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Maurice H. Stans, *Secretary*

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Bond Dissociation Energies in Simple Molecules

B. deB. Darwent

Department of Chemistry
The Catholic University of America
Washington, D.C. 20017



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Foreword

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The System now comprises a complex of data centers and other activities, carried on in academic institutions and other laboratories both in and out of government. The independent operational status of existing critical data projects is maintained and encouraged. Data centers that are components of the NSRDS produce compilations of critically evaluated data, critical reviews of the state of quantitative knowledge in specialized areas, and computations of useful functions derived from standard reference data. In addition, the centers and projects establish criteria for evaluation and compilation of data and make recommendations on needed improvements in experimental techniques. They are normally closely associated with active research in the relevant field.

The technical scope of the NSRDS is indicated by the principal categories of data compilation projects now active or being planned: nuclear properties, atomic and molecular properties, solid state properties, thermodynamic and transport properties, chemical kinetics, and colloid and surface properties.

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The NSRDS-NBS series of publications is intended primarily to include evaluated reference data and critical reviews of long-term interest to the scientific and technical community.

LEWIS M. BRANSCOMB, *Director*

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Bond Dissociation Energies in Simple Molecules

B. deB. Darwent

Bond dissociation energy values (kcal/mol) and (kJ/mol) of simple compounds are tabulated from a literature review covering the years 1962–1966 inclusively. Some selected values which appeared in the years 1956–1962 are also included. Organic compounds are excluded except those containing one carbon atom. The groups $>CO$ and $-CN$ are not considered to be organic.

The values are quoted usually at 0 K or 298 K and refer to the gaseous state. They represent the energy required to break a bond at the specified temperature with all substances in the zero vibrational state of the ground electronic state. The experimental method for the energy value listed is given and referenced in the table. A value recommended by the author is listed as the final value for each reaction.

Key words: Bond dissociation energy; gaseous state; inorganic simple compounds; recommended value; zero vibrational state of the ground electronic state.

Introduction

This review of bond dissociation energies of simple compounds includes values published, generally, between 1956 and 1966 inclusive. The period from 1956 to 1962 was covered less thoroughly than that of 1962 to 1966. Cottrell's book [3]¹ appeared in 1958 and is assumed to have covered the literature up to and including 1955; the compilation of Vedeneyev et al. [6] covered the field to 1962, but they did not attempt a complete coverage of the literature. In the present review all values appearing between 1962 and 1966, and selected values appearing between 1956 and 1962 have been given in the table, even if some of them may now be considered to be inaccurate or completely untrustworthy. This approach is of some value, especially for bonds on which only a few measurements have been made, since opinions of relative merit often change with time. The efficiency of retrieval of information, within the stated period, is estimated to be approximately 80 percent.

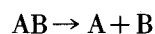
Organic compounds have been excluded, in view of Kerr's excellent review [8] of 1966, although compounds containing one carbon atom have been included; the groups $>CO$ and $-CN$ are not regarded as being organic.

Very recent data on thermochemical properties have been published by the National Bureau of Standards as Technical Note 270-3 [9]; many bond dissociation energies have been recalculated from those data. It should be pointed out that the data in Ref. [9] often include input from spectroscopic and other types of measurements. Thus a dissociation energy labeled "Thermochemical; based on [9]" in this tabulation is not necessarily derived solely from conventional thermochemical measurements.

The bonds are listed alphabetically under the more electropositive elements except for bonds

between H and other elements, which are given under the other element. Thus data on O-H, H-Cl, etc., are found under O, Cl, etc.

The bond dissociation energy D° for a bond A-B which is broken through the reaction



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

$$D^\circ = \Delta H_f^\circ(A) + \Delta H_f^\circ(B) - \Delta H_f^\circ(AB)$$

where ΔH_f° is the standard-state heat of formation. All values of D° refer to the gaseous state, and are given at either 0 K or 298 K, and in some cases at both temperatures. The few exceptions are noted under "Remarks". The value of D° at 0 K is equal to the energy required to break the A-B bond under the stipulated conditions that the reactant and product molecules are in their electronic and vibrational ground states. Thus it has a clearer physical interpretation than the dissociation energy at other temperatures. In the simplest case where the bond of a diatomic molecule is broken, D° at 298 K is greater than D° at 0 K by an amount which lies between RT and $(3/2)RT$ (i.e., 0.6 to 0.9 kcal/mol). In polyatomic molecules this difference may be somewhat greater.

The values of D° are listed in both kcal/mol and kJ/mol. The conversion factor is 1 kcal/mol = 4.184 kJ/mol.

No attempt will be made here to describe or discuss the many methods used to measure bond dissociation energies since that has already been done [1 to 8]. It is well known that individual methods are useful and reliable only for limited types of molecules and over limited ranges of conditions. Thus the classic static manometric

¹ Figures in brackets indicate the literature references on page 2.

method gives excellent results for I_2 , N_2O_4 , etc. but not for dibenzyl; the spectroscopic method gives values of the highest precision for simple molecules, especially when the dissociation products are unequivocal and a clear convergence can be obtained, but it is much less useful for more complex molecules.

Many determinations of bond dissociation energies have recently appeared using high temperatures chemistry techniques, e.g., effusion from a Knudsen cell and the use of mass spectrometry to identify and measure the concentrations of the effusing materials. Most of the measurements on the oxides of the Group IIA elements have been made by that technique and by flame photometry. In theory both methods are capable of giving values of at least modest precision for the bond dissociation energies. Although in some cases the data so obtained are often consistent and fairly precise, in other instances, e.g. CaO, there is considerable disagreement, not only between the two methods but also between values obtained by the same method.

There has been much controversy on the relative merits of these two techniques. The high temperature mass-spectrometry results are suspect [55] because of the possibility of fragmentation of the molecule under electron impact. In another review [190] it is claimed that Drowart and Goldfinger [10] had already refuted that suggestion. Actually, Drowart and Goldfinger did not really disprove the claim but rather stated that interaction with the alumina container is likely to be a more important source of uncertainty. On the other hand, there does appear to be doubt concerning both the nature of the emitter and the possibility of interference by other substances in the flame photometric work.

At this stage the only safe conclusion is that much more research is required.

The estimated uncertainties of individual measurements are those given by the original authors or reviewers. Recommended values are listed in bold type with estimated uncertainties. Those estimates are based on the extent of agreement between different measurements, more weight being given to the results from the more reliable method, when the datum results from a direct measurement. For thermochemically calculated values consideration is given to the precision of each of the thermochemical quantities involved in the calculation. No attempt has been made at a statistical evaluation of uncertainties. They are to some extent the result of my own prejudice, though often tempered by the advice of experts.

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Table of Bond Dissociation Energies

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Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
Ag-Ag	$\text{Ag}_2 \rightarrow 2\text{Ag}$	171.5	41.0			Effusion; M.S.	1957	95
		157.3	37.6			Effusion; M.S.	1956	198
		157.3	37.6			Effusion; M.S.	1960	91
		163	39			Analysis of data	1956	3
		157.3 ± 9.2	37.6 ± 2.2			Analysis of data	1962	6
		171 ± 8	41 ± 2			Analysis of data	1963	7
		156.9	37.5			Thermochemical;		
		159 ± 8	38 ± 2			based on 9	1967	
Ag-Au	$\text{AgAu} \rightarrow \text{Ag} + \text{Au}$	199.2 ± 9.2	47.6 ± 2.2			Effusion; M.S.	1960	91
Ag-Br	$\text{AgBr} \rightarrow \text{Ag} + \text{Br}$	289	69			Thermochemical	1956	3
		251.0	60			Thermochemical	1950	4
		289 ± 42	69 ± 10			Thermochemical	1962	6
		289 ± 42	69 ± 10					
Ag-Cl	$\text{AgCl} \rightarrow \text{Ag} + \text{Cl}$	301	72			Thermochemical	1956	3
		299.2	71.5			Thermochemical	1950	4
		318 ± 21	76 ± 5			Thermochemical	1962	6
		314 ± 21	75 ± 5					
Ag-Cu	$\text{AgCu} \rightarrow \text{Ag} + \text{Cu}$	170.3	40.7			Effusion; M.S.	1960	91
		170.3 ± 9.2	40.7 ± 2.2	174.1	41.6	Effusion; M.S.		
		170.3	40.7			Thermochemical;	1967	
		172 ± 8	41 ± 2			based on 9		
Ag-H	$\text{AgH} \rightarrow \text{Ag} + \text{H}$	243	58			Analysis of data	1956	3
		241.0	57.6			Thermochemical	1950	4
		222 ± 8	53 ± 2			Extrapolation of $X^1\Sigma$	1962	6
		230 ± 13	55 ± 3			levels		
Ag-I	$\text{AgI} \rightarrow \text{Ag} + \text{I}$	287.4	68.7			Convergence in B state	1950	4
Ag-O	$\text{AgO} \rightarrow \text{Ag} + \text{O}$	238 ± 42	57 ± 10			L.B.S. for ground state	1962	6
		134 ± 38	32 ± 9			L.B.S. for $B^2\Sigma$ state	1953	1
Ag-Sn	$\text{AgSn} \rightarrow \text{Ag} + \text{Sn}$	132.2 ± 21	31.6 ± 5			Effusion; M.S.	1960	63
Al-Al	$\text{Al}_2 \rightarrow 2\text{Al}$	188 ± 42	45 ± 10			M.S.	1962	6
		163	39	167	40	Thermochemical;	1967	
						based on 9		

*Throughout the table in the Methods, remarks column, the following abbreviations have been used: M.S.—Mass Spectrometer; L.B.S.—Linear Birge-Sponer Extrapolation; E.I.—Electron Impact; A.P.—Appearance Potential.

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.			
		0 K		298 K							
		kJ/mol	kcal/mol	kJ/mol	kcal/mol						
Al-Br	AlBr \rightarrow Al + Br	439	105			Analysis of data Thermochemical; based on 9	1960	140			
		439	105 105 \pm 2	443	106		1967				
Al-Cl	AlCl \rightarrow Al + Cl	490	117			Analysis of data Thermochemical; based on 9	1960	140			
		492.0	117.6	495.8	118.5		1967				
		490 \pm 13	117 \pm 3	494 \pm 13	118 \pm 3						
	AlCl ₂ \rightarrow AlCl + Cl	391.2 \pm 21	93.5 \pm 5	393.3	94.0	Thermochemical	1962	6			
		400 \pm 8	95.5 \pm 2	406 402 \pm 8	97 96 \pm 2						
AlCl ₃ \rightarrow AlCl ₂ + Cl	397 \pm 21	95 \pm 5	400	95.5	Thermochemical Thermochemical; based on 9	1962 1967	6				
	372 \pm 8	89 \pm 2	372 372 \pm 8	89 89 \pm 2							
OAlCl \rightarrow AlO + Cl				552	Thermochemical; based on 9 Thermochemical	1967 1962	6				
				515 \pm 84				123 \pm 20			
Al-F	AlF \rightarrow Al + F	653	156			Analysis of data Equilibrium pressure; AlF ₃ (C) + 2Al = 3AlF(S) Thermochemical Thermochemical Effusion; M.S. Effusion; M.S. AlF ₃ + 2Al = 3AlF Thermochemical; based on 9	1960	140			
		653.1 \pm 7.5	156.1 \pm 1.8				1959	178			
		661	158				1956	133			
		649	155				1957	95			
		665 \pm 13	159 \pm 3				1966	170			
		661 \pm 8	158 \pm 2				1963	174			
		654.8 \pm 8	156.5 \pm 2				1962	6			
		659.0	157.5	663.3	158.6		1967				
		659.0 \pm 6.2	157.5 \pm 1.5	663.6 \pm 6.2	158.6 \pm 1.5						
		AlF ₂ \rightarrow AlF + F	546.0 \pm 42	130.5 \pm 10				Thermochemical	1962	6	
		AlF ₃ \rightarrow AlF ₂ + F	544 \pm 46	130 \pm 11				Thermochemical	1962	6	
		OAlF \rightarrow AlO + F					674 \pm 84	161 \pm 20	Thermochemical Thermochemical; based on 9	1962	6
							761 761 \pm 42	182 182 \pm 10		1967	
Al-H	AlH \rightarrow Al + H	< 295	< 70.5			Predissociation Spectroscopic; predissociation Thermochemical Thermochemical; based on 9	1950	4			
		280.7 \pm 5.0	67.1 \pm 1.2				1961	53			
		280 \pm 21	67 \pm 5				1962	6			
		280	67	284.9	68.1		1967				
		280.3 \pm 6.3	67.0 \pm 1.5	284.9 \pm 6.3	68.1 \pm 1.5						

