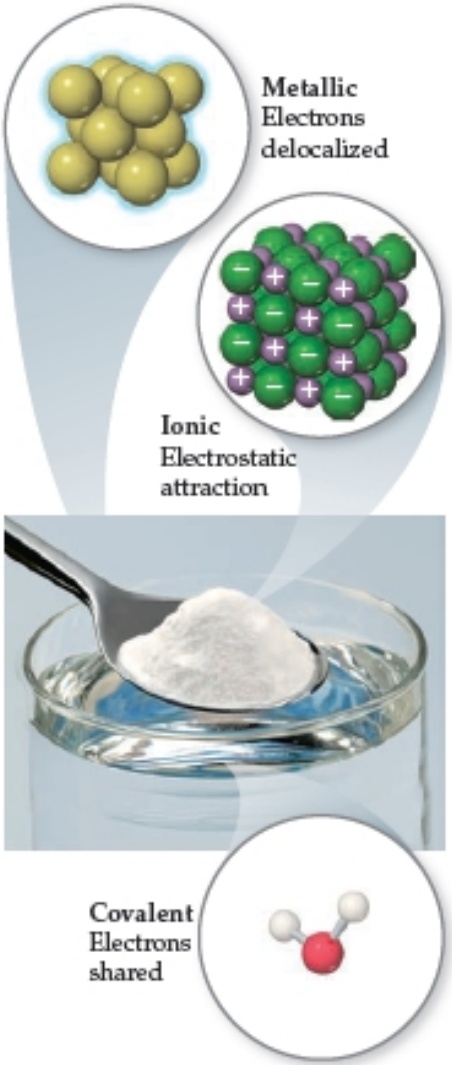
Ligações Químicas



Por que as propriedades das substâncias são tão diferentes?

