)
Mg—I	*ca.* 285
Mg—O	394(35)
Mg—OH	238(21)
Mg—S	310(75)
Manganese	
Mn—Mn	42(29)
Mn—Br	314(10)
Mn—Cl	361(10)
Mn—F	423(15)
Mn—I	283(10)
Mn—Cu	159(17)
Mn—O	402(34)
Mn—S	301(17)
Mn—Se	201(13)
Mercury	
Hg—Hg	17.2(21)
Hg—Br	72.8(42)
CH_3—$HgCH_3$	240.6
C_2H_5—HgC_2H_5	182.8(42)
C_3H_7—HgC_3H_7	197.1
Isopropyl—Hgisopropyl	170.3
C_6H_5—HgC_6H_5	285
Hg—Cl	100(8)
Hg—F	130(38)
Hg—H	39.8
Hg—I	38
Hg—K	8.24(21)
Hg—Na	>6.7
Hg—S	213
Hg—Se	(167)
Hg—Te	(142)

Bond	ΔHf_{298}, kJ/mol
Molybdenum	
Mo—I	372
Mo—O	607(34)
MoO—O	678(84)
MoO_2—O	565(84)
Neodymium	
Nd—F	545(13)
Nd—O	703(34)
Nd—S	474(15)
Nd—Se	385(17)
Nd—Te	305(17)
Neon	
Ne—Ne	3.93
Neptunium	
Np—O	720(29)
Nickel	
Ni—Ni	261.9(25)
Ni—Br	360(13)
Ni—Cl	372(21)
Ni—F	435
Ni—H	289(13)
Ni—I	293(21)
Ni—O	391.6(38)
Ni—S	360(21)
Ni—Si	318(17)
Niobium	
Nb—O	753(13)
Nitrogen	
N—N	945.33(59)
N—Br	276(21)
ON—Br	28.7(15)
N—Cl	389(50)
ON—Cl	159(6)
O_2N—Cl	142(4)
N—F	301(42)
FN—F	318(21)
F_2F—N	243(8)
ON—F	236(4)
O_2N—F	188(21)

TABLE 4.11 Bond Dissociation Energies (*Continued*)

Bond	ΔHf_{298}, kJ/mol
Nitrogen (*continued*)	
N—I	159(17)
F_2N—NF_2	88(4)
H_2N—NH_2	297(8)
H_2N—$NHCH_3$	271
H_2N—$N(CH_3)_2$	264
H_2N—NHC_6H_5	213
HN—N_2	38
ON—N	480.7(42)
ON—NO_2	39.8(8)
O_2N—NO_2	57.3(21)
HN═NH	456(42)
N≡N	946
N—O	630.57(13)
HN═O	481
NN—O	167
ON—O	305
N—P	617(21)
N—S	464(21)
Osmium	
O_3Os—O	301(21)
Oxygen	
O—O	498.34(20)
O—Br	235.1(4)
HO—CH_3	377(13)
HO—CH═CH_2	364
HO—CH_2CH═CH_2	456
HO—C_6H_5	431
HO—$CH_2C_6H_5$	322
HO—CHO	402(13)
HO—$COCH_3$	452(21)
HO—COC_2H_5	180
O—Cl	272(4)
HO—Cl	251(13)
O—F	222(17)
O—FO	467
FO—OF	261(84)
O—I	184(21)
HO—I	234(13)
O—N	630.57(13)
HO—NCH_3	209
HO—$OC(CH_3)_3$	192(8)
HO—OH	213.8(21)
O—OH	268(4)
CF_3O—OCF_3	192
CH_3O—OCH_3	157.3(8)
C_2H_5O—OC_2H_5	159
C_3H_7O—OC_3H_7	155
Palladium	
Pd—O	234(29)
Phosphorus	
P—P	490(11)
P—Br	266.5
P—C	513(8)
P—Cl	289(42)
P—F	439(96)
P—H	343(29)
P—N	617(21)
P—O	596.6
Br_3P═O	498(21)
Cl_3P═O	510(21)
F_3P═O	544(21)
P—S	346.0(17)
P═S	347
P—Se	363(10)
P—Te	298(10)
Platinum	
Pt—B	478(17)
Pt—H	352(38)
Pt—O	347(34)
Pt—P	417(17)
Pt—Si	501(18)
Potassium	
K—K	57.3(42)
K—Br	383(8)
K—Cl	427(8)
K—F	497.5(25)
K—H	183(15)
K—I	331(13)
K—Na	63.6(29)
K—O	239(34)
K—OH	343(8)
Praseodymium	
Pr—F	582(46)
Pr—O	753(17)
Pr—S	492.5(46)