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
Al-I	AlI \rightarrow Al + I	364.0	87.0			Analysis of fluctuation bands Analysis of data Thermochemical; based on 9	1960	140
		364 \pm 13	87 \pm 3				1962	6
		364	87	367.7	87.9		1967	
		364 \pm 4	87 \pm 1	368 \pm 4	88 \pm 1			
Al-O	AlO \rightarrow Al + O	481 \pm 21	115 \pm 5			Effusion; M.S. Flame photometry Thermochemical Thermochemical; based on 9	1960	104
		569	136				1958	16
		481 \pm 21	115 \pm 5				1962	6
		479.5	114.6	484.5	115.8		1967	
		481 \pm 8	115 \pm 2	485 \pm 8	116 \pm 2			
	OAlF \rightarrow AlF + O			582	139	Thermochemical; based on 9	1967	
OAlCl \rightarrow AlCl + O			540	129	Thermochemical; based on 9	1967		
			540 \pm 41	129 \pm 10				
Al-P	AlP \rightarrow Al + P	212.6 \pm 13	50.8 \pm 3			Effusion; M.S.	1966	169
Al-S	AlS \rightarrow Al + S	339 \pm 67	81 \pm 16			Spectroscopic; L.B.S. Spectroscopic; predissociation Thermochemical; based on 9	1959	54
		326 \pm 21	78 \pm 5				1962	6
		402	96	406	97		1967	
As-As	As ₂ \rightarrow 2As	379.9 \pm 21	90.8 \pm 5			Spectroscopic; predissociation Thermochemical; based on 9	1962	6
		379.9	90.8	382.8	91.5		1967	
		380 \pm 21	91 \pm 5	382.8 \pm 21	91.5 \pm 5			
As-Cl	AsCl ₃ \rightarrow AsCl ₂ + Cl	444	106	448	107	Thermochemical; based on 9	1967	
As-N	AsN \rightarrow As + N	628 \pm 126	150 \pm 30			L.B.S. Thermochemical; based on 9	1962	6
		577	138	582	139		1967	
As-O	AsO \rightarrow As + O	473 \pm 8	113 \pm 2	477	114	Spectroscopic; predissociation Thermochemical; based on 9	1960	6
		477.4	114.1	481.6	115.1		1967	
		477 \pm 8	114 \pm 2	481	115 \pm 2			
At-At	At ₂ \rightarrow 2At	115.9	27.7			Theoretical	1960	109

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
Au-Au	$\text{Au}_2 \rightarrow 2\text{Au}$	210.5	50.3			Thermochemical; M.S. Effusion; M.S. Effusion; M.S. Thermochemical; based on 9	1956	108
		221.8	53.0				1957	95
		215.5	51.5				1960	91
		215.1	51.4	217	51.9		1967	
		215.5 ± 6.3	51.5 ± 1.5	218 ± 6	52 ± 1.5			
Au-Cl	$\text{AuCl} \rightarrow \text{Au} + \text{Cl}$	293 ± 59	70 ± 14			Spectroscopic; L.B.S. Thermochemical; based on 9	1962	6
		289	69	293	70		1967	
		289 ± 63	69 ± 15	293 ± 63	70 ± 15			
Au-Cr	$\text{AuCr} \rightarrow \text{Au} + \text{Cr}$	210.9 ± 14.6	50.4 ± 3.5			M.S. Thermochemical; based on 9	1962	62
		213	51				1967	
		211.3 ± 6.3	50.5 ± 1.5					
Au-Cu	$\text{AuCu} \rightarrow \text{Au} + \text{Cu}$	228.0 ± 9.2	54.5 ± 2.2			Effusion; M.S.	1960	91
Au-H	$\text{AuH} \rightarrow \text{Au} + \text{H}$	297 ± 10	71 ± 2.5			Spectroscopic Thermochemical; based on 9	1962	6
		285.3	68.2	289.1	69.1		1967	
		285 ± 13	68 ± 3	289 ± 13	69 ± 3			
Au-Pd	$\text{AuPd} \rightarrow \text{Au} + \text{Pd}$	139.3 ± 21	33.3 ± 5			M.S.	1962	62
Au-Sn	$\text{AuSn} \rightarrow \text{Au} + \text{Sn}$	240.6 ± 17	57.5 ± 4			Effusion; M.S.	1962	63
B-B	$\text{B}_2 \rightarrow 2\text{B}$	274.1	65.5			M.S. M.S. Thermochemical; based on 9	1962	58
		260.7	62.3				1962	6
		293	70	297	71		1967	
		293 ± 21	70 ± 5	297 ± 21	71 ± 5			
	$\text{B}_2\text{Cl}_4 \rightarrow 2\text{BCl}_2$	331	79			Calorimetry Thermochemical	1959	102
		246.0	58.8				1962	6
	$\text{B}_2\text{F}_4 \rightarrow 2\text{BF}_2$			151	36	Thermochemical	1962	6
	$\text{B}_2\text{O}_2 \rightarrow 2\text{BO}$	> 416.7	> 99.6			Effusion; M.S. Thermochemical Thermochemical; based on 9	1956	90
		498 ± 84	119 ± 20	502	120		1962	6
502		120	506	121	1967			
502 ± 84		120 ± 20	506 ± 84	121 ± 20				
B-Br	$\text{BBr} \rightarrow \text{B} + \text{Br}$	431	103			Analysis of data Analysis of data Thermochemical; based on 9	1960	140
		433.0 ± 8	103.5 ± 2	436.8	104.4		1962	6
		433.0	103.5	436.4	104.3		1967	
		433.0 ± 21	103.5 ± 5	435 ± 21	104 ± 5			

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
B-C	BC → B + C	444	106			Thermochemical; based on 9	1967	
B-Cl	BCl → B + Cl	531 494 ± 42	127 118 ± 10	498	119	Analysis of data Spectroscopic; extrapolation	1960 1962	140 6
		531 531 ± 29	127 127 ± 7	536 536 ± 29	128 128 ± 7	Thermochemical; based on 9	1967	
	OBCl → BO + Cl			515 ± 75 460 460 ± 42	123 ± 18 110 110 ± 10	Thermochemical Thermochemical; based on 9	1962 1967	6
B-F	BF → B + F	774 774 ± 63 753 ± 13 757 ± 17	185 185 ± 15 180 ± 3 181 ± 4	778	186	Analysis of data Spectroscopic Effusion; M.S. M.S.; B(c) + CaF ₂ (c) = BF(g) + CaF(g)	1960 1962 1966 1965	140 6 170 69
		759.8 759.4 ± 10.5	181.6 181.5 ± 2.5	764.0 766 ± 13	182.6 183 ± 3	Thermochemical; based on 9	1967	
		565 ± 105 515 523 ± 63	135 ± 25 123 125 ± 15	569	136	Thermochemical M.S.; B(c) + CaF ₂ (c) = BF(g) + CaF(g)	1962 1965	6 69
		557 ± 84 665	133 ± 20 159	561	134	Thermochemical M.S.; B(c) + CaF ₂ (c) = BF(g) + CaF(g)	1962 1965	6 69
	FBO → Bo + F	820 ± 113	196 ± 27	824 711 711 ± 42	197 170 170 ± 10	Thermochemical Thermochemical; based on 9	1962 1967	6
B-H	BH → B + H	289 ± 38 327.2 327.2 326 ± 4	69 ± 9 78.2 ± 1 78.2 78 ± 1	331.0	79.1	Spectroscopic Predissociation Thermochemical; based on 9	1953 1962 1967	1 6
B-N	BN → B + N	385 ± 50	92 ± 12			L.B.S. for ground and ³ Π states	1962	6
		385 385 ± 21	92 92 ± 5	389 389 ± 21	93 93 ± 5	Thermochemical; based on 9	1967	

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
B-O	BO → B + O	715	171			L.B.S. for $X^2\Sigma$, $A^2\Pi$, $B^2\Sigma$, $C^2\Pi$.	1960	50
		770 ± 46	184 ± 11	774	185		1959	51
		782	187	787	188	Thermochemical;	1967	
		782 ± 42	187 ± 10	787 ± 42	188 ± 10	based on 9		
	ClBO → BCl + O			791 ± 75	189 ± 18	Thermochemical	1962	6
				711	170 171 ± 10	Thermochemical; based on 9	1967	
FBO → BF + O		816 ± 117	195 ± 28	820	196	Thermochemical	1962	6
				732 732 ± 42	175 175 ± 10	Thermochemical; based on 9	1967	
B-S	BS → B + S	577 ± 117	138 ± 28	582	139	Spectroscopic	1962	6
		494	118	498	119	Thermochemical;	1967	
		494 ± 42	118 ± 10	498 ± 42	119 ± 10	based on 9		
B-Si	BSi → B + Si	285	68			Thermochemical; based on 9	1967	
Ba-Br	BaBr → Ba + Br	269.9 ± 54	64.5 ± 13	274.1	65.5	Spectroscopic; L.B.S. for ground state	1962	4; 6
		This value is probably too low (see 11)						
	BaBr ₂ → BaBr + Br			598 ± 54	143 ± 13	Thermochemical	1962	6
		If D_1 is too low (see above); this value is too high						
Ba-Cl	BaCl → Ba + Cl	259 ± 50	62 ± 12	264	63	Spectroscopic; L.B.S. for ground state	1962	4; 6
		494 ± 21	118 ± 5			Flame photometry;	1964	11
		477 ± 25	114 ± 6			$H_2 + O_2 + N_2$	1965	23
	494	118 ± 10			$H_2 + O_2 + N_2$			
	BaCl ₂ → BaCl + Cl			728 ± 50	174 ± 12	Thermochemical	1962	6
		201 gives $D_1 + D_2 = 236 \text{ Kcal mol}^{-1}$; D_2 is probably about $236 - 118 \pm 10 = 118 \pm 10 \text{ Kcal mol}^{-1}$.						
		431 ± 42	103 ± 10			Flame photometry;	1965	23
		456 ± 42	109 ± 10			$H_2 + O_2 + N_2$		

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.		
		0 K		298 K						
		kJ/mol	kcal/mol	kJ/mol	kcal/mol					
Ba-S	BaS → Ba + S	396.2 ± 18.8	94.7 ± 4.5			Effusion; M.S.	1964	189		
Be-Cl	BeCl → Be + Cl	460 ± 63	110 ± 15	464	111	Spectroscopic; extrapolation of X ² Σ and A ² Π.	1962	6		
		385 385 ± 63	92 92 ± 15	389 389 ± 63	93 93 ± 15		Thermochemical; based on 9		1967	
	BeCl ₂ → BeCl + Cl	456 ± 63	109 ± 15	460	110	Thermochemical Thermochemical; based on 9	1962	6		
		536 ± 63	128 ± 15	539.7 540 ± 63	129.0 129 ± 15		1967			
Be-F	BeF → Be + F	669 ± 84	160 ± 20	674	161	Spectroscopic; extrapolation of X ² Σ and A ² Π. M.S.; Be + BeF ₂ = 2BeF M.S.; Al + BeF ₂ = BeF + AlF	1962	6		
		< 656.1 < 617.6	< 156.8 < 147.6				M.S.		1965	73
		564.4 ± 9.6 575.3 573 ± 42	134.9 ± 2.3 137.5 137 ± 10	579.1 577 ± 42	138.4 138 ± 10		Thermochemical; based on 9		1966 1967	166
	BeF ₂ → BeF + F	586 ± 84	140 ± 20	590	141	Thermochemical Thermochemical; based on 9	1962	6		
		690 ± 63	165 ± 15	698.7 699 ± 63	167.0 167 ± 15		1967			
	Be-H	BeH → Be + H	222 ± 29	53 ± 7	226	54	Spectroscopic; extrapolation of X ² Σ and A ² Π. Thermochemical; based on 9	1962	6	
222 222 ± 21			53 53 ± 5	226 226 ± 21	54 54 ± 5	1967				
Be-O	BeO → Be + O	445.2 ± 12.6 443.9 ± 9.6	106.4 ± 3 106.1 ± 2.3	449.4	107.4	M.S. Spectroscopic Thermochemical; based on 9	1962	6 86		
				448	107		1964			
		444 ± 21	106 ± 5	448 ± 21	107 ± 5		1967			
Bi-Bi	Bi ₂ → 2Bi	197 ± 4 192.5	47 ± 1 46.0	201 194.6	48 46.5	Thermochemical; Δ <i>H</i> _{vap.} Thermochemical; based on 9	1962	6		
		192 ± 4	46 ± 1	197 ± 4	47 ± 1		1967			
Bi-S	BiS → Bi + S			305	73	Thermochemical; based on 9	1967			

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
Bi-Se	BiSe \rightarrow Bi + Se	231.4	55.3	259	61.8	Effusion; M.S. Thermochemical; based on 9	1960 1967	61
Bi-Te	BiTe \rightarrow Bi + Te	202.5	48.4	225	53.7	Effusion; M.S. Thermochemical; based on 9	1960 1967	61
Br-Br	Br ₂ \rightarrow 2Br	190.08 \pm .12	45.43 \pm 0.03	192.9	46.1	Spectroscopic; conver- gence of bands Thermochemical; based on 9	1962	6
		190.18	45.455	192.86	46.095		1967	
		190.16 \pm 0.04	45.45 \pm 0.01	192.88 \pm 0.04	46.10 \pm 0.01			
Br-Cl	BrCl \rightarrow Br + Cl	215.30 \pm 0.25	51.458 \pm 0.06	218.4	52.2	Thermochemical Thermochemical; based on 9	1962	6
		215.85	51.59	218.91	52.32		1967	
		215.9 \pm 0.4	51.6 \pm 0.1	218.8 \pm 0.4	52.3 \pm 0.1			
Br-F	BrF \rightarrow Br + F	230.04 \pm 0.25	54.98 \pm 0.06	233.5	55.8	Spectroscopic; converg- ence of bands Thermochemical; based on 9	1962	6
		281.2	67.2	284.9	68.1		1967	
Br-H	HBr \rightarrow H + Br	362.71 \pm 0.54	86.69 \pm 0.13	366.5	87.6	Thermochemical Theoretical Thermochemical; based on 9	1962	6 178
		361.5	86.4				1963	
		362.50	86.64	366.27	87.54		1967	
		362.3 \pm 0.4	86.6 \pm 0.1	366.1 \pm 0.4	87.5 \pm 0.1			
Br-O	BrO \rightarrow Br + O	231.0	55.2			Spectroscopic Spectroscopic; extrapola- tion of A ² Π. Thermochemical; based on 9	1958	33 6
		231.4 \pm 2.5	55.3 \pm 0.6	235.1	56.2		1962	
		231.25	55.27	235.27	56.23		1967	
		231.4 \pm 0.4	55.3 \pm 0.1	235.1	56.2 \pm 0.1			
C-Br	CH ₃ Br \rightarrow CH ₃ + Br	224.7	53.7			E.I.; M.S. ($T=1000$ K) pyrolysis Analysis of data Thermochemical; based on 9	1959	179 6 8
				280	67		1962	
				293	70		1966	
		279.9	66.9	285.8	68.3		1967	
		280 \pm 8	67 \pm 2	285 \pm 8	68 \pm 2			
C-Br	CH ₂ Br ₂ \rightarrow CH ₂ Br + Br			249.8 \pm 14.6	59.7 \pm 3.5	E.I.; M.S. Pyrolysis	1959	179
				261.5	62.5 (at 950 K)		1962	
				255 \pm 13	61 \pm 3			