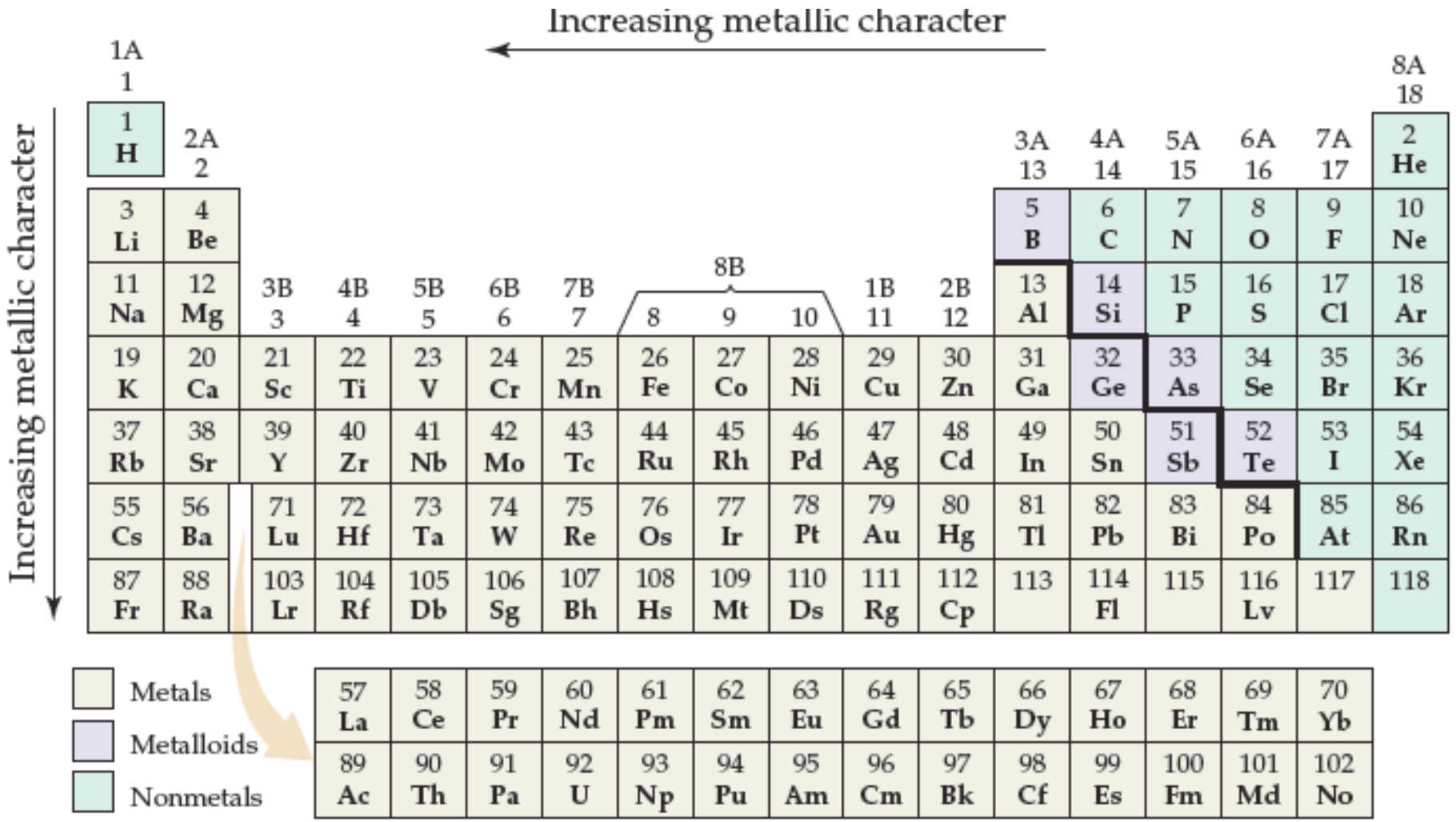
Tipos de Ligações Químicas

- Ligação iônica
- Ligação covalente
- Ligação metálica

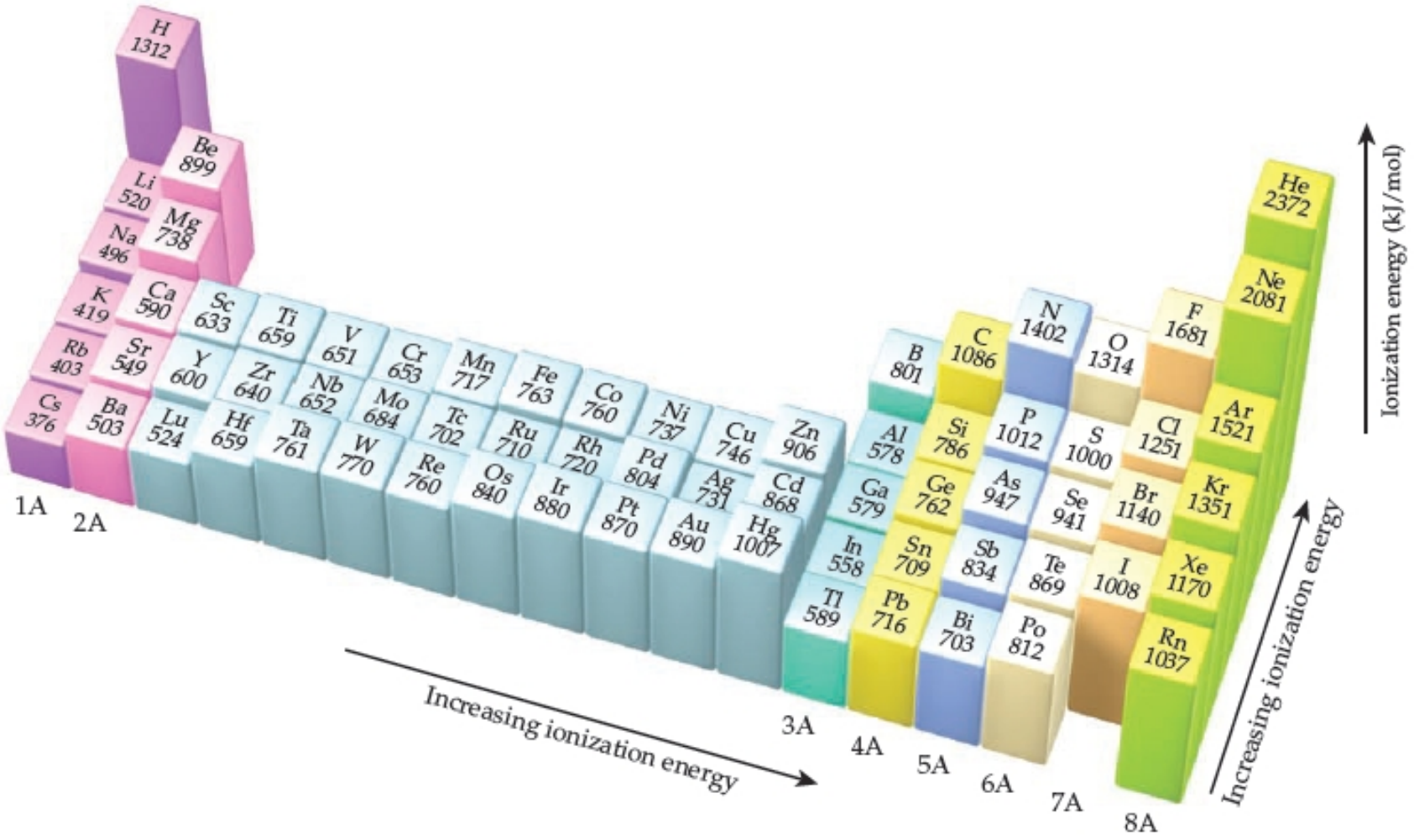
Por que os átomos se ligam?

Table 8.1 Lewis Symbols

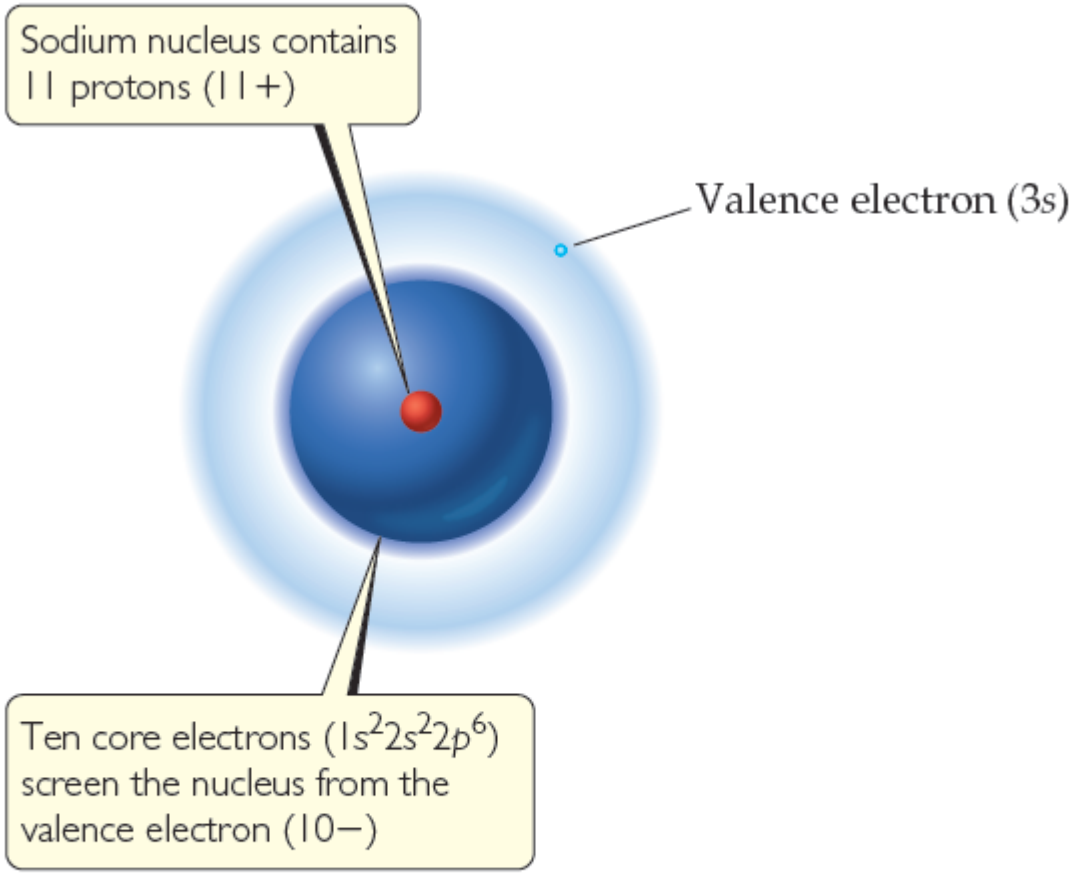
Group	Element	Electron Configuration	Lewis Symbol	Element	Electron Configuration	Lewis Symbol
1A	Li	$[He]2s^1$	$Li\cdot$	Na	$[Ne]3s^1$	$Na\cdot$
2A	Be	$[He]2s^2$	$\cdot Be\cdot$	Mg	$[Ne]3s^2$	$\cdot Mg\cdot$
3A	B	$[He]2s^22p^1$	$\cdot\dot{B}\cdot$	Al	$[Ne]3s^23p^1$	$\cdot\dot{Al}\cdot$
4A	C	$[He]2s^22p^2$	$\cdot\dot{C}\cdot$	Si	$[Ne]3s^23p^2$	$\cdot\dot{Si}\cdot$
5A	N	$[He]2s^22p^3$	$\cdot\dot{N}:$	P	$[Ne]3s^23p^3$	$\cdot\dot{P}:$
6A	O	$[He]2s^22p^4$	$:\dot{O}:$	S	$[Ne]3s^23p^4$	$:\dot{S}:$
7A	F	$[He]2s^22p^5$	$\cdot\ddot{F}:$	Cl	$[Ne]3s^23p^5$	$\cdot\ddot{Cl}:$
8A	Ne	$[He]2s^22p^6$	$:\ddot{Ne}:$	Ar	$[Ne]3s^23p^6$	$:\ddot{Ar}:$


