

2.1 Chemical Bonds and Interactions

NAME	BASIS OF INTERACTION	STRUCTURE	BOND ENERGY ^a (KCAL/MOL)
Covalent bond	Sharing of electron pairs		50–110
Hydrogen bond	Sharing of H atom		3–7
Ionic interaction	Attraction of opposite charges		3–7
van der Waals interaction	Interaction of electron clouds		1
Hydrophobic interaction	Interaction of nonpolar substances		1–2

^aBond energy is the amount of energy needed to separate two bonded or interacting atoms under physiological conditions.

Table 2.1 Chemical Bonds and Interactions

Appendix 6. Periodic Chart of the Elements

1	2	3	4	5	6	7	8-10	11	12	13	14	15	16	17	18
IA	IIA	IIIB	IVB	VB	VIB	VII	VIIIB	IB	IIB	IIIA	IVA	VA	VIA	VIIA	NOBLE GASES
1 H 1.0079 ¹	3 Li 6.941 ¹	11 Na 22.98977 ¹	19 K 39.098 ¹	27 Co 58.9332 ¹	35 Br 79.904 ¹	43 Tc 98.9064 ¹	51 Sb 121.75 ¹	59 Pr 140.9077 ¹	67 Ho 164.9304 ¹	75 Re 186.207 ¹	83 Bi 208.9804 ¹	91 Pa 231.0359 ¹	99 Es (254)	107 Unh (262)	109 Une (266)
2 He 4.00260 ¹	4 Be 9.01218 ¹	12 Mg 24.305 ¹	20 Ca 40.08 ¹	28 Ni 58.70 ¹	36 Kr 83.80 ¹	44 Ru 101.07 ¹	52 Te 127.60 ¹	60 Nd 144.24 ¹	68 Er 167.26 ¹	76 Os 190.2 ¹	84 Po (210)	92 U 238.0289 ¹	100 Fm (257)	108 Uno (265)	110 Uue (269)
5 B 10.81 ¹	13 Al 26.98154 ¹	21 Sc 44.9559 ¹	29 Cu 63.546 ¹	37 Rb 85.4678 ¹	45 Rh 102.9055 ¹	53 I 126.9045 ¹	61 Pm (147)	69 Tm 168.9342 ¹	77 Yb 173.04 ¹	85 At (210)	93 Np 237.0482 ¹	101 Md (258)	109 Lr (260)	117 Ts (294)	119 Og (294)
6 C 12.011 ¹	14 Si 28.086 ¹	22 Ti 47.90 ¹	30 Zn 65.38 ¹	38 Sr 87.62 ¹	46 Pd 106.4 ¹	54 Xe 131.30 ¹	62 Sm 150.4 ¹	70 Yb 173.04 ¹	78 Pt 195.09 ¹	86 Rn (222)	94 Pu 244 ¹	102 No (259)	110 Ds (285)	118 Og (294)	120 Ubn (304)
7 N 14.0067 ¹	15 P 30.97376 ¹	23 V 50.9414 ¹	31 Ga 69.72 ¹	39 Y 88.9059 ¹	47 Ag 107.868 ¹	55 Cs 132.9054 ¹	63 Eu 151.96 ¹	71 Lu 174.97 ¹	79 Au 196.9665 ¹	87 Fr (223)	95 Am (243)	103 Lr (260)	111 Nh (286)	119 Og (294)	121 Ubn (306)
8 O 15.9994 ¹	16 S 32.06 ¹	24 Cr 51.996 ¹	32 Ge 72.59 ¹	40 Zr 91.22 ¹	48 Cd 112.40 ¹	56 Ba 137.34 ¹	64 Gd 157.25 ¹	72 Hf 178.49 ¹	80 Hg 200.59 ¹	88 Ra 226.0254 ¹	96 Cf (251)	104 Fm (257)	112 Cn (285)	120 Og (294)	122 Ubn (308)
9 F 18.99840 ¹	17 Cl 35.452 ¹	25 Mn 54.9380 ¹	33 As 74.9216 ¹	41 Nb 92.9064 ¹	49 In 114.82 ¹	57 La 138.9055 ¹	65 Tb 158.9254 ¹	73 Ta 180.9479 ¹	81 Tl 204.37 ¹	89 Ac (227)	97 Bk (247)	105 Db (261)	113 Nh (286)	121 Og (294)	123 Ubn (310)
10 Ne 20.179 ¹	18 Ar 39.948 ¹	26 Fe 55.847 ¹	34 Se 78.96 ¹	42 Mo 95.94 ¹	50 Sn 118.59 ¹	58 Ce 140.12 ¹	66 Dy 162.50 ¹	74 Hf 178.49 ¹	82 Pb 207.2 ¹	90 Th 232.0381 ¹	98 Cf (251)	106 Lv (293)	114 Fl (289)	122 Og (294)	124 Ubn (312)

* Lanthanide Series

58 Ce 140.12	59 Pr 140.9077 ¹	60 Nd 144.24 ¹	61 Pm (147)	62 Sm 150.4 ¹	63 Eu 151.96 ¹	64 Gd 157.25 ¹	65 Tb 158.9254 ¹	66 Dy 162.50 ¹	67 Ho 164.9304 ¹	68 Er 167.26 ¹	69 Tm 168.9342 ¹	70 Yb 173.04 ¹	71 Lu 174.97 ¹
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† Actinide Series

90 Th 232.0381 ¹	91 Pa 231.0359 ¹	92 U 238.0289 ¹	93 Np 237.0482 ¹	94 Pu 244 ¹	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (254)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)
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IONIZATION ENERGIES and ELECTRONEGATIVITIES

314 H 2.1	124 Li 1.0	215 Be 1.5	119 Na 0.9	100 K 0.8	141 Ca 1.0	151 Sc 1.3	158 Ti 1.5	155 V 1.6	156 Cr 1.6	171 Mn 1.5	182 Fe 1.8	181 Co 1.8	176 Ni 1.8	178 Cu 1.9	216 Zn 1.6	138 Ga 1.6	187 Ge 1.8	242 As 2.0	225 Se 2.4	300 Cl 3.0	402 F 4.0	566 He

--- → First ionization energy, kcal/mol

--- → Electronegativity, based on arbitrary scale of fluorine = 4.0

----- Electro Negativity Increases ----->

129 La 1.1	159 Ce 1.1	133 Pr 1.1	145 Nd 1.1	129 Sm 1.1	131 Eu 1.1	142 Gd 1.1	155 Tb 1.1	157 Dy 1.1	Ho	Er	Tm	143 Yb 1.1	No 1.3
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Bond formation based on Ionic values

0.0 — 0.5 Covalent Bond
0.6 — 1.5 Polar Covalent
1.5 ~ and greater Ionic bonds form

Example of calculation:

O = 3.5 H = 2.1

Water H₂O is 3.5 - 2.1 = 1.4

Based on the values below 1.4 ionization energy is Polar Covalent