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
C—C	CHBr ₃ → CHBr ₂ + Br			257.7 ± 17 232.2	61.6 ± 4 55.5	E.I.; M.S. Pyrolysis	1959 1962	179 6
	CBr ₄ → CBr ₃ + Br			207.9 205 209	49.7 49 (at 750 K) 50	E.I.; M.S. Pyrolysis Thermochemical; based on 9	1959 1962 1967	179 6 6
		205 205 ± 13	49 49 ± 3	209 209 ± 13	50 50 ± 3			
	CCl ₃ Br → CCl ₃ + Br			207.1 ± 12.6 205 230.5 ± 5.0	49.5 ± 3 49 55.1 ± 1.2	(T=400–500 K); E.I.; M.S. (T=800 K), pyrolysis Recalculation of earlier data on photo- bromination.	1962 1962 1965	6 6 70
		213 213 ± 13	51 51 ± 3	226 ± 8 218 218 ± 13	54 ± 2 52 52 ± 3	Analysis of data Thermochemical; based on 9	1966 1967	8 8
	CF ₃ Br → CF ₃ + Br			272 290.4 ± 3.3	65 69.4 ± 0.8	(T=1050 K), pyrolysis Equilibrium Br ₂ + CF ₃ H = HBr + CF ₃ Br	1962 1967	6 15
		276	66	276 285 ± 13	66 68 ± 3	Thermochemical; based on 9	1967	6
	BrCN → CN + Br	377	90	380	91	Thermochemical; based on 9	1967	
	C ₂ → 2C	599.1 ± 13 602 ± 21 602 ± 21	143.2 ± 3 144 ± 5 144 ± 5	603.3 607 ± 21	144.2 145 ± 5	M.S. Spectroscopic	1962 1962	6 203
	CH ₃ CN → CH ₃ + CN			431 431 506	103 103 121	(T=400–500 K); E.I. A.P.; M.S. Thermochemical; based on 9	1962 1959 1967	6 179 6
		498 498 ± 21	119 119 ± 5	506 506 ± 21	121 121 ± 5			
	CH ₂ FCN → CH ₂ F + CN			~460	~110	(T=400–500 K); E.I.; M.S.	1960	16
CHF ₂ CN → CHF ₂ + CN			485	116	(T=400–500 K); E.I.; M.S.	1960	16	
CF ₃ CN → CF ₃ + CN			502	120	(T=400–500 K); E.I.; M.S.	1960	16	

Table of Bond Dissociation Energies – Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.	
		0 K		298 K					
		kJ/mol	kcal/mol	kJ/mol	kcal/mol				
C–N	$C_2N_2 \rightarrow 2CN$	607	145	435	104	A.P.; M.S. Shock wave; thermochemical ($T=1700-2500$ K)	1961	127	
				523 ± 33	125 ± 8	Shock wave	1962	164	
				607	145	Analysis of data	1966	8	
		598	143	602	144	Thermochemical;	1967		
		598 ± 21	143 ± 5	603 ± 21	144 ± 5	based on 9			
	$CH_2CO \rightarrow CH_2 + CO$	337.2	80.6	342.7	81.9	Thermochemical; based on 9	1967		
				44.4 47.3 46 ± 4	10.6 11.3 11 ± 1	Analysis of data Thermochemical; based on 9	1966 1967	8	
	C–Cl	$CCl \rightarrow C + Cl$	322	77			Spectroscopic; L. B. S. for ground state.	1961	17
			335 ± 42	80 ± 10	338.1	80.8	Analysis of data	1961	6
		$CCl_4 \rightarrow CCl_3 + Cl$			284.1 ± 13 301 ± 10	67.9 ± 3 72 ± 2.5	A.P.; M.S. A.P.; M.S.	1956 1958	124 18
337.2			80.6			Based on rate constants; previous data.	1961	141	
				318 311.7 ± 8	76 74.5 ± 2	A.P.; M.S. Thermochemical analysis of earlier data on photobromination.	1961 1965	19 70	
				305 ± 8	73 ± 2	Analysis of data;	1966	8	
280			67	285 293 ± 21	68 70 ± 5	thermochemical. Thermochemical; based on 9	1967		
$CF_3Cl \rightarrow CF_3 + Cl$				347 ± 12 ~ 335	83 ± 3 ~ 80	A.P.; M.S.	1956 1962	124 6	
		335	80	339 339 ± 13	81 81 ± 3	Thermochemical; based on 9	1967		
$CH_3Cl \rightarrow CH_3 + Cl$				328 336.8	78.4 80.5	A.P.; M.S. ($T=400-500$ K); E.I.; M.S.	1959 1962	179 6	
	318	76			Based on rate constants; previous data	1961	141		
			351 ± 8	84 ± 2	Analysis of data; thermochemical	1966	8		
	335.1	80.1	341.4 339 ± 21	81.6 81 ± 5	Thermochemical; based on 9	1967			

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
C-F	$\text{CH}_2\text{Cl}_2 \rightarrow \text{CH}_2\text{Cl} + \text{Cl}$			307.9 ± 11.7	73.6 ± 2.8	$(T=400-500 \text{ K})$; A.P.; M.S. Based on rate constants; previous data	1959	179
		314 ± 75					1961	141
	$\text{CH}_2\text{Cl} \rightarrow \text{CH}_2 + \text{Cl}$			318.4 ± 13	76.1 ± 3	A.P.; M. S. (Based on $D(\text{CH}-\text{H})=119.9$ Kcal mol ⁻¹). Recalculated; based on $D(\text{CH}-\text{H})=99.3$ Kcal mol ⁻¹ .	1959	179
				498	119		1967	
	$\text{ClCN} \rightarrow \text{CN} + \text{Cl}$	435	104	439	105	Thermochemical; based on 9	1967	
	$\text{COCl} \rightarrow \text{CO} + \text{Cl}$	26.4	6.3			Based on rate constants; previous data	1961	141
	$\text{COCl}_2 \rightarrow \text{COCl} + \text{Cl}$	328.4	78.5			Based on rate con- stants; previous data.	1961	141
	$\text{CCl}_3\text{F} \rightarrow \text{CCl}_3 + \text{F}$			427 ± 29	102 ± 7	$(T=400-500 \text{ K})$; E.I.; M.S. Recalculation of earlier data on photo- bromination	1962	6
				448 ± 11.7	107 ± 2.8		1965	70
				444 ± 13	106 ± 3	Analysis of data Thermochemical; based on 9	1966	8
		410	98	414	99		1967	
				444 ± 21	106 ± 5			
	$\text{CF}_4 \rightarrow \text{CF}_3 + \text{F}$			506 ± 10.5	121 ± 2.5	E.I.; M.S. E.I.; M.S.	1958	18
			506 ± 17	$121 + 4$	1962		6	
	523	125	527	126	Thermochemical; based on 9	1967		
			532.6	127.3	Thermochemical; based on 202	1967		
			523 ± 17	125 ± 4				
$\text{CH}_3\text{F} \rightarrow \text{CH}_3 + \text{F}$			494	118	Analysis of data Thermochemical	1962	6	
			452 ± 13	108 ± 3		1966	8	
			452 ± 21	108 ± 5				
C-H	$\text{CH} \rightarrow \text{C} + \text{H}$	335 ± 4	80 ± 1			Spectroscopic; predissociation	1956	3
		318.4	76.1				Theoretical	1962
		335 ± 21	80 ± 5			Spectroscopic; ² H emission	1964	79
		334.7	80.0	338.9	81.0	Thermochemical; based on 9	1967	
				339 ± 2.1	81 ± 0.5			

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.	
		0 K		298 K					
		kJ/mol	kcal/mol	kJ/mol	kcal/mol				
CH ₂ → CH + H				502	120	A.P.; M.S.	1959	179	
	436.4	104.3				Theoretical	1962	134	
			536 ± 25	128 ± 6		Analysis of data	1962	6	
			< 405.0 ± 9.6	< 96.8 ± 2.3		Recalculation of earlier M.S. data	1963	67	
			452 ± 25	108 ± 6		Analysis of data	1966	8	
	415.5	99.3	421.7	100.8		Thermochemical; based on 9 and 122.	1967		
	CH ₃ → CH ₂ + H	485	116				Theoretical	1962	134
		< 540	< 129	356 ± 29	85 ± 7		Analysis of data	1962	6
							Recalculation of earlier M.S. data	1963	67
		469.86	112.30				Photoionization	1965	122
466.5		111.5	435 ± 25	104 ± 6		Analysis of data	1966	8	
469.9 ± 0.4	112.3 ± 0.1	471.1	112.6	473 ± 4	113 ± 1	Thermochemical; based on 9	1967		
CH ₄ → CH ₃ + H				397	95	A.P.; M.S.	1959	179	
	423	101				Photobromination	1956	3	
			434.7	103.9		Photohalogenation	1961	155	
	425.1 ± 8	101.6 ± 2	431 ± 8	103 ± 2		Analysis of data	1962	6	
	423	101				Theoretical	1962	134	
	425.47 ± 0.21	101.69 ± 0.05				Photoionization	1965	122	
			435 ± 4	104 ± 1		Analysis of data	1966	8	
			434.3	103.8			1967		
	425.1	101.6	431.8	103.2		Thermochemical; based on 9	1967		
	101.6 ± 2.0	102.7 ± 2.0							
CD ₄ → CD ₃ + D	438.99 ± 0.2	104.92 ± 0.05			Photoionization	1965	123		
CBr ₃ H → CBr ₃ + H			389 ± 8	93 ± 2	(<i>T</i> = 400 K); photobromination	1962	6		
			377	90	Thermochemical	1962	6		
	368 ± 8	88 ± 2	377 ± 8	90 ± 2					
CH ₃ Br → CH ₂ Br + H	~414	~99			Photobromination	1956	3		
	402	96			Thermochemical	1962	6		
	406 ± 21	97 ± 5							
CCl ₃ H → CCl ₃ + H			377 ± 8	90 ± 2	Photobromination	1956	3		
			389	93	Rate constant data	1961	141		
			372 ± 13	89 ± 3	(<i>T</i> = 400–500 K); E.I.; M.S.	1962	6		
			389	93	(<i>T</i> = 430 K); photochlorination	1962	6		
			400.4 ± 6.3	95.7 ± 1.5	Recalculation of earlier data on photobromination	1965	70		
	372	89	380	91	Thermochemical; based on 9	1967			
372 ± 13	89 ± 3	377 ± 13	90 ± 3						

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
CH ₃ CN → CH ₂ CN + H HCN → H + CN				<331 464 ± 25 540 ± 13	<79 111 ± 6 129 ± 3	A.P.; M.S. Thermochemical Shock wave; Kr + C ₂ N ₂ ; Kr + HCN	1956	3
							1961	120
		531 531 ± 21	127 127 ± 5	540 ± 13 540	129 ± 3 129	Analysis of data Thermochemical; based on 9	1966	8
							540 ± 21	129 ± 5
HCO → H + CO		119.7	28.6	127.2 ± 9.6 75	30.4 ± 2.3 18	(T = 400–500 K); E.I.; M.S. Analysis of data Thermochemical; based on 9	1962	6
							124.7	29.8
H ₂ CO → HCO + H		314	75	<326 314 ± 8 368 ± 8 318	<78 75 ± 2 88 ± 2 76	Photolysis E.I.; M.S. Analysis of data Thermochemical; based on 9	1962	6
						Analysis of data Thermochemical; based on 9	1966	8
CF ₃ H → CF ₃ + H				431 ± 17 427 ± 8	103 ± 4 102 ± 2	E.I.; M.S.; $\Delta H_f(\text{CF}_3) = -117 \pm 2$ From CF ₃ + CH ₄ → CF ₃ H + CH ₃	1956	124
				431 ± 17 458.1 ± 6.3 427 ± 8 443.5	103 ± 4 109.5 ± 1.5 102 ± 2 106.0	E.I.; M.S. Photohalogenation CD ₃ + CF ₃ H → CD ₃ H + CF ₃ ; Br + CF ₃ H = HBr + CF ₃ ; Br + CH ₄ = HBr + CH ₃	1962	6
						Equilibrium Analysis of data Equilibrium Thermochemical; based on 9	1964	175
		423 439 ± 13	101 105 ± 3	444.8 444 ± 4 444.8 431	106.3 106 ± 1 106.3 103	Equilibrium Analysis of data Equilibrium Thermochemical; based on 9	1966	150
						Equilibrium Analysis of data Equilibrium Thermochemical; based on 9	1967	15
CH ₃ Cl → CH ₂ Cl + H		410	98	372.0 ± 13	88.9 ± 3	Photochlorination	1956	124
CH ₂ Cl ₂ → CHCl ₂ + H				333.0 ± 21 397	79.6 ± 5 95	E.I.; M.S. Photochlorination	1959	179
CH ₃ CN → CH ₂ CN + H				< 331	< 79	E.I.; M.S.	1961	125
CH ₃ OH → CH ₂ OH + H				385	92	Br + CH ₃ OH → HBr + CH ₂ OH	1962	139