Increasing metallic character
Increasing metallic character
1A 1
2A 2
3A 13
4A 14
5A 15
6A 16
7A 17
8A 18
3B 3
4B 4
5B 5
6B 6
7B 7
8B
8
9
10
1B 11
2B 12
1 H
2 He
3 Li
4 Be
5 B
6 C
7 N
8 O
9 F
10 Ne
11 Na
12 Mg
13 Al
14 Si
15 P
16 S
17 Cl
18 Ar
19 K
20 Ca
21 Sc
22 Ti
23 V
24 Cr
25 Mn
26 Fe
27 Co
28 Ni
29 Cu
30 Zn
31 Ga
32 Ge
33 As
34 Se
35 Br
36 Kr
37 Rb
38 Sr
39 Y
40 Zr
41 Nb
42 Mo
43 Tc
44 Ru
45 Rh
46 Pd
47 Ag
48 Cd
49 In
50 Sn
51 Sb
52 Te
53 I
54 Xe
55 Cs
56 Ba
71 Lu
72 Hf
73 Ta
74 W
75 Re
76 Os
77 Ir
78 Pt
79 Au
80 Hg
81 Tl
82 Pb
83 Bi
84 Po
85 At
86 Rn
87 Fr
88 Ra
103 Lr
104 Rf
105 Db
106 Sg
107 Bh
108 Hs
109 Mt
110 Ds
111 Rg
112 Cp
113
114 Fl
115
116 Lv
117
118
57 La
58 Ce
59 Pr
60 Nd
61 Pm
62 Sm
63 Eu
64 Gd
65 Tb
66 Dy
67 Ho
68 Er
69 Tm
70 Yb
89 Ac
90 Th
91 Pa
92 U
93 Np
94 Pu
95 Am
96 Cm
97 Bk
98 Cf
99 Es
100 Fm
101 Md
102 No
Metals
Metalloids
Nonmetals