TABLE 4.11 Bond Dissociation Energies (*Continued*)

Bond	ΔHf_{298}, kJ/mol
Praseodymium (*continued*)	
Pr—Se	446(23)
Pr—Te	326(42)
Promethium	
Pm—F	540(42)
Pm—O	674(63)
Pm—S	423(63)
Pm—Se	339(63)
Pm—Te	255(63)
Radium	
Ra—Cl	343(75)
Rhodium	
Rh—Rh	285(21)
Rh—B	476(21)
Rh—C	583.7(63)
Rh—O	377(63)
Rh—Si	395(18)
Rh—Ti	391(15)
Rubidium	
Rb—Rb	45.6(21)
Rb—Br	389(13)
Rb—Cl	448(21)
Rb—F	494(21)
Rb—H	167(21)
Rb—I	335(13)
Rb—O	255(84)
Rb—OH	351(8)
Ruthenium	
Ru—O	481(63)
$O_3Ru—O$	439
Ru—Si	397(21)
Ru—Th	592(42)
Samarium	
Sm—Cl	423(13)
Sm—F	531(18)
Sm—O	619(13)
Sm—S	389
Sm—Se	331(15)
Sm—Te	272(15)
Scandium	
Sc—Sc	163(21)
Sc—Br	444(63)
Sc—C	393(63)
Sc—Cl	318
Sc—F	589(13)
Sc—N	469(84)
Sc—O	674(13)
Sc—S	478(13)
Sc—Se	385(17)
Sc—Te	289(17)
Selenium	
Se—Se	332.6(4)
Se—Br	297(84)
Se—C	582(96)
Se—Cl	322
Se—F	339(42)
Se—H	305(2)
Se—N	381(63)
Se—O	423(13)
Se—P	364(10)
Se—S	381(21)
Se—Si	531(25)
Se—Te	268(8)
Silicon	
Si—Si	327(10)
Si—Br	343(50)
Si—C	435(21)
Si—Cl	456(42)
Si—F	540(13)
Si—H	298.49(46)
Si—I	339(84)
Si—N	439(38)
Si—O	798(8)
Si—S	619(13)
Si—Se	531(25)
$H_3Si—SiH_3$	339(17)
$(CH_3)_3Si—Si(CH_3)_3$	339
$(Aryl)_3Si—Si(aryl)_3$	368(31)
Si—Te	506(38)
Silver	
Ag—Ag	163(8)
Ag—Au	203(9)
Ag—Bi	193(42)

TABLE 4.11 Bond Dissociation Energies (*Continued*)

Bond	ΔHf_{298}, kJ/mol
Silver (*continued*)	
Ag—Br	293(29)
Ag—Cl	341.4
Ag—Cu	176(8)
Ag—F	354(16)
Ag—Ga	180(15)
Ag—Ge	175(21)
Ag—H	226(8)
Ag—I	234(29)
Ag—In	176(17)
Ag—O	213(84)
Ag—Sn	136(21)
Ag—Te	293(96)
Sodium	
Na—Na	77.0
Na—Br	370(13)
Na—Cl	410(8)
Na—F	481(8)
Na—H	201(21)
Na—I	301(8)
Na—K	63.6(29)
Na—O	257(17)
Na—OH	381(13)
Na—Rb	59(4)
Strontium	
Sr—Br	332(19)
Sr—Cl	406(13)
Sr—F	542(7)
Sr—H	163(8)
Sr—I	263(42)
Sr—O	454(15)
Sr—OH	381(42)
Sr—S	314(21)
Sulfur	
S—S	429(6)
S—Cl	255
S—F	343(5)
O_2S—F	71
S—N	464(21)
S—O	521.70(13)
OS—O	551.4(84)
O_2S—O	348.1(42)
HS—SH	272(21)
Tantalum	
Ta—N	611(84)
Ta—O	805(13)
Tellurium	
Te—B	354(20)
Te—H	268(2)
Te—I	193(42)
Te—O	391(8)
Te—P	298(10)
Te—S	339(21)
Te—Se	268(8)
Terbium	
Tb—F	561(42)
Tb—O	707(13)
Tb—S	515(42)
Tb—Te	339(42)
Thallium	
Tl—Tl	63
Tl—Br	333.9(17)
Tl—Cl	372.8(21)
Tl—F	445(19)
Tl—H	188(8)
Tl—I	272(8)
Thorium	
Th—Th	289
Th—C	484(25)
Th—N	577.4(21)
Th—O	854(13)
Th—P	377
Thullium	
Tm—F	569(42)
Tm—O	557(13)
Tm—S	368(42)
Tm—Se	276(42)
Tm—Te	276(42)
Tin	
Sn—Sn	195(17)
Sn—Br	339(4)