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.		
		0 K		298 K						
		kJ/mol	kcal/mol	kJ/mol	kcal/mol					
C-I	$\text{CH}_3\text{I} \rightarrow \text{CH}_3 + \text{I}$	230	55	221.7	53.0	A.P.; M.S.	1959	179		
						Previous data on $\text{HI} + \text{CH}_3\text{I} = \text{CH}_4 + \text{I}_2$	1961	103		
				220.1	52.6	E.I.	1962	6		
				230 ± 4	55 ± 1	Equilibrium	1963	65		
						$\text{HI} + \text{CH}_3\text{I} = \text{CH}_4 + \text{I}_2$				
		227.2	54.3	232.6	55.6	Thermochemical;	1967			
		226 ± 13	54 ± 3	232.2 ± 13	55.5 ± 3	based on 9				
	$\text{CNI} \rightarrow \text{CN} + \text{I}$	335	80	339	81	Thermochemical;	1967			
						based on 9				
C-N	$\text{CN} \rightarrow \text{C} + \text{N}$			808	193	A.P.; M.S.	1961	127		
				728 ± 13	174 ± 3	Shock wave;	1961	120		
						$\text{Kr} + \text{C}_2\text{N}_2$				
				812 ± 21	194 ± 5	816	195	Analysis of various data	1962	6
				723.4 ± 9.6	172.9 ± 2.3	732	175	Effusion; M.S.	1962	162
				732	175	732	175	Thermochemical;	1967	
				730.1 ± 21	174.5 ± 5	732 ± 21	175 ± 5	based on 9		
			$\text{CH}_3\text{NH}_2 \rightarrow \text{CH}_3 + \text{NH}_2$			335	80	A.P.; M.S.	1959	128
						331	79	Analysis of data	1966	8
						335	80	Thermochemical;	1967	
				331 ± 13	79 ± 3	based on 9				
	$\text{CH}_3\text{NO}_2 \rightarrow \text{CH}_3 + \text{NO}_2$			243	58	Analysis of data	1962	6		
		238.9	57.1	246.9	59.0	Thermochemical;	1967			
				247 ± 13	59 ± 3	based on 9				
C-O	$\text{CO} \rightarrow \text{C} + \text{O}$	1070.23	255.79	1074.83	256.89	Analysis of data	1962	6		
		1071.77	256.16	1076.38	257.26	Thermochemical;	1967			
		1071.94	256.2 ± 0.1	1076.5 ± 0.4	257.3 ± 0.1	based on 9				
		± 0.4								
	$\text{CO}_2 \rightarrow \text{CO} + \text{O}$	526.14	125.75	532.20	127.20	Thermochemical	1962	6		
		526.14	125.75	532.16	127.19	Thermochemical;	1967			
		525.9 ± 0.4	125.7 ± 0.1	532.2 ± 0.4	127.2 ± 0.1	based on 9				
	$\text{CH}_3\text{OH} \rightarrow \text{CH}_3 + \text{OH}$	374.5	89.5				1956	132		
				381.2	91.1	A.P.; M.S.	1959	179		
				~ 377	~ 90	Photodissociation	1962	6		
				381 ± 8	91 ± 2	Thermochemical	1966	8		
				378.7	90.5	Thermochemical;	1967			
		370.7	88.6	377 ± 13	90 ± 3	based on 9				
		370.3 ± 13	88.5 ± 3							
	$\text{HCOOH} \rightarrow \text{CHO} + \text{OH}$			~ 377	~ 90	Photodissociation	1962	6		
				400.4	95.7	Thermochemical;	1967			
				402 ± 13	96 ± 3	based on 9				

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
C-S	$\text{CH}_3\text{COOH} \rightarrow \text{CH}_3\text{CO} + \text{OH}$			~ 377 452.3 452 ± 21	~ 90 108.1 108 ± 5	Photodissociation Thermochemical; based on 9	1962 1967	6
	$\text{OCS} \rightarrow \text{CS} + \text{O}$	619	148	628	150	Thermochemical; based on 9	1967	
	$\text{CS} \rightarrow \text{C} + \text{S}$	757 ± 151	181 ± 36			Spectroscopic; L.B.S. for $X^1\Sigma$ state	1959	20
		735.5 757 ± 21	175.8 181 ± 5	740.1 761 ± 21	176.9 182 ± 5	Thermochemical	1962	6
	$\text{OCS} \rightarrow \text{CO} + \text{S}$	305.0	72.9	310.5	74.2	Thermochemical; based on 9	1967	
	$\text{CS}_2 \rightarrow \text{CS} + \text{S}$	389	93	397	95	Thermochemical; based on 9	1967	
	$\text{CH}_3\text{S} \rightarrow \text{CH}_3 + \text{S}$			289	69		1962	137
	$\text{CH}_3\text{SH} \rightarrow \text{CH}_3 + \text{SH}$			305 ± 21 293 ± 21	73 ± 5 70 ± 5	Thermochemical; $\Delta H_f(\text{SH}) = 35.0$ ($T = 400^\circ\text{--}500^\circ$); E.I.; M.S.	1962 1962	135 6
	297 297 ± 13	71 71 ± 3	305 305 ± 13	73 73 ± 3	Thermochemical; based on 9	1967		
	$\text{CH}_3\text{SO}_2 \rightarrow \text{CH}_3 + \text{SO}_2$			97.5 ± 7.5	23.3 ± 1.8	Thermochemical	1961	142
Ca-Cl	$\text{CaCl} \rightarrow \text{Ca} + \text{Cl}$	< 266.1	< 63.6			Spectroscopic; predissociation.	1962	6
		335 ± 42 427 ± 25 427 ± 42	80 ± 10 102 ± 6 102 ± 10			Calorimetric Flame photometry	1963 1965	186 23
	$\text{CaCl}_2 \rightarrow \text{CaCl} + \text{Cl}$	431 ± 42 431 ± 42	103 ± 10 103 ± 10			Flame photometry	1965	23
Ca-F	$\text{CaF} \rightarrow \text{Ca} + \text{F}$	< 303.8	< 72.6			Spectroscopic; predissociation.	1962	6
		515 ± 19 565 ± 29 552 ± 42	123 ± 4.6 135 ± 71 132 ± 10			Effusion; M.S.	1963	174

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
Ca-O	CaF ₂ → CaF + F	548 ± 42	131 ± 10			Flame photometry; recalculated from ref. 21.	1965	23
		569 548 ± 42	136 131 ± 10			Flame photometry	1964	21
	CaO → Ca + O	481 ± 17	115 ± 4			Analysis of data on flames	1962	6
		347 ± 42	83 ± 10			Theoretical	1964	144
		389 ± 21	93 ± 5			Effusion; M.S.	1964	190
		353.1 ± 25	84.4 ± 6			Effusion; M.S.	1964	189
		382.0 ± 5.9	91.3 ± 1.4			Flame photometry; CO flame	1965	71
		490 ± 21	117 ± 5			Flame photometry; H ₂ flame	1965	22
		531 ± 21 460 ± 84	127 ± 5 110 ± 20			Flame photometry; H ₂ flame	1966	191
	CaOH → Ca + OH	≤ 397 ± 42	≤ 95 ± 10			Flame photometry; C ₂ H ₂ + CO flames	1957	52
418 ± 33		100 ± 8			Flame photometry; H ₂ flame	1965	22	
Ca(OH) ₂ → CaOH + OH	490 ± 75	117 ± 18			Ref 191 gives $D_1 + D_2 = 217 \pm 10$ and 22 gives $D_2 = 100 \pm 8$			
Ca-S	CaS → Ca + S	289 ± 19	69 ± 4.6			M.S.	1962	6
		332.6 ± 9.6	79.5 ± 2.3			M.S.; Effusion of Ca + S ₂ = CaS + S	1963	80
		308.4 ± 18.8 310 ± 21	73.7 ± 4.5 74 ± 5			M.S.; Effusion	1964	189
Cd-S	CdS → Cd + S	≤ 377	≤ 90	381	91	Spectroscopic; limit of continuum	1953	1
		≤ 197	≤ 47			M.S.	1963	80
Cl-Cl	Cl ₂ → 2Cl	238.9 ± 0.25	57.10 ± 0.06	242.3	57.9	Spectroscopic	1962	6
		239.99	57.36	243.34	58.16	Thermochemical;	1967	
		239.7 ± 0.4	57.3 ± 0.1			based on 9		
Cl-F	ClF → Cl + F	246.9 ± 0.8	59.0 ± 0.2	250.2	59.8	Spectroscopic;	1962	6
		251.5	60.1	255.2	61.0	convergence of bands	1967	
		248.9 ± 2.1	59.5 ± 0.5			Thermochemical; based on 9		

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.	
		0 K		298 K					
		kJ/mol	kcal/mol	kJ/mol	kcal/mol				
Cl-H	$O_3ClF \rightarrow O_3Cl + F$			251 255	60 61	A.P.; M.S. Thermochemical	1957 1962	60 6	
	$HCl \rightarrow H + Cl$	427.60 ± 1.46 424.7 428.15 428.02 ± 0.42	102.20 ± 0.35 101.5 102.33 102.3 ± 0.1	431.45 431.96	103.12 103.24	Thermochemical Theoretical Thermochemical; based on 9	1962 1963 1967	6 188	
	Cl-O	$ClO \rightarrow Cl + O$	246.9 265.01 ± 0.13	63.31 63.34 ± 0.03	269.16	64.33	Spectroscopic Spectroscopic; convergence of bands.	1958 1962	33 6
			264.85 267.8 ± 4.2	63.30 64 ± 1	269.03	64.30	Thermochemical; based on 9	1967	
Cl-O	$ClO_2 \rightarrow ClO + O$	267	66	278.2	66.5	Spectroscopic; predissociation	1962	6	
		241.0 ± 6.3 230 ± 8 243.9 243 ± 13	57.6 ± 1.5 55 ± 2 58.3 58 ± 3	245.6 248.5	58.7 59.4	Thermochemical E.I.; M.S. Thermochemical; based on 9	1962 1967 1967	6 27	
		ClO ₃ → ClO ₂ + O			199.2 197.1	47.6 47.1	Thermochemical Thermochemical; based on 9	1962 1967	6
					201 ± 4	48 ± 1			
Co-Co	$Cl_2O \rightarrow Cl + ClO$	142.7 139.3 139.3 ± 4	34.1 33.3 33.3 ± 1	146.4 143.1	35.0 34.2	Thermochemical Thermochemical; based on 9	1962 1967	6	
		Co ₂ → 2Co	163 ± 25 163 164.0 ± 17	39 ± 6 39 39.2 ± 4	167	40	Effusion; M.S. Thermochemical; based on 9	1964 1967	56
			$(CO)_4Co-Co(CO)_4 \rightarrow 2Co(CO)_4$			48.1 ± 19.2	11.5 ± 4.6	A.P.; M.S.	1967
Cr-Cr	$Cr_2 \rightarrow 2Cr$	< 167 < 184	< 40 < 44	< 172	< 41	M.S. Effusion; M.S.	1962 1964	62;6 56	
		Cr-O	$CrO \rightarrow Cr + O$	425.5 ± 29 418 423 ± 29	101.7 ± 7 100 101 ± 7			Effusion; M.S. Thermochemical; based on 9	1961 1967

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
	$\text{CrO}_2 \rightarrow \text{CrO} + \text{O}$	527 ± 63 527 531 ± 63	126 ± 15 126 126 ± 15			Effusion; M.S. Thermochemical; based on 9	1961 1967	85
	$\text{CrO}_3 \rightarrow \text{CrO}_2 + \text{O}$	477 ± 84	114 ± 20			Effusion; M.S.	1961	85
Cs-Br	$\text{CsBr} \rightarrow \text{Cs} + \text{Br}$			381	91	Effusion; Ioni- zation on hot wire M.S.	1962 1962	163 6
		416.3 ± 13	99.5 ± 3					
Cs-Cl	$\text{CsCl} \rightarrow \text{Cs} + \text{Cl}$	422.2	100.9	425.9	101.8	Effusion; Ioni- zation on hot wire Thermochemical Flame photometry	1962 1962 1962	163 6 6
		425.1 ± 13 448 ± 13 435 ± 21	101.6 ± 3 107 ± 3 104 ± 5	428.9	102.5			
Cs-F	$\text{CsF} \rightarrow \text{Cs} + \text{F}$	481	115	485	116	Effusion; Ioni- zation on hot wire Thermochemical Flame photometry Theoretical	1962 1962 1962 1963	163 6 6 188
		481 ± 25 515 ± 33 487.4 502 ± 42	115 ± 6 123 ± 8 116.5 120 ± 10	485	116			
Cs-I	$\text{CsI} \rightarrow \text{Cs} + \text{I}$	315.5	75.4	319.2	76.3	Effusion; Ioni- zation on hot wire Flame photometry	1962 1962	163 6
		350.2 ± 17 335 ± 21	83.7 ± 4 80 ± 5	354.0	84.6			
Cs-O	$\text{CsOH} \rightarrow \text{Cs} + \text{OH}$	381 ± 13	91 ± 3			Flame photometry	1966	192
Cu-Cu	$\text{Cu}_2 \rightarrow 2\text{Cu}$	201 ± 38	48 ± 9			Spectroscopic; L.B.S. for ground state. M.S.	1962 1960; 1962	6 108; 6
		190.4 ± 9.2 190.4 ± 13	45.5 ± 2.2 45.5 ± 3					
Cu-F	$\text{CuF} \rightarrow \text{Cu} + \text{F}$	293 ± 96	70 ± 23	297	71	Spectroscopic; L.B.S. for ground state Effusion; M.S.	1953; 1962 1966	3; 6 151
		364 ± 38	87 ± 9					
	$\text{CuF}_2 \rightarrow \text{CuF} + \text{F}$	366.5	87.6			Effusion; M.S.	1966	151