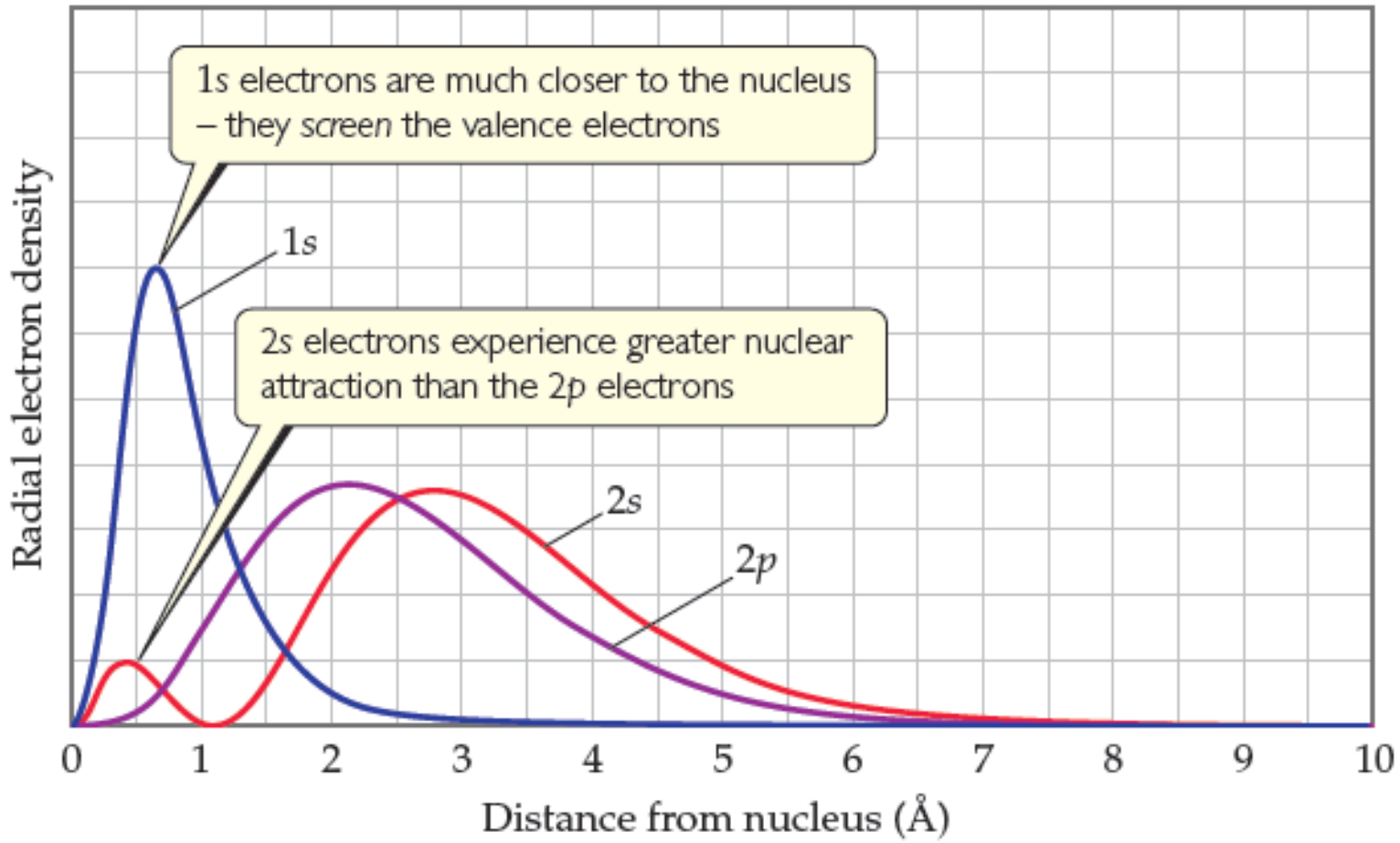
Energia de Ionização



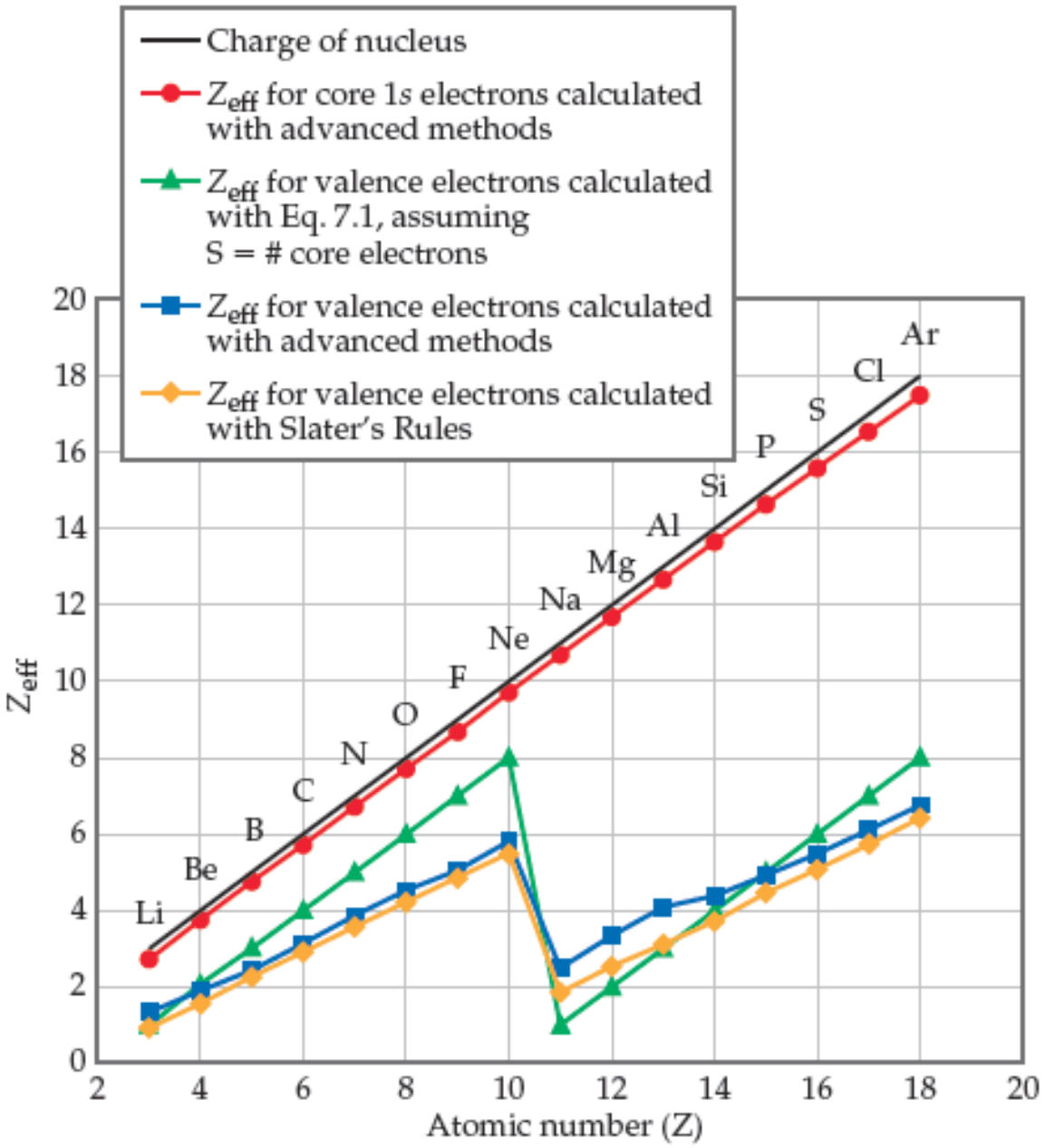
Raio Atômico



▲ **Figure 7.3** **Effective nuclear charge.** The effective nuclear charge experienced by the 3*s* electron in a sodium atom depends on the 11+ charge of the nucleus and the 10− charge of the core electrons.



▲ **Figure 7.4** **Comparison of 1*s*, 2*s*, and 2*p* radial probability functions.**


Charge of nucleus
Z_{eff} for core 1s electrons calculated with advanced methods
Z_{eff} for valence electrons calculated with Eq. 7.1, assuming S = # core electrons
Z_{eff} for valence electrons calculated with advanced methods
Z_{eff} for valence electrons calculated with Slater's Rules
Li
Be
B
C
N
O
F
Ne
Na
Mg
Al
Si
P
S
Cl
Ar
Z_{eff}
Atomic number (Z)
0
2
4
6
8
10
12
14
16
18
20

