

## FOR VARIOUS TYPES OF BONDS

 Bond Dissociation Energies<sup>a,b</sup>—Single Bonds: Diatomic Molecules

Bond	Energy	Bond	Energy	Bond	Energy
H—H	104.2 [436.0]	F—Cl	61 [255]	H—F	135.8 <sup>c</sup> [568]
D—D	106.0 [444.5]	F—Br	60 [251]	H—Cl	103.0 <sup>c</sup> [431]
F—F	38 [159]	F—I	58 [243]	H—Br	87.5 <sup>c</sup> [366]
Cl—Cl	58 [243]	Cl—Br	52 [218]	H—I	71.3 <sup>c</sup> [298]
Br—Br	46.0 [192]	Cl—I	50 [209]		
I—I	36.1 [151]				

## Polyatomic Molecules

Bond	Energy	Bond	Energy
H—CH <sub>3</sub>	104 [435]	CH <sub>3</sub> CH <sub>2</sub> —CHCH <sub>2</sub>	89 [372]
H—CH <sub>2</sub> CH <sub>3</sub>	98 [410]	CH <sub>3</sub> CH <sub>2</sub> —C <sub>6</sub> H <sub>5</sub>	90 [377]
H—CHCH <sub>2</sub>	103 [431]	CH <sub>2</sub> CH—CHCH <sub>2</sub>	100 [418]
H—C <sub>6</sub> H <sub>5</sub>	103 [431]	HCC—CCH	150 [628]
H—CCH	~125 [523]	C <sub>6</sub> H <sub>5</sub> —C <sub>6</sub> H <sub>5</sub>	100 [418]
H—CH <sub>2</sub> C <sub>6</sub> H <sub>5</sub>	85 [356]	CH <sub>2</sub> CH—C <sub>6</sub> H <sub>5</sub>	99 [414]
H—CH <sub>2</sub> CHCH <sub>2</sub>	85 [356]	CH <sub>3</sub> —COCH <sub>3</sub>	82 [343]
H—CH <sub>2</sub> OH	93 [389]	CH <sub>3</sub> CH <sub>2</sub> —COCH <sub>3</sub>	79 [331]
H—CF <sub>3</sub>	104 [435]	CH <sub>3</sub> —CN	122 [510]
H—CCl	96 [401]	CH <sub>2</sub> CH—COCH <sub>3</sub>	89 [372]
H—COCH <sub>3</sub>	87.5 [366]	CH <sub>2</sub> CH—CN	128 [536]
H—CN	130 [543]	CH <sub>3</sub> CO—COCH <sub>3</sub>	83 [347]
F—CH <sub>3</sub>	108 [451]	NC—CN	144 [602]
Cl—CH <sub>3</sub>	83.5 [349]	CF <sub>3</sub> —CF <sub>3</sub>	97 [406]
Br—CH <sub>3</sub>	70 [293]	H—OH	119 [498]
I—CH <sub>3</sub>	56 [234]	H—O <sub>2</sub> H	90 [377]
F—CH <sub>2</sub> CH <sub>3</sub>	106 [443]	H—SH	90 [377]
Cl—CH <sub>2</sub> CH <sub>3</sub>	81.5 [341]	H—OCH <sub>3</sub>	102 [427]
Br—CH <sub>2</sub> CH <sub>3</sub>	69 [289]	H—OC <sub>6</sub> H <sub>5</sub>	85 [356]
I—CH <sub>2</sub> CH <sub>3</sub>	53.5 [224]	H—O <sub>2</sub> CCH <sub>3</sub>	112 [469]
Cl—CHCH <sub>2</sub>	84 [351]	HO—CH <sub>3</sub>	91.5 [383]
F—C <sub>6</sub> H <sub>5</sub>	116 [485]	HO—CH <sub>2</sub> CH <sub>3</sub>	91.5 [383]
Br—C <sub>6</sub> H <sub>5</sub>	72 [301]	HO—C <sub>6</sub> H <sub>5</sub>	103 [431]
I—C <sub>6</sub> H <sub>5</sub>	65 [272]	HO—COCH <sub>3</sub>	109 [456]
F—CF <sub>3</sub>	129 [540]	CH <sub>3</sub> O—CH <sub>3</sub>	80 [335]
Cl—CF <sub>3</sub>	85 [356]	CH <sub>3</sub> O—CH <sub>2</sub> CH <sub>3</sub>	80 [335]
Br—CF <sub>3</sub>	70 [293]	CH <sub>3</sub> O—CHCH <sub>2</sub>	87 [366]
I—CF <sub>3</sub>	54 [226]	CH <sub>3</sub> O—C <sub>6</sub> H <sub>5</sub>	91 [381]
F—CCl <sub>3</sub>	106 [444]	CH <sub>3</sub> O—COCH <sub>3</sub>	97 [406]
Cl—CCl <sub>3</sub>	73 [305]	HO—OH	51 [213]
Br—CCl <sub>3</sub>	54 [226]	HO—Br	57 [238]
F—COCH <sub>3</sub>	119 [79]	CH <sub>3</sub> O—OCH <sub>3</sub>	36 [151]
Cl—COCH <sub>3</sub>	83.5 [349]	H <sub>2</sub> N—H	103 [431]
I—COCH <sub>3</sub>	52.5 [220]	H <sub>2</sub> N—CH <sub>3</sub>	79 [331]
CH <sub>3</sub> —CH <sub>3</sub>	88 [368]		
CH <sub>3</sub> —CH <sub>2</sub> CH <sub>3</sub>	85 [356]		
CH <sub>3</sub> —CH <sub>2</sub> OH	83 [347]		