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
Cu-H	CuH \rightarrow Cu + H	276 \pm 8	66 \pm 2	280	67	Flame photometry	1956;	136;
				264	63	Thermochemical; based on 9	1962	6
Cu-Sn	CuSn \rightarrow Cu + Sn	173.2 \pm 17	41.4 \pm 4	177.4	42.4	Effusion; M.S. Thermochemical; based on 9	1962	63; 6
		173.4	41.4				1967	
		173.4 \pm 17	41.4 \pm 4					
F-F	F ₂ \rightarrow 2F	153.1	36.6			Thermochemical; M.S. Spectroscopic;	1956	89
		155.2 \pm 3.6	37.1 \pm 0.85				continuous absorption	1957
		172.8 \pm 2.1	41.3 \pm 0.5			Molecular beam; magnetic detection	1959	129
		154.8 \pm 4	37.0 \pm 1	159.0	38.0	Dissociation equilibrium	1962	6
		161.1 \pm 2.5	38.5 \pm 0.6	165.3	39.5	Thermochemical	1962	6
		170.54	40.76	174.9 \pm 0.8	41.8 \pm 0.2	Effusion; Knudsen cell	1966	167
		153.80	36.76	157.99	37.76	Thermochemical; based on 9	1967	
		154.8 \pm 4	37.0 \pm 1.0					
F-H	HF \rightarrow H + F	565.3 \pm 1.3	135.1 \pm 0.3	566.1	135.3	Spectroscopic; extrapolation of X ¹ Σ levels	1959	28
		556.1	132.9				Theoretical	1963
		561.1	134.1			Shock tube	1965	74
		564.0	134.8	568.2	135.8	Thermochemical; based on 9	1967	
		565 \pm 4	135 \pm 1					
F-O	FO \rightarrow F + O	106.3	25.4			A.P.; M.S. Assumed $D_0(\text{F-O})$ $= 1/2D_0(\text{F}_2\text{O})$	1957	106
		184 \pm 42	44 \pm 10	189	45.1		1962	6
		151	36	155	37	Thermochemical; based on 9	1967	
	155 \pm 13	37 \pm 3						
	FOO \rightarrow F + O ₂	63	15			Thermal decom- position of F ₂ O ₂	1965	43
	F ₂ O \rightarrow FO + F	270.3	64.6			A.P.; M.S. E.I.; M.S.	1957	106
269.9		64.5	274.5	65.6	1962		66	
180 \pm 42		43 \pm 10	186.2	44.5	Estimated	1962	6	
268		64	272	65	Thermochemical; based on 9	1967		
268 \pm 13		64 \pm 3						
F ₂ O ₂ \rightarrow FO ₂ + F	77.8	18.4			A.P.; M.S.	1966	152	

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
Fe-Fe	Fe ₂ Br ₄ → 2FeBr ₂			145.2 ± 17 158.2	34.7 ± 4 37.8	Effusion; M.S. Equilibrium studies Thermochemical; based on 9	1959	100
				172 167 ± 17	41 40 ± 4		1962	6
	Fe ₂ Cl ₄ → 2FeCl ₂	134 ± 13	32 ± 2	151.9	36.3	Effusion; M.S. Equilibrium studies Thermochemical; based on 9	1958	118
				142 146 ± 13	34 35 ± 3		1962	6
Fe-Br	FeBr ₃ → FeBr ₂ + Br			222 188	53 45	Thermochemical Thermochemical; based on 9	1962	6
				188 ± 21	45 ± 5		1967	
Fe-Cl	FeCl ₃ → FeCl ₂ + Cl			209 227.2	50 54.3	Thermochemical Thermochemical; based on 9	1962	6
				226 ± 8	54 ± 2		1967	
Fe-I	FeI ₃ → FeI ₂ + I			144 96	34.4 23	Equilibrium studies Thermochemical; based on 9	1962	6
							1967	
Fe-S	FeS → Fe + S	≅ 315.9	≅ 75.5			M.S.; Fe + S ₂ = FeS + S	1963	80
Ga-Br	GaBr → Ga + Br	415.5 ± 0.4	99.3 ± 0.1	419.7	100.3	Spectroscopic Flame photometry Thermochemical; based on 9	1960	140
		429.3 ± 17	102.6 ± 4				1962	6
		435 435 ± 17	104 104 ± 4	439 444 ± 17	105 106 ± 4		1967	
Ga-Cl	GaCl → Ga + Cl	474.9 ± 4	113.5 ± 1	478.2	114.3	Spectroscopic Flame photometry Thermochemical; based on 9	1960	140
		480.7 ± 17	114.9 ± 4				1962	6
		477 477 ± 13	114 114 ± 3	477	114		1967	
Ga-F	GaF → Ga + F	602.1 ± 21	143.9 ± 5	605.8	144.8	Spectroscopic Effusion; M.S. Thermochemical; based on 9	1960	140
		577 ± 15	138 ± 3.5				1966	170
		602 602 ± 13	144 144 ± 3	607	145		1967	

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
Ga-Ga	$\text{Ga}_2 \rightarrow 2\text{Ga}$	≤ 146	≤ 35	151	36	M.S.	1957	30;
		113 113 ± 17	27 27 ± 4	117 117 ± 17	28 28 ± 4	Thermochemical; based on 9	1967	29
Ga-H	$\text{GaH} \rightarrow \text{Ga} + \text{H}$	272	65	276	66	Thermochemical; based on 9	1967	
Ga-I	$\text{GaI} \rightarrow \text{Ga} + \text{I}$	335	80			Spectroscopic Flame photometry Thermochemical; based on 9	1960	140
		381 ± 29	91 ± 7				1962	6
		351 351 ± 21	84 84 ± 5	356 356 ± 21	85 85 ± 5		1967	
Ga-O	$\text{GaO} \rightarrow \text{Ga} + \text{O}$	343 ± 50	58 ± 12			Spectroscopic; L.B.S. for ground state Spectroscopic Estimate Thermochemical; based on 9	1953	3
		293 ± 42	70 ± 10	297	71		1962	6
		347	83	351	84		1962	6
		243	58	247	59		1967	
		247 ± 42	59 ± 10					
Ga-OH	$\text{GaOH} \rightarrow \text{Ga} + \text{OH}$	427 ± 21	102 ± 5			Flame photometry Thermochemical; based on 9	1958	196
		427	102	431	103		1967	
		431 ± 21	103 ± 5					
Ge-Br	$\text{GeBr} \rightarrow \text{Ge} + \text{Br}$	251 ± 29	60 ± 7	255	61	Spectroscopic; extrapolation of ^2II state Thermochemical; based on 9	1953	3; 6
		251	60	251	60		1962	
		251 ± 29	60 ± 7				1967	
	$\text{GeBr}_2 \rightarrow \text{GeBr} + \text{Br}$			410	98	Thermochemical; based on 9	1967	
Ge-C	$\text{GeC} \rightarrow \text{Ge} + \text{C}$	456 ± 21	109 ± 5			M.S. Thermochemical; based on 9	1959	123
		456	109	460	110		1967	
Ge-Cl	$\text{GeCl} \rightarrow \text{Ge} + \text{Cl}$	339 ± 21	81 ± 5	343	82	Spectroscopic; extrapolation of $^2\Delta$ levels Thermochemical; based on 9	1953	3; 6
							1962	
		339 339 ± 21	81 81 ± 5	343 343 ± 21	82		1967	

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
Ge-F	GeF → Ge + F	477 ± 84	114 ± 20	481	115	Spectroscopic; L.B.S. for X ² Π	1962	6
		485 484 ± 42	116 115 ± 10	490	117			
	GeF ₂ → GeF + F	548	131			Thermochemical; based on 9	1967	
Ge-Ge	Ge ₂ → 2Ge	268 ± 21	64 ± 5			Effusion; M.S. Thermochemical; based on 9	1959	123
		276 272 ± 21	66 65 ± 5	280 280 ± 21	67 67 ± 5			
	Ge ₂ H ₆ → 2GeH ₃	315.9	75.5	142	34	Pyrolysis A.P.; M.S.	1962	6
							1966	153
Ge-H	GeH → Ge + H	318	76	322	77	Thermochemical	1962	6
	GeH ₄ → GeH ₃ + H	365	87.2			A.P.; M.S.	1966	153
Ge-O	GeO → Ge + O	657 ± 17	157 ± 4			L.B.S. for X ¹ Σ Thermochemical; based on 9	1962	6
		665 ± 17	159 ± 4	669	160			
		665	159	674	161			
		669 ± 21	160 ± 5	674 ± 21	161 ± 5			
Ge-S	GeS → Ge + S	544 ± 13	130 ± 3	548	131	Spectroscopic; extrapolation of <i>E</i> state levels. Thermochemical; based on 9	1962	6
		556	133	565	135			
		556 ± 17	133 ± 4	561 ± 17	134 ± 4			
Ge-Se	GeSe → Ge + Se	479.1 ± 25	114.5 ± 6	482.8	115.4	Spectroscopic; extrapolation of <i>E</i> state levels. Thermochemical; based on 9	1962	6
		502	120	506	121			
		502 ± 25	120 ± 6	506 ± 25	121 ± 6			
Ge-Si	GeSi → Ge + Si	297 ± 21	71 ± 5			Effusion; M.S. Thermochemical; based on 9	1959	123
		297	71	301	72			
		297 ± 17	71 ± 4	301 ± 17	72 ± 4			
	H ₃ GeSiH ₃ → GeH ₃ + SiH ₃	418.0	99.9			M.S.	1966	153

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
Ge-Te	GeTe \rightarrow Ge + Te	393 \pm 42	94 \pm 10	397	95	Spectroscopic; extrapolation of E state	1962	6
		398 \pm 17	95 \pm 4				Spectroscopic; thermochemical	1964
		393	94	397	95	Thermochemical; based on 9	1967	
		393 \pm 21	94 \pm 5	397 \pm 21	95 \pm 5			
	GeTe ₂ \rightarrow GeTe + Te			188	45	Thermochemical; based on 9	1967	
H-H	H ₂ \rightarrow 2H	432.027	103.257	436.0	104.2	Spectroscopic	1960	31
		\pm 0.004	\pm 0.001					
		432.195	103.297			Theoretical	1966	195
		432.00	103.25	435.93	104.19		Thermochemical; based on 9	1967
		432.00	103.25					
		\pm 0.04	\pm 0.01					
	HD \rightarrow H + D	435.458	104.077			Spectroscopic	1960	31
		435.642	104.121					
		435.43	104.07	439.32	105.00	Theoretical	1966	195
		435.43	104.07				Thermochemical; based on 9	1967
		\pm 0.04	\pm 0.01					
	D ₂ \rightarrow 2D	439.567	105.059			Spectroscopic	1960	31
		439.747	105.102					
		439.53	105.05	443.34	105.96	Theoretical	1966	195
		439.53	105.05				Thermochemical; based on 9	1967
		\pm 0.04	\pm 0.01					
Hf-O	HfO \rightarrow Hf + O	764.0	182.6 \pm 6			Effusion; M.S.	1963	92
		772	184.6					
		774 \pm 21	185 \pm 5			Thermochemical; based on 9	1967	
Hg-Br	HgBr \rightarrow Hg + Br			71	17	Toluene carrier pyrolysis	1956	154
		68.6	16.4	72.8	17.4			
		68.6 \pm 4	16.4 \pm 1	72.6 \pm 4	17.4 \pm 1	Spectroscopic; extrapolation of ground state	1960	32
Hg-Cl	HgCl \rightarrow Hg + Cl			96	23	Toluene carrier pyrolysis	1956	154
		96 \pm 8	23 \pm 2	100	24			
		96 \pm 8	23 \pm 2	100 \pm 8	24 \pm 2	Spectroscopic; L.B.S. for ground state	1950	4

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
Hg-S	HgS \rightarrow Hg + S	268 ± 21	64 ± 5	272	65	Spectroscopic; limit of continuum M.S.	1953	1
		≤ 208.8	≤ 49.9				1963	80
I-Br	IBr \rightarrow I + Br	175.381	41.917	177.8	42.5	Spectroscopic Thermochemical; based on 9	1962	6
		± 0.063	± 0.015				1967	
		175.39	41.92	177.90	42.52			
		175.3 ± 0.4	41.9 ± 0.1	177.8 ± 0.4	42.5 ± 0.1			
I-Cl	ICl \rightarrow I + Cl	208.28 ± 0.4	49.78 ± 0.1	211.3	50.5	Spectroscopic; con- vergence of bands Thermochemical; based on 9	1962	6
		207.82	49.67	210.75	50.37		1967	
		207.9 ± 0.4	49.7 ± 0.1	211.3 ± 0.4	50.5 ± 0.1			
I-F	IF \rightarrow I + F	277.0 ± 5.0	66.2 ± 1.2	280	67	Spectroscopic; graphical extrapolation of B ₃ I Thermochemical; based on 9	1962	6
		277.86	66.41	281.50	67.78		1967	
		277.8 ± 4	66.4 ± 1	280 ± 4	67 ± 1			
I-H	HI \rightarrow H + I	294.60 ± 0.42	70.41 ± 0.1	298.3	71.3	Thermochemical Theoretical Thermochemical; based on 9	1962	6
		290.4	69.4				1963	188
		294.60	70.41	298.32	71.30		1967	
		294.6 ± 0.4	70.4 ± 0.1	298.3 ± 0.4	71.3 ± 0.1			
I-I	I ₂ \rightarrow 2I	148.808 ± 0.13	35.566 ± 0.03	151.0	36.1	Spectroscopic; band con- vergence Thermochemical; based on 9	1962	6
		148.963	35.603	151.239	36.147		1967	
		148.95	35.60					
		± 0.04	± 0.01					
I-O	IO \rightarrow I + O	176 ± 21	42 ± 5			Spectroscopic; B.S. extrapolation Flame photometry Spectroscopy; L.B.S. for X ² Π and A ² Π Thermochemical; based on 9	1958	33
		239 ± 25	57 ± 6				1961	143
		184 ± 21	44 ± 5	188	45		1962	6
		177.0	42.3	180.7	43.2		1967	
		180 ± 21	43 ± 5	184 ± 21	44 ± 5			