Formação de Redes Cristalinas

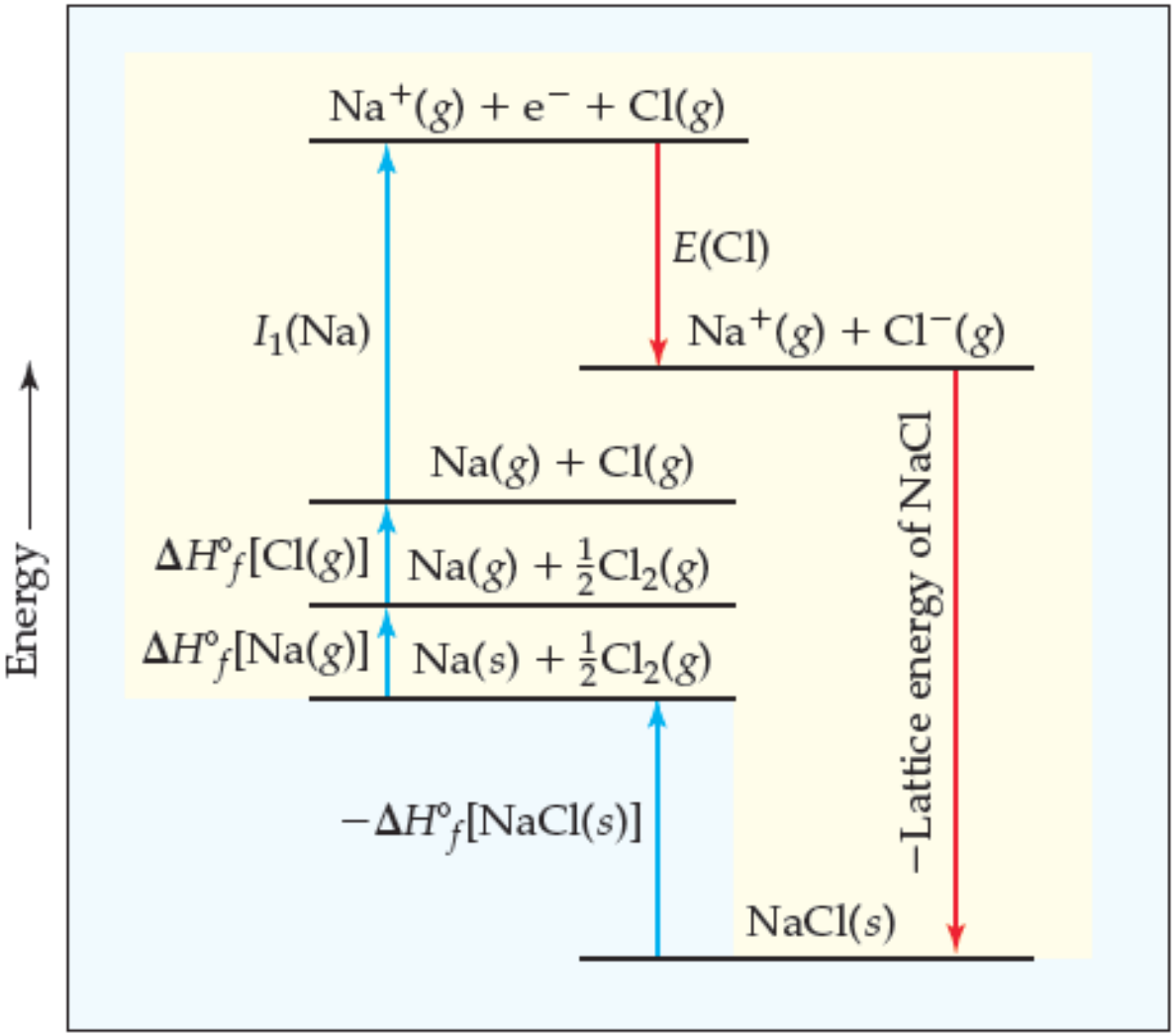
Table 8.2 Lattice Energies for Some Ionic Compounds

Compound	Lattice Energy (kJ/mol)	Compound	Lattice Energy (kJ/mol)
LiF	1030	$MgCl_2$	2326
LiCl	834	$SrCl_2$	2127
LiI	730		
NaF	910	MgO	3795
NaCl	788	CaO	3414
NaBr	732	SrO	3217
NaI	682		
KF	808	ScN	7547
KCl	701		
KBr	671		
CsCl	657		
CsI	600		

$$E_{lattice} = K \frac{Q_1 Q_2}{d}$$

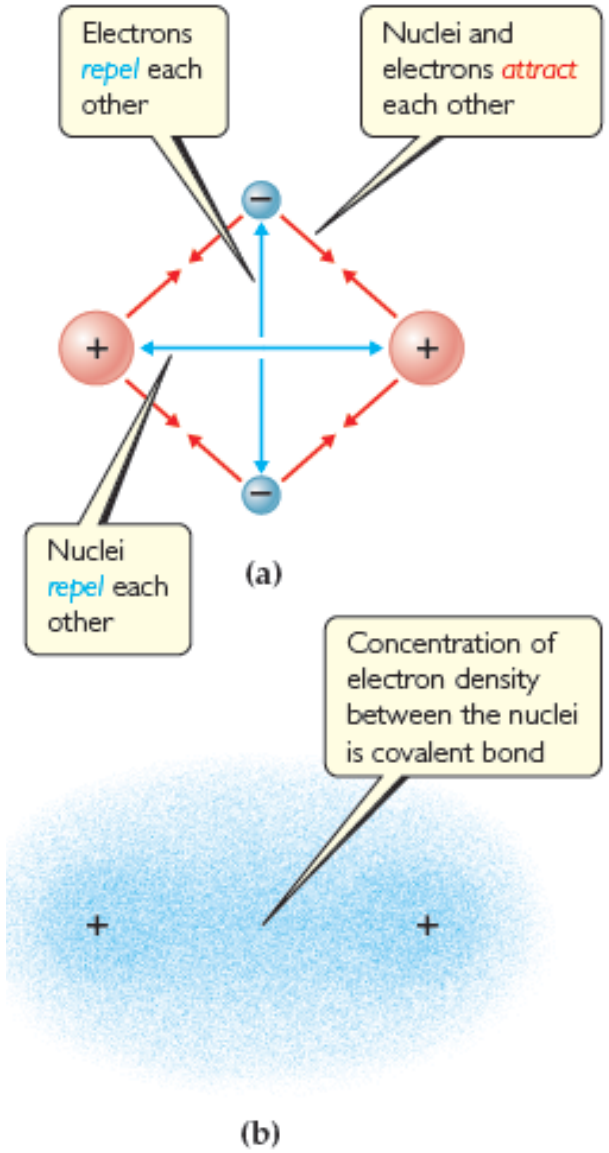
Qual é a ordem crescente de energia de retículo cristalino?