Bond	Energy	Bond	Energy
		H <sub>2</sub> N—CH <sub>2</sub> CH <sub>3</sub>	78 [326]
		H <sub>2</sub> N—C <sub>6</sub> H <sub>5</sub>	91 [381]
CH <sub>3</sub> —CF <sub>3</sub>	100 [418]	H <sub>2</sub> N—COCH <sub>3</sub>	~96 [401]
CH <sub>3</sub> —CHCH <sub>2</sub>	92 [385]	O <sub>2</sub> N—NO <sub>2</sub>	13.6 [57]
CH <sub>3</sub> —C <sub>6</sub> H <sub>5</sub>	93 [389]	O <sub>2</sub> N—COCH <sub>3</sub>	97 [406]
CH <sub>3</sub> —CCH	117 [490]		
CH <sub>3</sub> —CH <sub>2</sub> C <sub>6</sub> H <sub>5</sub>	72 [301]		
CH <sub>3</sub> —CH <sub>2</sub> CHCH <sub>2</sub>	72 [301]		

## Multiple Bonds

Bond	Energy	Bond	Energy
O=O	119 [498]	CF <sub>2</sub> =CF <sub>2</sub>	76.3 [319]
O=CO	128 [536]	CH <sub>2</sub> =NH	~154 [644]
O=CH <sub>2</sub>	175 [732]	C≡O	257 [1075]
O=NH	115 [481]	N≡N	226 [946]
HN=NH	~109 [456]	N≡CH	224 [937]
CH <sub>2</sub> =CH <sub>2</sub>	163 [682]	HC≡CH	230 [962]

 Representative Average Bond Energies<sup>d</sup>—Single Bonds

	C	N	O	F	Cl	Br	I	Si
H	100 [418]	93 [389]	110 [460]	136 [569]	103 [431]	88 [368]	71 [297]	72 [301]
C	81 [339]	69 [289]	84 [351]	105 [439]	79 [331]	67 [280]	57 [238]	69 [289]
N		38 [159]	43 [180]	65 [272]	48 [201]			
O			33 [138]	50 [209]	50 [209]	53 [222]	57 [238]	103 [430]
F				50 [209]	60 [251]	60 [251]	67 [280]	141 [586]
Cl					53 [222]	50 [209]	96 [402]	
Br						43 [180]	69 [289]	
I							50 [209]	
Si								45 [188]

## Multiple Bonds

Elements	Single bond	Double bond	Triple bond
O—O	33 [138]	96 [402]	
N—N	38 [159]	100 [418]	226 [946]
C—C	81 [339]	148 [619]	194 [812]
C—O	84 [351]	172 [720]	
C—N	69 [289]	148 [619]	213 [891]

<sup>a</sup>From Gordon, A. J.; Ford, R. A. "The Chemists Companion"; Wiley: New York, 1972. Reprinted by permission of John Wiley & Sons. Copyright 1972 John Wiley & Sons, Inc.

<sup>b</sup>In kcal mol<sup>-1</sup>. Numbers in brackets are values in kJ mol<sup>-1</sup>.

<sup>c</sup>Benson, S. W. *J. Chem. Educ.* 1965, 42, 502. Reprinted by permission of the Division of Chemical Education.

<sup>d</sup>From Waser, J.; Trueblood, K. N.; Knobler, C. M. "Chem One"; McGraw-Hill: New York, 1976. Adapted by permission of McGraw-Hill.