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
In-Br	InBr \rightarrow In + Br	385 \pm 3	92 \pm 0.7			Spectroscopic; thermochemical Flame photometry Thermochemical; based on 9	1960	140
		387.9 \pm 13	92.7 \pm 3				1961	34
		409.6	97.9	412.1	98.5		1967	
		406 \pm 21	97 \pm 5	414 \pm 21	99 \pm 5			
In-Cl	InCl \rightarrow In + Cl	428.4 \pm 8	102.4 \pm 2			Spectroscopic; thermochemical Flame photometry Thermochemical; based on 9	1960	140
		434.7 \pm 13	103.9 \pm 3				1961	34
				439	105		1967	
		435 \pm 8	104 \pm 2	439 \pm 8	105 \pm 2			
In-F	InF \rightarrow In + F	526.8 \pm 8	125.9 \pm 2			Spectroscopic Flame photometry Thermochemical; based on 9	1960	140
		523 \pm 33	125 \pm 8				1961	34
		522.2	124.8	525.5	125.6		1967	
		523 \pm 8	125 \pm 2	525 \pm 8	126 \pm 2			
In-H	InH \rightarrow In + H	< 238	< 57			Spectroscopic; predissociation Thermochemical; based on 9	1950	4
		243	58	247	59		1967	
		238 \pm 21	57 \pm 5					
In-I	InI \rightarrow In + I	331 \pm 4	79 \pm 1			Spectroscopic; analysis of data Flame photometry Thermochemical; based on 9	1960	140
		326 \pm 17	78 \pm 4				1961	34
		340.6	81.4	342.7	81.9		1967	
		339 \pm 17	81 \pm 4					
In-In	In ₂ \rightarrow 2In	93.7 \pm 10.5	22.4 \pm 2.5			Effusion; M.S. Thermochemical; based on 9	1959	82
		103.8	24.8	105.9	25.3		1967	
		100 \pm 13	24 \pm 3	100 \pm 13	24 \pm 3			
In-O	InO \rightarrow In + O	96 \pm 42	23 \pm 10			Spectroscopic; L.B.S. for ground state Thermochemical; estimate M.S.; Effusion; In ₂ O ₃ Thermochemical; based on 9	1953	1
		314	75	318	76		1962	6
		< 318	< 76				1963	66
		105	25	105	25			
							1967	
		InOH \rightarrow In + OH	360 \pm 29	86 \pm 7			Flame photometry	1958
		360	86	360	86	Thermochemical; based on 9	1967	
		360 \pm 21	86 \pm 5	360 \pm 21	86 \pm 5			
In-S	InS \rightarrow In + S			146	35	Thermochemical; based on 9	1967	
In-Sb	InSb \rightarrow In + Sb	148.1 \pm 10.5	35.4 \pm 2.5			Effusion; M.S. Thermochemical; based on 9	1959	82
				161.1	38.5		1967	

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
K-Br	KBr → K + Br	379.1 ± 4	90.6 ± 1	382.8	91.5	Thermochemical Flame photometry	1953	3
		379.5 ± 8	90.7 ± 2				1961	34
		378.7 ± 8	90.5 ± 2	382.8 ± 8	91.5 ± 2			
K-Cl	KCl → K + Cl	416.7 ± 8	99.6 ± 2			Flame photometry Thermochemical Theoretical	1961	34
		423.4 ± 1.7	101.2 ± 0.4	425.9	101.8		1962	6
		394	94.1				1963	188
		423 ± 8	101 ± 2	427 ± 8	102 ± 2			
K-F	KF → K + F	490 ± 34	117 ± 8			Flame photometry Thermochemical Theoretical	1961	34
		492.9 ± 5.0	117.8 ± 1.2	496.2	118.6		1962	6
		494	118				1963	188
		490 ± 21	117 ± 5	494 ± 21	118 ± 5			
K-I	KI → K + I	336.4	80.4			Flame photometry Thermochemical Theoretical	1961	34
		322 ± 13	77 ± 3	326	78		1962	6
		322	77				1963	188
		326 ± 13	78 ± 3	331 ± 13	79 ± 3			
K-O	KOH → K + OH			369.4	88.3	Thermochemical Flame photometry	1962	6
		339 ± 8	81 ± 2				1966	192
La-La	La ₂ → 2La	241.0 ± 21	57.6 ± 5			M.S.; photoionization	1963	93
La-O	LaO → La + O	786.2 ± 35.6	187.9 ± 8.5			Effusion; M.S. Effusion; M.S.	1956	197
		779.5 ± 19.2	186.3 ± 4.6				1961	96
		782 ± 21	187 ± 5					
La-S	LaS → La + S	573 ± 25	137 ± 6			Effusion; M.S.	1965	145
Li-Br	LiBr → Li + Br	420.9 ± 13	100.6 ± 3			Flame photometry Thermochemical	1961	34
		418 ± 13	100 ± 3	423	101		1962	6
		418 ± 21	100 ± 5	423 ± 21	101 ± 5			
Li-Cl	LiCl → Li + Cl	462.3 ± 13	110.5 ± 3			Flame photometry Thermochemical Theoretical	1961	34
		470.7 ± 4.6	112.5 ± 1	474.5	113.4		1962	6
		483.3	115.5				1963	188
		464 ± 13	111 ± 3	469 ± 13	112 ± 3			
Li-F	LiF → Li + F	569 ± 34	136 ± 8			Flame photometry Thermochemical Theoretical	1961	34
		574.9 ± 5.0	137.4 ± 1.2	578.6	138.3		1962	6
		590	141				1963	188
		573 ± 21	137 ± 5	577 ± 21	138 ± 5			

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
Li-I	LiI \rightarrow Li + I	344.3 \pm 13	82.3 \pm 3			Flame photometry Thermochemical Theoretical	1961	34
		349.8 \pm 13	83.6 \pm 3	354.0	84.6		1962	6
		341.0	81.5				1963	188
		347 \pm 13	83 \pm 3	351 \pm 13	84 \pm 3			
Li-O	LiO \rightarrow Li + O	341.0	81.5			Effusion; M.S. M.S.; LiO, Li ₂ O	1959	99
		326 \pm 21	78 \pm 5	331	79		1962	6
		331 \pm 13	79 \pm 3	335 \pm 13	80 \pm 3			
	LiOH \rightarrow Li + OH	434.3	103.8	439.3	105.0	M.S.	1960	35
		427	102	432	103.2	Flame photometry	1962	6
		411.3	98.3	416.3	99.5	Flame photometry	1962	6
423 \pm 8		101 \pm 2			Flame photometry	1966	192	
	423 \pm 21	101 \pm 5	427 \pm 21	102 \pm 5				
Mg-F	MgF \rightarrow Mg + F	502 \pm 84	120 \pm 20	506	121	Spectroscopic; extrapolation of X ² Σ , A ² Π and B ² Σ M.S.; Effusion; 2MgF = Mg + MgF ₂ M.S.; Effusion; AlF ₃ + 2Mg = 2MgF + AlF	1962	6
		441.4 \pm 5.0	105.5 \pm 1.2				1964	68
		448.9 \pm 6.7	107.3 \pm 1.6				1964	68
		460 \pm 42	110 \pm 10					
	MgF ₂ \rightarrow MgF + F	540 \pm 84	129 \pm 20	544	130	Thermochemical M.S.; Effusion; AlF ₃ + 2Mg = 2MgF + AlF	1962	6
		582.4 \pm 25	139.2 \pm 6				1964	68
565 \pm 42		135 \pm 10						
Mg-O	MgO \rightarrow Mg + O	410 \pm 8	98 \pm 2			Flame photometry Flame photometry Transpiration in O ₂ Transpiration in O ₂ Theoretical M.S.; Effusion	1959	177
		418 \pm 13	100 \pm 3				1962	6
		335	80				1963	36
		389	93				1963	37
		42 \pm 42	10 \pm 10				1964	144
		360 \pm 21	86 \pm 5				1964	190
		377 \pm 42	90 \pm 10					
	MgOH \rightarrow Mg + OH	234 \pm 21	56 \pm 5			Flame photometry	1959	177
Mn-Br	MnBr \rightarrow Mn + Br	280 \pm 54	67 \pm 13			Spectroscopic; L.B.S. of ground state Flame photometry	1950	4
		310.5 \pm 8	74.2 \pm 2				1961	34
		293 \pm 21	70 \pm 5					

Table of Bond Dissociation Energies – Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
Mn-Cl	MnCl → Mn + Cl	318 ± 63	76 ± 15			Spectroscopic; L.B.S. of ground state	1950	4
		356.9 ± 8	85.3 ± 2	360.7	86.2	Flame photometry	1961	34
		335 ± 42	80 ± 10					
Mn-I	MnI → Mn + I	279.1 ± 13	66.7 ± 3	283.3	67.7	Flame photometry	1961	34
Mn-Mn	Mn ₂ → 2Mn	< 88	< 21			Effusion; M.S.	1964	56
	Mn ₂ (CO) ₁₀ → 2Mn(CO) ₅			142 ± 54	34 ± 13	($T = 375\text{--}419$ K); ΔH_{sub} ; V.P.	1960	183
Mn-O	MnO → Mn + O	402 ± 13	96 ± 3	406	97	Flame photometry	1959	176
Mn-S	MnS → Mn + S	298.7 ± 17	71.4 ± 4			Effusion; M.S.	1965	114
Mo-O	MoO → Mo + O	485 ± 63	116 ± 15			M.S.	1960	199
	MoO ₂ → MoO + O	749	179			Effusion; V.P.; $D_1 + D_2 = 285$	1958	101
		611 ± 105 669 ± 84	146 ± 25 160 ± 20			M.S.; $D_1 + D_2 = 262 \pm 10$	1960	199
MoO ₃ → MoO ₂ + O	527	126			Effusion; V.P.; $D_1 + D_2 + D_3 = 410.3$	1958	101	
	623 ± 130 561 ± 84	149 ± 31 134 ± 20			M.S.; $D_1 + D_2 + D_3 = 411.7$	1960	199	
N-Br	NBr → N + Br	289 ± 59	69 ± 14			Spectroscopic; L.B.S. of ground state	1950	4
		280 ± 21 285 ± 21	67 ± 5 68 ± 5			Spectroscopic	1961	38
	ONBr → NO + Br			117	28	Calculated from equilibrium constants.	1962	6
		116.23 116.3 ± 6.3	27.78 27.8 ± 1.5	119.96 120.1 ± 6.3	28.67 28.7 ± 1.5	Thermochemical; based on 9	1967	
N-Cl	NCl → N + Cl			259	62	Thermochemical	1962	6
	NCl ₂ → NCl + Cl			280	67	Thermochemical	1962	6
	NCl ₃ → NCl ₂ + Cl			381	91	Thermochemical	1962	6

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.	
		0 K		298 K					
		kJ/mol	kcal/mol	kJ/mol	kcal/mol				
N-F	ONCl → NO + Cl			155	37	Calculated from equilibrium constants	1962	6	
		156.1	37.3	160.2	38.3	Thermochemical;	1967		
		155 ± 6	37 ± 1.5	159 ± 6	38 ± 1.5	based on 9			
	O ₂ NCl → NO ₂ + Cl			141.4	33.8	Thermochemical	1962	6	
		138.1	33.0	142.3	34.0	Thermochemical;	1967		
		138 ± 4	33.0 ± 1	142.3 ± 4	34.0 ± 1	based on 9			
	NF → N + F	251 ± 42	60 ± 10	255	61	Estimate	1962	6	
		297	71			Thermochemical	1961	161	
		297 ± 42	71 ± 10	301 ± 42	72 ± 10				
	NF ₂ → NF + F	295.0 ± 6.7	70.5 ± 1.6			Thermochemical; M.S.	1961	107	
	297	71			Thermochemical	1961	161		
	332.2 ± 42	79.4 ± 10	336.8	80.5	Thermochemical	1962	6		
	314 ± 21	75 ± 5	318 ± 21	76 ± 5					
N-F	NF ₃ → NF ₂ + F	244.3 ± 18.4	58.4 ± 4.4			Thermochemical; M.S.	1961	107	
		238	57			Thermochemical	1961	161	
		230	55			Thermochemical	1961	126	
		238	57			A.P.; M.S.	1961	126	
		238.1 ± 21	56.9 ± 5	243.5	58.2	Thermochemical	1962	6	
		241.4	57.7	246.9	59.0	Thermochemical;	1967		
		238 ± 8	57 ± 2	243 ± 8	58 ± 2	based on 9			
	ONF → NO + F	231.8	55.4			Calorimetric	1959	182	
		231.8 ± 8	55.4 ± 2	236.8	56.6	Thermochemical	1962	6	
		231.0	55.2	235.6	56.3	Thermochemical;	1967		
	231.0 ± 4	55.2 ± 1	235.6 ± 4	56.3 ± 1	based on 9				
N-F	O ₂ NF → NO ₂ + F			187.0	44.7	Thermochemical;	1962	98	
						$\Delta H_f^\circ(298)\text{NO}_2\text{F} = -20 \pm 5$			
		197 ± 21	47 ± 5	197 ± 21	47 ± 5	Thermochemical; from 9	1967		
					and $\Delta H_f^\circ(298)\text{NO}_2\text{F} = -20 \pm 5$				
N-H	NH → N + H	347 ± 13	83 ± 3			A.P.; M.S.	1958	130	
		347 ± 13	83 ± 3	351	84	A.P.; M.S.	1962	6	
		309.6 ± 15	74.0 ± 3.7			Spectroscopic; ³ Π - ³ Σ - absorption; shock tube	1966	49	
		356	85	360	86	Thermochemical;	1967		
		356 ± 8	85 ± 2	356 ± 8	85 ± 2	based on 9			
	N-H	NH ₂ → NH + H			385	92	E.I.; M.S.	1959	200
			377 ± 17	90 ± 4	381	91	Thermochemical	1962	6
					377	90	Thermochemical;	1967	
			372 ± 8	89 ± 2	377 ± 8.4	90 ± 2	based on 9		