NaF , CsI e CaO

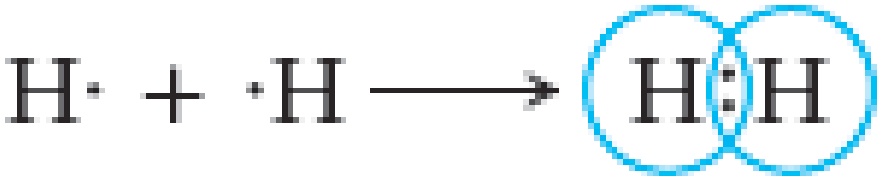


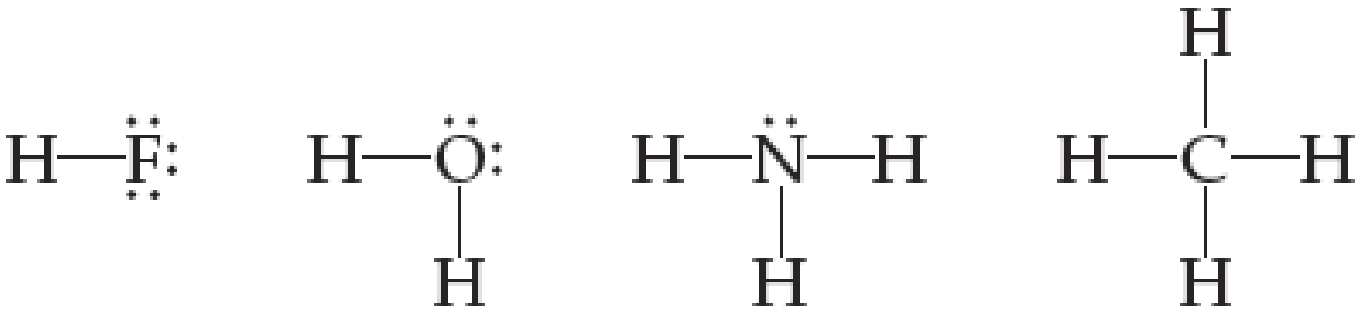
▲ **Figure 8.5 Born–Haber cycle for formation of NaCl.** This Hess's law representation shows the energetic relationships in the formation of the ionic solid from its elements.

Ligação Covalente



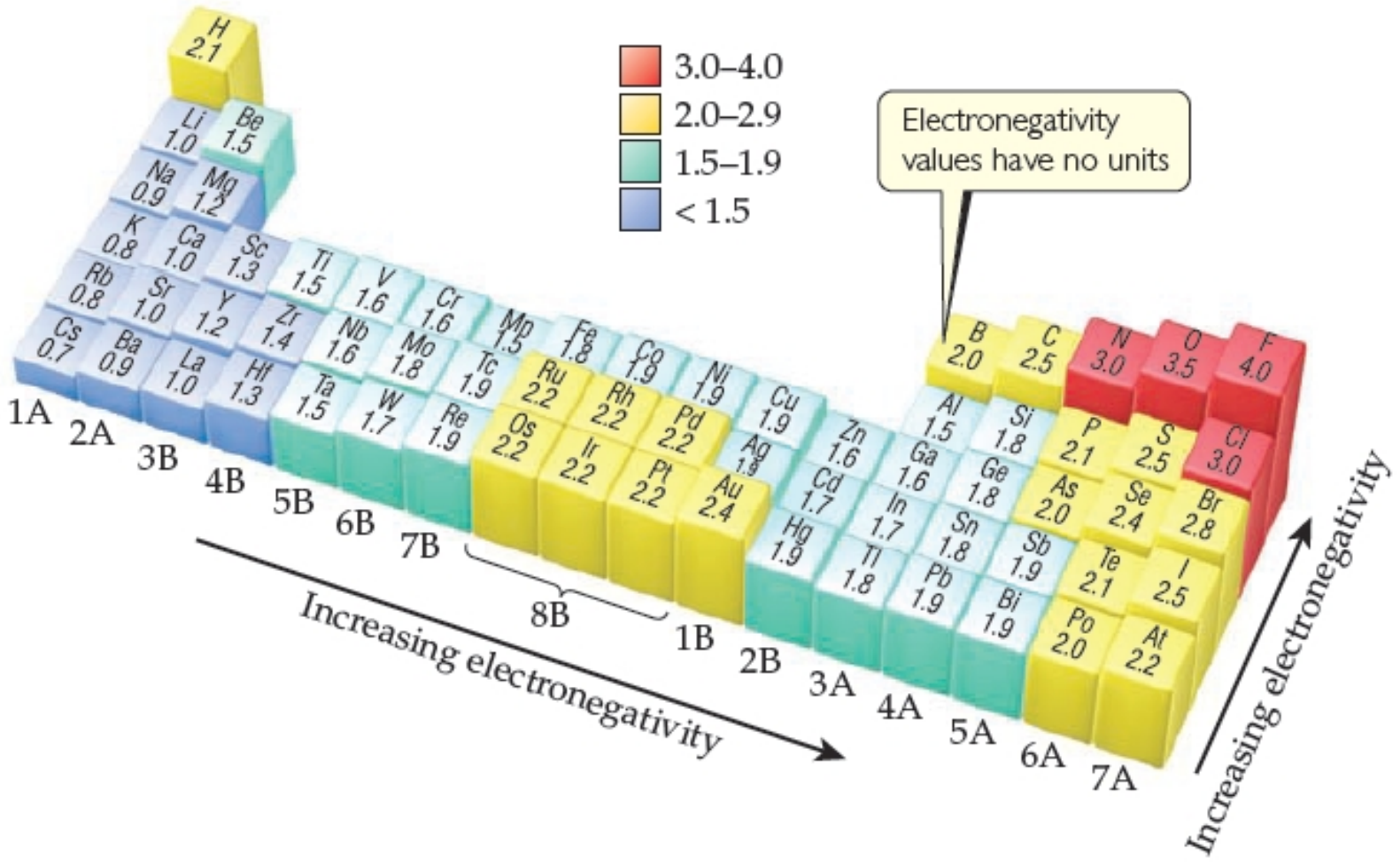
▲ **Figure 8.6** **The covalent bond in H_2.** (a) The attractions and repulsions among electrons and nuclei in the hydrogen molecule. (b) Electron distribution in the H_2 molecule.





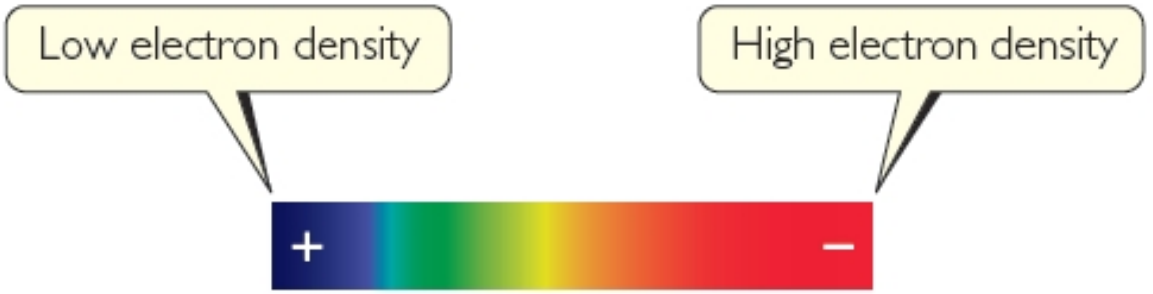
$N-N$	$N=N$	$N\equiv N$
1.47 Å	1.24 Å	1.10 Å