TABLE 4.11 Bond Dissociation Energies (*Continued*)

Bond	ΔHf_{298}, kJ/mol
Tin (*continued*)	
BrSn—Br	326
Br_3Sn—Br	272
$(C_2H_5)_3Sn$—C_2H_5	*ca.* 238
Sn—Cl	406(13)
Sn—F	467(13)
Sn—H	267(17)
Sn—I	234(42)
Sn—O	548(21)
Sn—S	464(3)
Sn—Se	401.3(59)
Sn—Te	319.2(8)
Titanium	
Ti—Ti	141(21)
Ti—Br	439
Ti—C	435(25)
Ti—Cl	494
Ti—F	569(34)
Ti—H	*ca.* 159
Ti—I	310(42)
Ti—N	464
Ti—O	662(16)
Ti—S	426(8)
Ti—Se	381(42)
Ti—Te	289(17)
Tungsten	
W—Cl	423(42)
W—F	548(63)
W—O	653(25)
OW—O	632(84)
O_2W—O	598(42)
W—P	305(4)
Uranium	
U—O	761(17)
OU—O	678(59)
O_2U—O	644(88)
U—S	523(10)
Vanadium	
V—V	242(21)
V—Br	439(42)
V—C	469(63)
V—Cl	477(63)
V—F	590(63)
V—N	477(8)
V—O	644(21)
V—S	490(16)
V—Se	347(21)
Xenon	
Xe—Xe	6.53(30)
Xe—F	13.0(4)
Xe—O	36.4
Ytterbium	
Yb—Cl	322
Yb—F	521(10)
Yb—H	159(38)
Yb—O	397.9(63)
Yb—S	167
Yttrium	
Y—Y	159(21)
Y—Br	485(84)
Y—C	418(63)
Y—Cl	527(42)
Y—F	605(21)
Y—N	481(63)
Y—O	715.1(30)
Y—S	528(11)
Y—Se	435(13)
Y—Te	339(13)
Zinc	
Zn—Zn	29
Zn—Br	142(29)
C_2H_5C—C_2H_5	*ca.* 201
Zn—Cl	229(20)
Zn—F	368(63)
Zn—H	85.8(21)
Zn—I	138(29)
Zn—O	284.1
Zn—S	205(13)
Zn—Se	136(13)
Zn—Te	205

TABLE 4.11 Bond Dissociation Energies (*Continued*)

Bond	ΔHf_{298}, kJ/mol	Bond	ΔHf_{298}, kJ/mol
Zirconium		Zirconium (*continued*)	
Zr—C	561(25)	Zr—O	760(8)
Zr—F	623(63)	Zr—S	575(17)
Zr—N	565(25)		

Source: T. L. Cottrell, *The Strengths of Chemical Bonds*, 2d ed., Butterworth, London, 1958; B. deB. Darwent, *National Standard Reference Data Series*, National Bureau of Standards, no. 31, Washington, 1970; S. W. Benson, *J. Chem. Educ.* **42:**502 (1965); and J. A. Kerr, *Chem. Rev.* **66:**465 (1966).