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.	
		0 K		298 K					
		kJ/mol	kcal/mol	kJ/mol	kcal/mol				
N-N	NH ₃ → NH ₂ + H			444 ± 13	106 ± 3	E.I.; M.S. Thermochemical Thermochemical; based on 9	1958	105	
		435 ± 8	104 ± 2	441.0	105.4		1962	6	
		431 ± 8	103 ± 2	435	104		1967		
	N ₂ H ₄ → N ₂ H ₃ + H			318 ± 21	76 ± 5	E.I.; M.S. E.I.; M.S.	1958	105	
				318	76		1959	128	
				318 ± 8	76 ± 2				
	N-N	N ₂ → 2N	941.69 ± 0.46	225.07 ± 0.11	945.42	225.96	Analysis of spectroscopic and other data Thermochemical; based on 9	1962	6
			941.685	225.068	945.408	225.958		1967	
			941.69 ± 0.04	225.07 ± 0.01	945.42 ± 0.04	225.96 ± 0.01			
		N ₂ F ₄ → 2NF ₂			115.9 ± 29	27.7 ± 7	A.P.; M.S. A.P.; M.S. A.P.; M.S. Equilibrium; N ₂ F ₄ = 2NF ₂ ; Manometer Equilibrium N ₂ F ₄ = 2NF ₂ ; Spectrophotometric Shock tube dissociation of N ₂ F ₄ Thermochemical; based on 9	1960	110
				90.0 ± 6.7	21.5 ± 1.6	1961		107	
				86.6	20.7	1961		161	
				83.3	19.9	1961		126	
				90.8	21.7	1961		126	
				81.2 ± 2.9	19.4 ± 0.7	1965		39	
				87.9	21.0	1967			
		84 ± 4	20 ± 1	88 ± 4	21 ± 1				
N-N	N ₂ H ₄ → 2NH ₂			243 ± 38	58 ± 9	E.I.; M.S. A.P.; M.S. Pyrolysis of N ₂ H ₄ Pyrolysis; Toluene carrier Thermochemical; based on 9	1958	105	
				251	60		1959	128	
				259	62		1962	6	
				238.9	57.1		1963	156	
				247	59		1967		
				247 ± 13	59 ± 3				
N-N	HN ₃ → NH + N ₂	29	7	39.7	9.5	A.P.; M.S. Thermochemical; based on 9	1958	130	
				38	9		1967		
				38 ± 4	9 ± 1				
N-N	N ₂ O → NO + N			< 434.3 ± 9.6	< 103.8 ± 2.3	A.P.; M.S. Thermochemical Thermochemical; based on 9	1961	59	
		475.7 ± 4	113.7 ± 1	481.6	115.1		1962	6	
		475.09	113.55	480.91	114.94		1967		
		474.9 ± 4	113.5 ± 1	480.7 ± 4	114.9 ± 1				
N-N	N ₂ O ₃ → NO + NO ₂	36.4 ± 4.2	8.7 ± 1	41.0	9.8	Equilibrium data Thermochemical; based on 9	1962	6	
		35.1	8.42	39.5	9.49		1967		
		35.1 ± 0.8	8.4 ± 0.2	39.7 ± 0.8	9.5 ± 0.2				

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.		
		0 K		298 K						
		kJ/mol	kcal/mol	kJ/mol	kcal/mol					
	$N_2O_4 \rightarrow 2NO_2$	50.84	12.15	54.68	13.07	Equilibrium $N_2O_4 = 2NO_2$ Recalculated equilibrium data Thermochemical; based on 9	1962	64		
		53.43	12.77	57.28 ± 0.21	13.69 ± 0.05		1962	6		
		53.18 53.1 ± 2.1	12.71 12.7 ± 0.5	57.20 57.3 ± 2.1	13.67 13.7 ± 0.5		1967			
Na-Br	$NaBr \rightarrow Na + Br$	366.1	87.5	370.3	88.5	Thermochemical; fluorescence Theoretical	1962	6		
		356.9 366.1 ± 13	85.3 87.5 ± 3	370.3 ± 13	88.5 ± 3		1963	188		
Na-Cl	$NaCl \rightarrow Na + Cl$	410 ± 2	98 ± 0.5	410.0	98.0	Thermochemical Theoretical	1962	6		
		423.0 410 ± 8	101.1 98 ± 2	410 ± 8	98 ± 2		1963	188		
Na-I	$NaI \rightarrow Na + I$	301.7 ± 8	72.1 ± 2	299.6	71.6	Thermochemical; fluorescence Theoretical	1961	34		
		295.4 ± 0.4 297 ± 8	70.6 ± 0.1 71 ± 2				1962	6		
							1963	188		
Na-O	$NaOH \rightarrow Na + OH$			381 ± 13	91 ± 3	Thermochemical Flame photometry Flame photometry	1962	6		
	$NaO_2 \rightarrow NaO + O$	322 ± 17	77 ± 4				1966	192		
		272 ± 13	65 ± 3				1966	194		
Nd-F	$NdF \rightarrow Nd + F$			545.2 ± 12.6	130.3 ± 3.0	Effusion; M.S.	1966	171		
Nd-O	$NdO \rightarrow Nd + O$	692.9 ± 28.9	165.6 ± 6.9	695	166	Effusion; M.S. M.S.	1960	96		
		690 ± 25 690 ± 42	165 ± 6 165 ± 10				695 ± 42	166 ± 10	1962	6
Ni-Br	$NiBr \rightarrow Ni + Br$	356 ± 13	85 ± 3	360	86	Flame photometry	1961	34		
Ni-Cl	$NiCl \rightarrow Ni + Cl$	368 ± 21	88 ± 5	372	89	Flame photometry Thermochemical	1961	34		
		314 347 ± 42	75 83 ± 10				1962	6		
Ni-I	$NiI \rightarrow Ni + I$	289 ± 21	69 ± 5	293	70	Flame photometry	1961	34		
Ni-Ni	$Ni_2 \rightarrow 2Ni$	228.0 ± 2.1	54.5 ± 0.5			Effusion; M.S.	1964	76		

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
O-H	OH \rightarrow O + H			431.4 \pm 19.2	103.1 \pm 4.6	A.P.; M.S.; Spectroscopic Spectroscopic; extrapolation of A ² Π and B ² Σ. Thermochemical; based on 9.	1956	111
		424.09 \pm 1.3	101.36 \pm 0.3	428.19	102.34		1961	40
		424.09	101.36	428.19	102.34		1962	6
		423.8 \pm 2.1	101.3 \pm 0.5	428.0 \pm 2.1	102.3 \pm 0.5			
	H ₂ O \rightarrow OH + H			485.3 \pm 19.2	116.0 \pm 4.6	A.P.; M.S. Spectroscopic [OH] A.P.; M.S. Recalculation of data from Ref. 198. Thermochemical Thermochemical; based on 9	1956	111
		485.8 \pm 4.2	116.1 \pm 1.0	490.8	117.3		1961	41
		488.3	116.7				1958	198
		492.5	117.7				1959	88
		493.7 \pm 0.1	118.0 \pm 0.03	498.7	119.2		1962	6
		493.63	117.98	498.73	119.20		1967	
		493.7 \pm 0.8	118.0 \pm 0.2	498.7 \pm 0.8	119.2 \pm 0.2			
	HO ₂ \rightarrow H + O ₂			201.7	48.2	A.P.; M.S. Thermochemical; based on 9	1956	111
197 \pm 13		47 \pm 3	197	47	1967			
192		46						
	192 \pm 13	46 \pm 3	197 \pm 13	47 \pm 3				
H ₂ O ₂ \rightarrow HO ₂ + H			374.5	89.5	A.P.; M.S. Thermochemical Thermochemical; based on 9	1956	111	
	369.0	88.2	370.7	88.6		1962	6	
	365.3 \pm 8	87.3 \pm 2	377	90		1967		
	372	89						
	370.3 \pm 8.4	88.5 \pm 2.0	374.5 \pm 8.4	89.5 \pm 2.				
O-O	O ₂ \rightarrow 2O		117.97 \pm 0.05	498.40	119.12	Spectroscopic; extrap- olation of B ³ Σ _g ⁻ . Thermochemical; based on 9	1962	6
		493.570	117.966	498.340	119.106		1967	
		493.59 \pm 0.4	117.97 \pm 0.1					
	HO ₂ \rightarrow OH + O			271.5	64.9	Thermochemical Thermochemical; based on 9	1962	6
		266.1 \pm 8	63.6 \pm 2	268	64		1967	
		259	62					
		264.4 \pm 4	63.2 \pm 1					
	H ₂ O ₂ \rightarrow 2OH			210.5	50.3	Photochemical E.I.; M.S. Recalculation of Ref. 198 data Kinetic Kinetic A.P.; M.S. Thermochemical Thermochemical; based on 9		6
		203.8	48.7				1958	198
		200.0 \pm 13	47.8 \pm 3				1959	88
		202.5	48.4	198.74	47.50		1958	42
		204.2	48.8				1959	87
			209.2 \pm 13.4	50.0 \pm 3.2	1962		119	
207.36 \pm 1.46		49.56 \pm 0.35	214.14	51.18	1962		6	
207.44		49.58	214.22	51.20	1967			
	207.1 \pm 2.1	49.5 \pm 0.5	213.8 \pm 2.1	51.1 \pm 0.5				
FO ₂ \rightarrow FO + O	463.2	110.7			A.P.; M.S.	1966	152	

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
	$F_2O_2 \rightarrow 2FO$			259.8	62.1	Thermochemical; assumptions of O-F bond energies	1959	131
		434.3	103.8	260.7 ± 84	62.3 ± 20	Thermochemical A.P.; M.S. on F_2O_2	1962	6
				326	78	Thermochemical; based on 9	1965	149
							1967	
Os-O	$OsO_4 \rightarrow OsO_3 + O$	452	108			A.P.; M.S.	1965	147
				302.9	72.4	Thermochemical; based on 9	1967	
				301 ± 21	72 ± 5			
P-O	$PO \rightarrow P + O$	592.0 ± 2.5	141.5 ± 0.6	595.4	142.3	Spectroscopic; con- vergence of $B^2\Sigma$ levels	1962	6
		520.9	124.5			Theoretical	1965	146
		592.0 ± 4	141.5 ± 1	595.4 ± 4	142.3 ± 1			
P-P	$P_2 \rightarrow 2P$	485.60 ± 0.38	116.06 ± 0.09	489.07	116.89	Spectroscopic; pre- dissociation of $B^1\Sigma$; graphical extrapolation of $X^1\Sigma$	1962	6
				472.8	113	A.P.; M.S.	1963	172
				467.8	111.8	Effusion; M.S. (3rd law)	1966	165
				511.7	122.3	Effusion; M.S. (2nd law)	1966	165
		481	115	485	116	Thermochemical; based on 9	1967	
		481 ± 8	115 ± 2	485 ± 8	116 ± 2			
	$P_2Cl_4 \rightarrow 2PCl_2$			243	58	A.P.; M.S.	1963	172
Pb-O	$PbO \rightarrow Pb + O$	391.6 ± 3.3	93.6 ± 0.8	396.6	94.8	Thermochemical	1962	6
		369.9 ± 5.9	88.4 ± 1.4			A.P.; M.S.	1965	180
		377 ± 13	90 ± 3	381 ± 13	91 ± 3			
Pb-S	$PbS \rightarrow Pb + S$	305 ± 21	73 ± 5	310	74	Thermochemical	1962	6
		331.0 ± 12	79.1 ± 2.8			Effusion; M.S.	1962	84
		318 ± 21	76 ± 5	322 ± 21	77 ± 5			
Pb-Se	$PbSe \rightarrow Pb + Se$	257.3 ± 10.5	61.5 ± 2.5			Effusion; M.S.	1961	159
		257.3 ± 10.5	61.5 ± 2.5	261.1	62.4	M.S.	1962	6
		257.3 ± 10.5	61.5 ± 2.5	261.1 ± 10.5	62.4 ± 2.5			