Polaridade de Ligações Químicas



▲ **Figure 8.7** **Electronegativity values based on Pauling's thermochemical data.**

	F_2	HF	LiF
Electronegativity difference	4.0 − 4.0 = 0	4.0 − 2.1 = 1.9	4.0 − 1.0 = 3.0
Type of bond	Nonpolar covalent	Polar covalent	Ionic

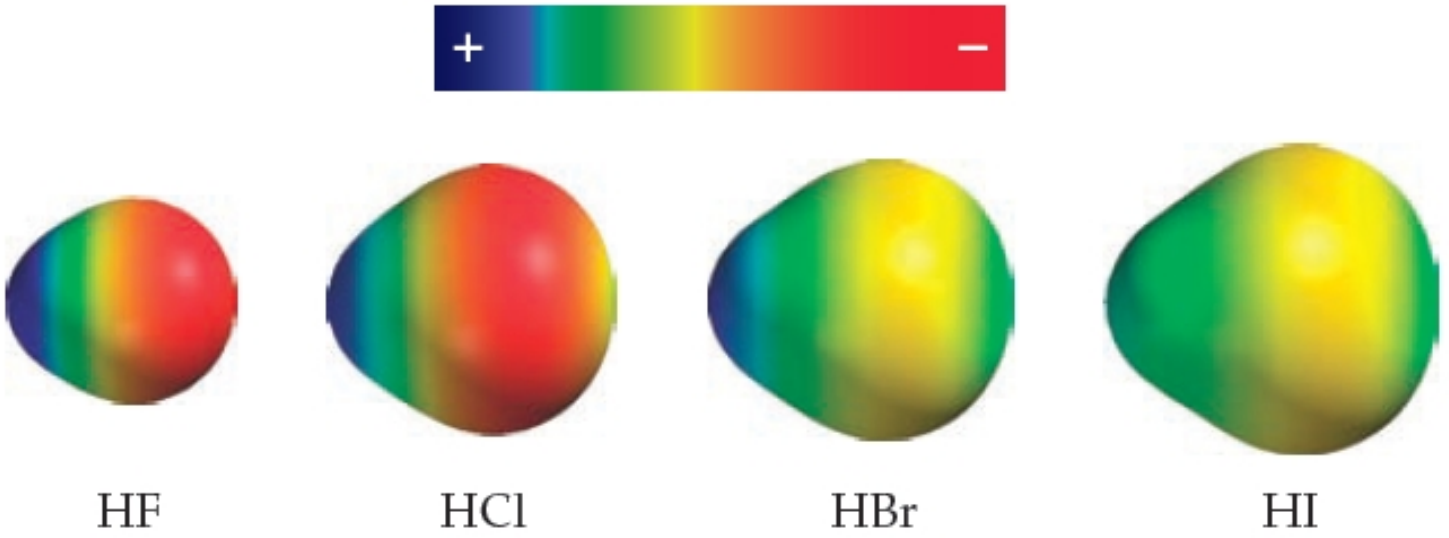


F_2 HF LiF

Qual ligação é mais polar?

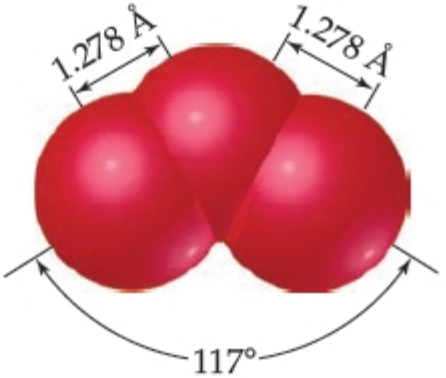
(a) B—Cl or C—Cl,

(b) P—F or P—Cl.

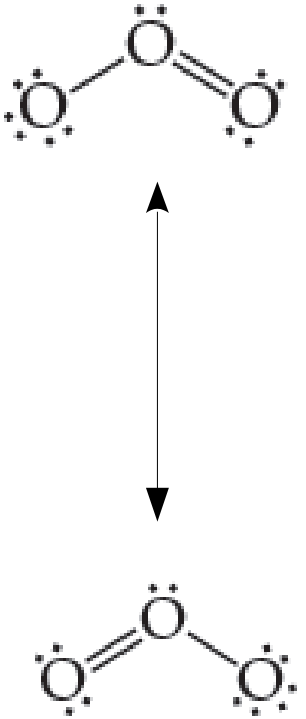


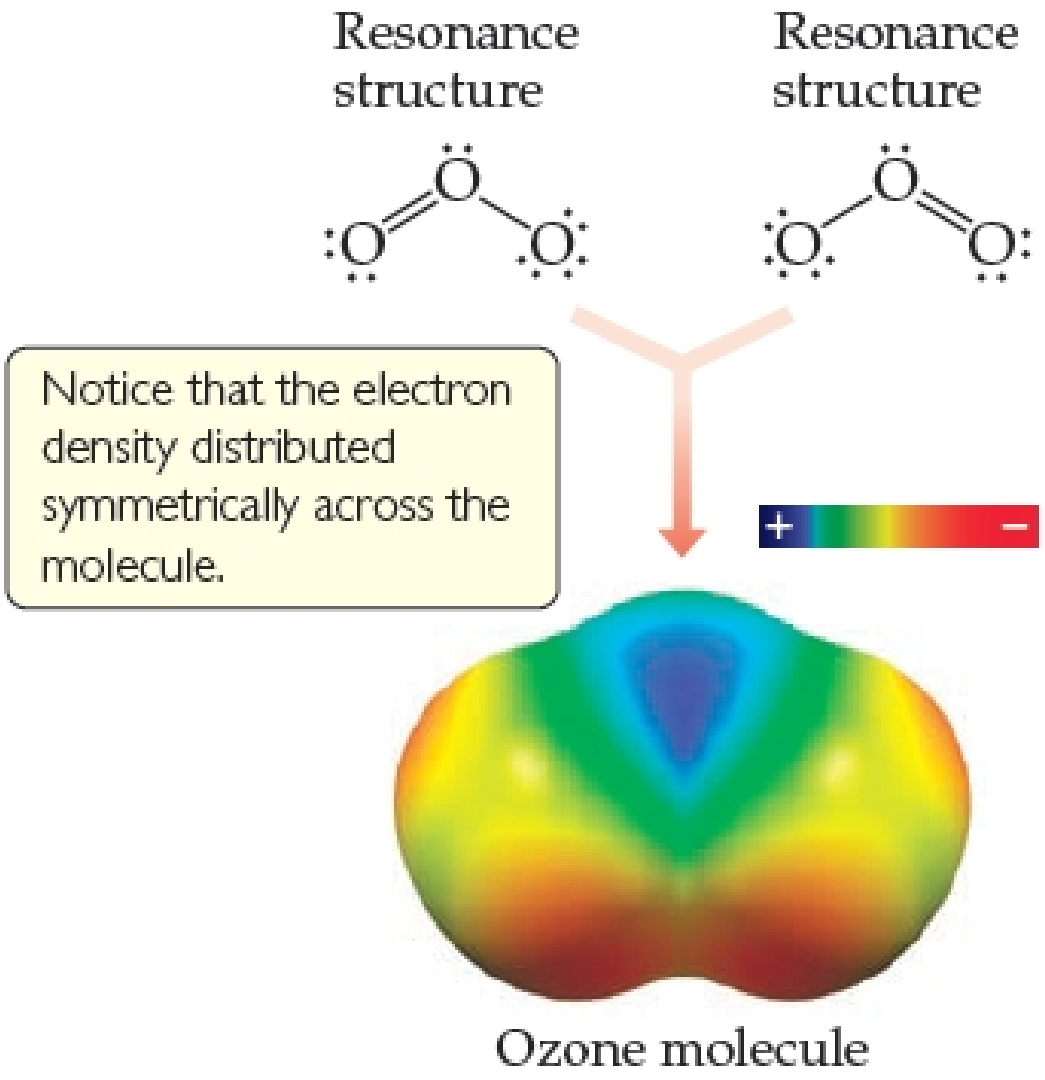
▲ **Figure 8.10** **Charge separation in the hydrogen halides.** In HF, the strongly electronegative F pulls much of the electron density away from H. In HI, the I, being much less electronegative than F, does not attract the shared electrons as strongly, and, consequently, there is far less polarization of the bond.