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
Pb-Te	PbTe \rightarrow Pb + Te	215.1 \pm 8.4	51.4 \pm 2.0			Effusion; M.S. M.S.	1961	159
		215.1 \pm 8	51.4 \pm 2	218.8	52.3		1962	6
		215.1 \pm 8	51.4 \pm 2	218.8 \pm 8	52.3 \pm 2			
Rb-Br	RbBr \rightarrow Rb + Br	383.7 \pm 8	91.7 \pm 2			Flame photometry Thermochemical	1961	34
		385 \pm 25	92 \pm 6				1962	6
		385 \pm 25	92 \pm 6					
Rb-Cl	RbCl \rightarrow Rb + Cl	424.7 \pm 8	101.5 \pm 2			Flame photometry Thermochemical	1961	34
		459.4 \pm 13	109.8 \pm 3	463.2	110.7		1962	6
		444 \pm 21	106 \pm 5	448 \pm 21	107 \pm 5			
Rb-F	RbF \rightarrow Rb + F	502 \pm 33	120 \pm 8			Flame photometry Thermochemical	1961	34
		477 \pm 13	114 \pm 3	480.3	114.8		1962	6
		490 \pm 21	117 \pm 5	494 \pm 21	118 \pm 5			
Rb-I	RbI \rightarrow Rb + I	339.7 \pm 8	81.2 \pm 2			Flame photometry Thermochemical	1961	34
		323.0 \pm 13	77.2 \pm 3	326.8	78.1		1962	6
		331 \pm 13	79 \pm 3	335 \pm 13	80 \pm 3			
Rb-O	RbOH \rightarrow Rb + OH	347 \pm 8	83 \pm 2			Flame photometry	1966	192
Ru-O	RuO ₄ \rightarrow RuO ₃ + O	435	104			A.P.; M.S.	1965	147
S-F	SO ₂ F \rightarrow SO ₂ + F	67.53	16.14			A.P.; M.S.	1958	117
	SO ₂ F ₂ \rightarrow SO ₂ F + F	656.1	156.8			A.P.; M.S.	1958	117
	SF ₆ \rightarrow SF ₅ + F	\leq 326	\leq 78			A.P.; M.S.	1961	160
S-H	HS \rightarrow H + S	340.6 \pm 12.1	81.4 \pm 2.9	344.3	82.3	Spectroscopic; ex- trapolation of A ² Σ Thermochemical; based on 9	1962	6
		351	84	356	85		1967	
		349.4 \pm 6.3	83.5 \pm 1.5	353.1 \pm 6.3	84.4 \pm 1.5			
H ₂ S	H ₂ S \rightarrow HS + H	379.5	90.7	384.9	92.0 \pm 3	Thermochemical Thermochemical; based on 9	1962	6
		377	90	381	91		1967	
		377 \pm 4	90 \pm 1	381 \pm 4	91 \pm 1			

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.	
		0 K		298 K					
		kJ/mol	kcal/mol	kJ/mol	kcal/mol				
S-O	SO \rightarrow S + O	497.1	118.8			A.P.; M.S. Spectroscopic; B.S. extrapolation Spectroscopic; pre- dissociation Spectroscopic Spectroscopic; ex- amination of data Thermochemical; based on 9	1958	117	
		531.8	127.1				1962	45	
		517.02 \pm 0.13	123.57 \pm 0.03	521.70	124.69		1962	6	
		516.7	123.5				1964	77	
		517.1	123.6				1965	75	
		517.1 517.1 \pm 8	123.6 123.6 \pm 2	521.7	124.7		1967		
	SO ₂ \rightarrow SO + O				385 \pm 29 548	92 \pm 7 131	A.P.; M.S. Thermochemical; secondary source Thermochemical Spectroscopic; continuum limit Thermochemical; based on 9	1957	44
								1959	113
		541.58 \pm 1.3	129.44 \pm 0.3	546.51	130.62	1962		6	
		515.9 \pm 33.5	123.3 \pm 8			1964		77	
		547.3 547.3 \pm 8	130.8 130.8 \pm 2.0	552.3	132.0	1967			
	SO ₃ \rightarrow SO ₂ + O		341.83 \pm 0.63	81.70 \pm 0.15	347.3	83.0	Thermochemical Thermochemical; based on 9	1962	6
			342.50	81.86	348.07	83.19		1967	
			342.7 \pm 4	81.9 \pm 1	348.1 \pm 4	83.2 \pm 1			
	S-S	S ₂ \rightarrow 2S	414.6	99.1			Secondary source Theoretical Thermochemical Dissociation equilibrium; M.S. Effusion; M.S.; CaS Effusion; M.S.; SrS Effusion; M.S.; BaS Thermochemical; based on 9	1959	112
424.3			101.4			1961		158	
412.1 \pm 2.5			98.5 \pm 0.6	417.6	99.8	1962		6	
424.7			101.5			1963		81	
407.5 \pm 18.8			97.4 \pm 4.5			1964		189	
391.2 \pm 29			93.5 \pm 7			1964		189	
395.8 \pm 23.0			94.6 \pm 5.5			1964		189	
425.1			101.6	429.3	102.6	1967			
424.7 \pm 6.3			101.5 \pm 1.5	428.9 \pm 6.3	102.5 \pm 1.5				
H ₂ S ₂ \rightarrow 2HS			261.9	62.6			Theoretical Thermochemical A.P.; M.S. Thermochemical; based on 9	1961	158
					277.0 \pm 25	66.2 \pm 6		1962	6
				247 \pm 13	59 \pm 3	1962		97	
				274.9 272 \pm 21	65.7 65 \pm 5	1967			
Sb-Sb	Sb ₂ \rightarrow 2Sb	295.4 \pm 6.3	70.6 \pm 1.5	299.6	71.6	Effusion; M.S.	1959	82	
Sb-Te	SbTe \rightarrow Sb + Te	251.0	60.0			Effusion; M.S.	1960	61	

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.		
		0 K		298 K						
		kJ/mol	kcal/mol	kJ/mol	kcal/mol					
Sc-Sc	$\text{Sc}_2 \rightarrow 2\text{Sc}$	108.4 ± 21	25.9 ± 5			Effusion; M.S.	1963	93		
Sc-F	$\text{ScF} \rightarrow \text{Sc} + \text{F}$			506 ± 71	121 ± 17	Spectroscopic; L.B.S.	1962	46		
Si-H	$\text{SiH} \rightarrow \text{Si} + \text{H}$	310 ± 25	74 ± 6	314.2	75.1	Spectroscopic; extrapolation of $^2\Delta$	1957	47		
	$\text{SiH}_4 \rightarrow \text{SiH}_3 + \text{H}$	398.3	95.2	335	80				Thermochemical M.S.	1962 1966
Sn-O	$\text{SnO} \rightarrow \text{Sn} + \text{O}$	561 ± 8	134 ± 2	565	135	Equilibrium $\text{SnO}_2 + \text{Sn} = 2\text{SnO}$ A.P.; M.S.	1962	6		
		529.3 ± 8.4	126.5 ± 2.0						1965	181
		544 ± 21	130 ± 5	548 ± 21	131 ± 5					
Sn-S	$\text{SnS} \rightarrow \text{Sn} + \text{S}$	469 ± 13	112 ± 3	473	113	Thermochemical Effusion; M.S.	1962	6		
		460 ± 13	110 ± 3						1962	84
		464 ± 21	111 ± 5	469 ± 21	112 ± 5					
Sr-Cl	$\text{SrCl} \rightarrow \text{Sr} + \text{Cl}$	289 ± 59	69 ± 14	293	70	Spectroscopic; L.B.S. of ground state Flame photometry	1962	6		
		410 ± 25	98 ± 6						1965	23
		335 ± 84	80 ± 20	339 ± 84	81 ± 20					
	$\text{SrCl}_2 \rightarrow \text{SrCl} + \text{Cl}$			611 ± 59	146 ± 14	Thermochemical Flame photometry	1962	6		
		418 ± 25	100 ± 6						1965	23
Sr-F	$\text{SrF} \rightarrow \text{Sr} + \text{F}$	335 ± 67	80 ± 16	339	81	Spectroscopic; L.B.S. of ground state Effusion; M.S. $2\text{SrF} = \text{Sr} + \text{SrF}_2$ Flame photometry	1962	6		
		525.5 ± 13	125.6 ± 3						1964	68
		552 ± 29	132 ± 7							
	540 ± 42	129 ± 10								
	$\text{SrF}_2 \rightarrow \text{SrF} + \text{F}$			774 ± 67	185 ± 16	Thermochemical Effusion; M.S. $2\text{SrF} = \text{Sr} + \text{SrF}_2$ Flame photometry	1962	6		
		578.2 ± 21	138.2 ± 5						1964	68
		556 ± 42	133 ± 10							
	565 ± 42	135 ± 10								

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
Sr-O	SrO \rightarrow Sr + O	469 \pm 8	112 \pm 2	472 \pm 4	112.9	Flame photometry analysis of various data	1962	6
		427 \pm 42	102 \pm 10			Theoretical	1964	144
		385 \pm 25	92 \pm 6			Effusion; M.S.	1964	189
		396.6	94.8			Flame photometry; CO flame	1965	71
		515 \pm 21	123 \pm 5			Flame photometry; H ₂ flame	1966	191
		460 \pm 84	110 \pm 20					
Sr-O	SrOH \rightarrow Sr + OH	\leq 377 \pm 42	\leq 90 \pm 10			Flame photometry; C ₂ H ₂ + CO flame	1957	52
		410 \pm 63	98 \pm 15				1965	22
	Sr(OH) ₂ \rightarrow SrOH + OH	490 \pm 113	117 \pm 23			Ref. 191 gives $D_1 + D_2 = 215 \pm 12$ and 22 gives $D_2 = 98 \pm 15$ kcal mol ⁻¹		
Sr-S	SrS \rightarrow Sr + S	222 \pm 21	53 \pm 5	226	54	Spectroscopic; long λ of continuum	1962	6
		335	80			Effusion; M.S.	1963	80
		310.0 \pm 18.8	74.1 \pm 4.5			Effusion; M.S.	1964	189
		314 \pm 42	75 \pm 10					
Ta-O	TaO \rightarrow Ta + O	810.4 \pm 50	193.7 \pm 12			Effusion; M.S.	1957	115
Te-Se	TeSe \rightarrow Te + Se	241.0	57.6			Effusion; M.S.	1960	61
Te-Te	Te ₂ \rightarrow 2Te	218 \pm 8	52 \pm 2			Effusion; M.S.	1961	159
Th-O	ThO \rightarrow Th + O	820	196	824	197	M.S.	1962	6
		< 820	< 196			Effusion; M.S.	1963	173
	ThO ₂ \rightarrow ThO + O	< 770	< 184			Effusion; M.S.; Ref. 173 gives $D_1 + D_2 < 375.9$ kcal mol ⁻¹	1963	173
Ti-O	TiO \rightarrow Ti + O	653 \pm 25	156 \pm 6	657	157	M.S.	1962	6
		541.4	129.4			Theoretical	1964	78
Ti-Ti	Ti ₂ \rightarrow 2Ti	< 243	< 58			Effusion; M.S.	1964	56

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
Tl-Br	TlBr \rightarrow Tl + Br	328.0	78.4	331.8	79.3	Thermochemical; spectroscopic data	1960	140
		324.7	77.6			Flame photometry	1961	34
		326 \pm 21	78 \pm 5	331 \pm 21	79 \pm 5			
Tl-Cl	TlCl \rightarrow Tl + Cl			377	90	Thermochemical; spectroscopic data	1960	140
		364 \pm 8	87 \pm 2			Flame photometry	1961	140
Tl-F	TlF \rightarrow Tl + F	460	110			Thermochemical; spectroscopic	1960	140
		460 \pm 42	110 \pm 10			Flame photometry	1961	34
		452 \pm 10.5	108 \pm 2.5			Calorimetry	1965	148
		423 \pm 14.6	101 \pm 3.5			Effusion; M.S.; Tl + MgF = TlF + Mg	1966	170
		439 \pm 21	105 \pm 5					
Tl-I	TlI \rightarrow Tl + I	272 \pm 13	65 \pm 3	276	66	Thermochemical	1960	140
		285 \pm 13	68 \pm 3			Flame photometry	1961	34
		280 \pm 21	67 \pm 5	285 \pm 21	68 \pm 5			
U-O	UO \rightarrow U + O	749 \pm 29	179 \pm 7			M.S.	1960	199
		674 \pm 59	161 \pm 14			M.S.	1960	199
		640 \pm 88	153 \pm 21			M.S.	1960	199
U-S	US \rightarrow U + S	561 \pm 9.6	134 \pm 2.3			Effusion; M.S.	1966	168
V-O	VO \rightarrow V + O	617.6 \pm 19.2	147.6 \pm 4.6			Effusion; M.S.	1957	116
		617.6 \pm 19.2	147.6 \pm 4.6			Effusion; M.S.	1957	116
W-O	WO \rightarrow W + O	678 \pm 42	162 \pm 10			M.S.; Effusion	1959	83
		644 \pm 42	154 \pm 10			M.S.; partial pressure	1960	199
		661 \pm 42	158 \pm 10					

Table of Bond Dissociation Energies—Continued

Bond	Reaction	Dissociation energy, D°				Method, remarks	Date	Ref.
		0 K		298 K				
		kJ/mol	kcal/mol	kJ/mol	kcal/mol			
	$\text{WO}_2 \rightarrow \text{WO} + \text{O}$	661 ± 42 594 ± 71 628 ± 84	158 ± 10 142 ± 17 150 ± 20			M.S.; Effusion M.S.; partial pressure	1959 1960	83 199
	$\text{WO}_3 \rightarrow \text{WO}_2 + \text{O}$	573 ± 42 615 ± 100 594 ± 42	137 ± 10 147 ± 24 142 ± 10			M.S.; Effusion M.S.; partial pressure	1959 1960	83 199
Y-La	$\text{YLa} \rightarrow \text{Y} + \text{La}$	197	47			Effusion; M.S.	1963	93
Y-Y	$\text{Y}_2 \rightarrow 2\text{Y}$	156.1 ± 21	37.3 ± 5			Effusion; M.S.	1963	93
Zn-S	$\text{ZnS} \rightarrow \text{Zn} + \text{S}$	406 ± 29 203.8 201 ± 13 201 ± 13	97 ± 7 48.7 48 ± 3 48 ± 3	410	98	Spectroscopic; continuum limit Effusion; M.S.; $\text{ZnS} \rightarrow \text{Zn} + 1/2\text{S}_2$ Effusion; M.S.	1962 1963 1965	6 80 184
Zn-Se	$\text{ZnSe} \rightarrow \text{Zn} + \text{Se}$	132.6 ± 12.6	31.7 ± 3.0			Effusion; M.S.	1965	184
Zr-O	$\text{ZrO} \rightarrow \text{Zr} + \text{O}$	753 ± 21	180 ± 5			Effusion; M.S.	1957	121

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