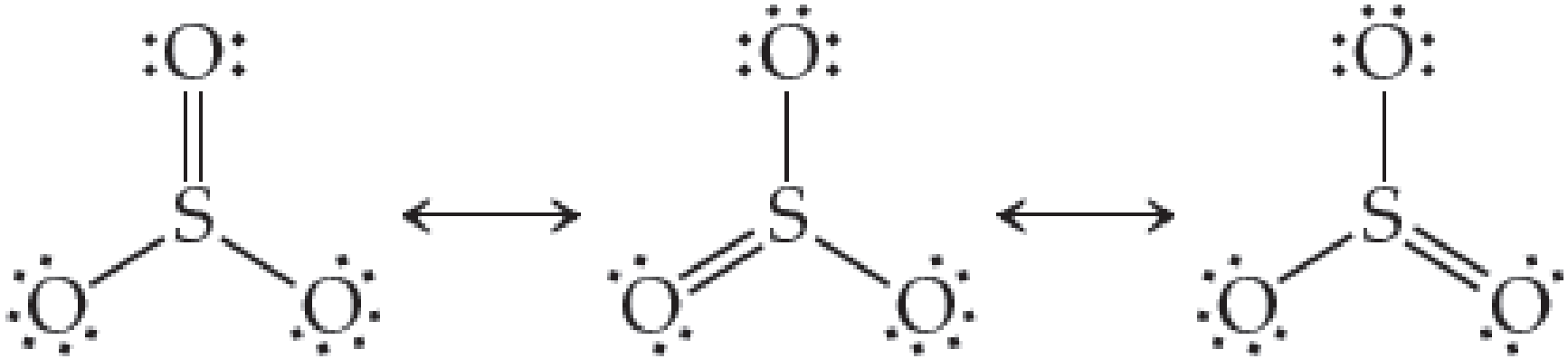
Estruturas de Ressonância

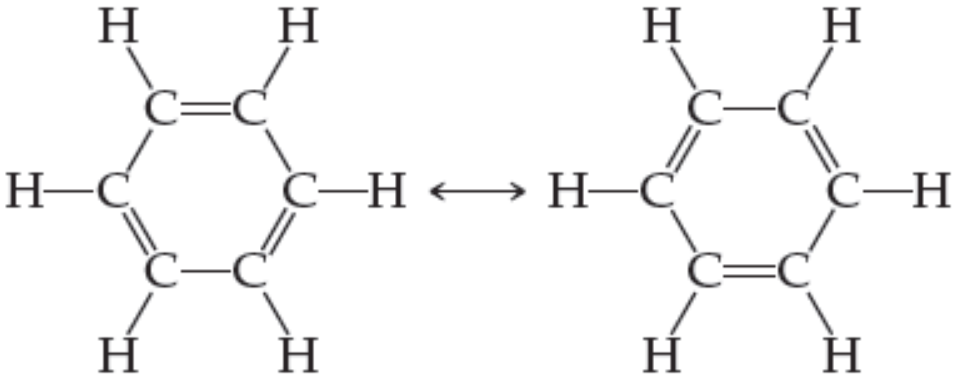


▲ Figure 8.12 Molecular structure of ozone.




Resonance structure
Resonance structure
Notice that the electron density distributed symmetrically across the molecule.
+
−
Ozone molecule

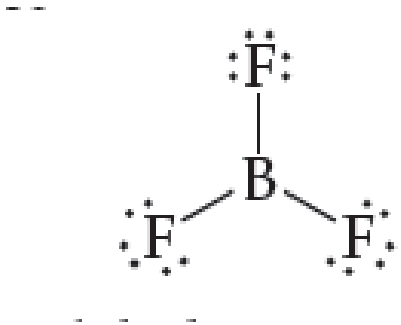




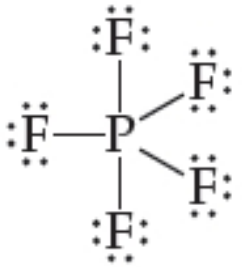
▲ **Figure 8.14 Benzene, an "aromatic" organic compound.** The benzene molecule is a regular hexagon of carbon atoms with a hydrogen atom bonded to each one. The dashed lines represent the blending of two equivalent resonance structures, leading to C—C bonds that are intermediate between single and double bonds.

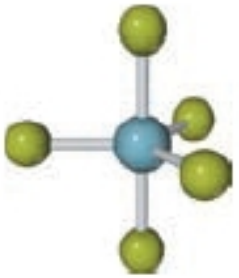
Exceções à Regra do Octeto

Número ímpar de elétrons



Número de elétrons menor que 8





Número de elétrons maior que 8
(átomos hipervalentes)