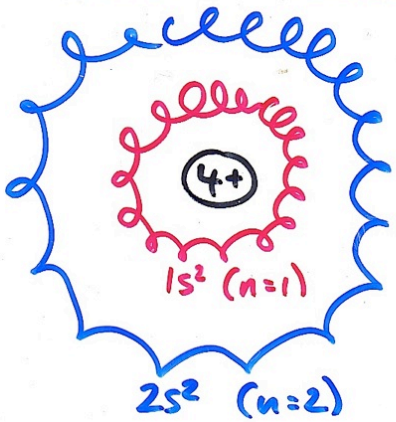
Be

$1s^2 2s^2$

	kJ/mol	
I_1	899	removal of $2s^2$
I_2	1757	
I_3	14,850	removal of $1s^2$
I_4	21,005	



Carbon Z=6 $1s^2 2s^2 2p^2$

	kJ/mol	
I_1	1086	$2p^2$
I_2	2350	
I_3	4620	$2s^2$
I_4	6220	
I_5	38,000	$1s^2$
I_6	47,261	

N: $I_1 = 1400\ kJ/mol$ — $7p^+$

O: $I_1 = 1314\ kJ/mol$ — $8p^+$

smaller IE?

WHY?

e⁻ config N: $1s^2 2s^2 2p^3$

O: $1s^2 2s^2 2p^4$

orbital diag:

N: 

O: 

4th e⁻ is added to an orbital which already has an e⁻!

⇒ Will be easier to remove due to e⁻ ↔ e⁻ repulsion!

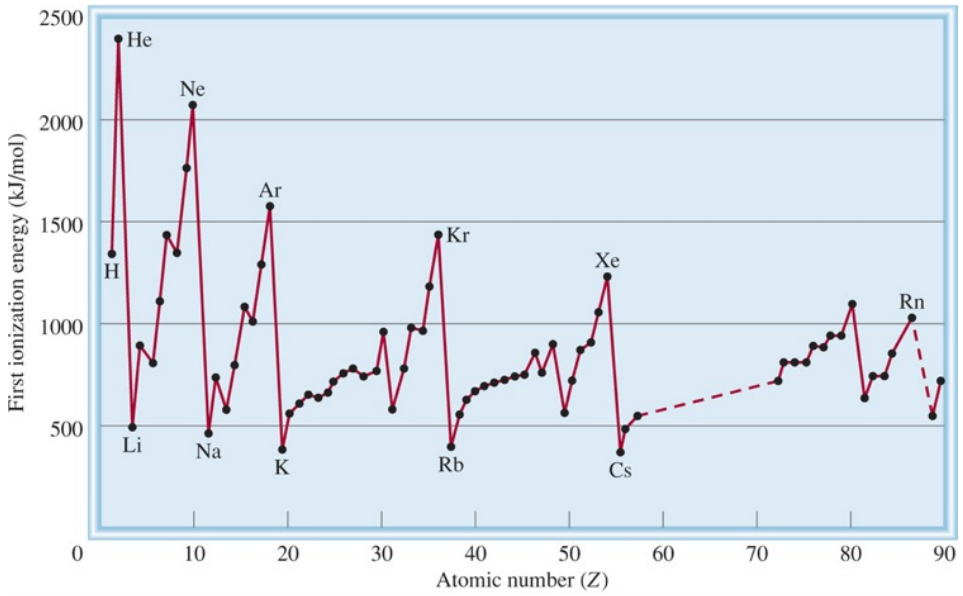


Table 8.2 The Ionization Energies (kJ/mol) of the First 20 Elements

Z	Element	First	Second	Third	Fourth	Fifth	Sixth
1	H	1,312					
2	He	2,373	5,251				
3	Li	520	7,300	11,815			
4	Be	899	1,757	14,850	21,005		
5	B	801	2,430	3,660	25,000	32,820	
6	C	1,086	2,350	4,620	6,220	38,000	47,261
7	N	1,400	2,860	4,580	7,500	9,400	53,000
8	O	1,314	3,390	5,300	7,470	11,000	13,000
9	F	1,680	3,370	6,050	8,400	11,000	15,200
10	Ne	2,080	3,950	6,120	9,370	12,200	15,000
11	Na	495.9	4,560	6,900	9,540	13,400	16,600
12	Mg	738.1	1,450	7,730	10,500	13,600	18,000
13	Al	577.9	1,820	2,750	11,600	14,800	18,400
14	Si	786.3	1,580	3,230	4,360	16,000	20,000
15	P	1,012	1,904	2,910	4,960	6,240	21,000
16	S	999.5	2,250	3,360	4,660	6,990	8,500
17	Cl	1,251	2,297	3,820	5,160	6,540	9,300
18	Ar	1,521	2,666	3,900	5,770	7,240	8,800
19	K	418.7	3,052	4,410	5,900	8,000	9,600
20	Ca	589.5	1,145	4,900	6,500	8,100	11,000

Electron Affinity

$X_{(g)} + e^- \longrightarrow X^-_{(g)} + \text{Energy}$

Energy ↑ Electron Affinity

In general, more energy is released as we go across each period

WHY? More p^+ in nucleus to attract the e^-s.

ex: ${}_9F: 1s^2 2s^2 2p^5 \xrightarrow{+1e} {}_9F^-: 1s^2 2s^2 2p^6$

What about Ne? 1 more p^+ ?!

${}_{10}Ne: 1s^2 2s^2 2p^6 \xrightarrow{+1e^-} {}_{10}Ne^- \; 1s^2 2s^2 2p^6 3s^1$

e^- is added to 3rd shell!
- Really far away from p^+

Table 8.3 Electron Affinities (kJ/mol) of Some Representative Elements and the Noble Gases*

1A	2A	3A	4A	5A	6A	7A	8A
H							He
73							<0
Li	Be	B	C	N	O	F	Ne
60	≤0	27	122	0	141	328	<0
Na	Mg	Al	Si	P	S	Cl	Ar
53	≤0	44	134	72	200	349	<0
K	Ca	Ga	Ge	As	Se	Br	Kr
48	2.4	29	118	77	195	325	<0
Rb	Sr	In	Sn	Sb	Te	I	Xe
47	4.7	29	121	101	190	295	<0
Cs	Ba	Tl	Pb	Bi	Po	At	Rn
45	14	30	110	110	?	?	<0

*The electron affinities of the noble gases, Be, and Mg have not been determined experimentally, but are believed to be close to zero or negative.

Chapter 9 Chemical Bonding 1

Lewis dot symbols.

valence e⁻s are important for bonding.

outer-shell e⁻s

Lewis

ex: $_{11}Na$ $1s^2 2s^2 2p^6 \underbrace{3s^1}_{\text{valence}}$ (core) — Na·

ex: $_{4}Be$ $\underbrace{1s^2}_{\text{core}} \underbrace{2s^2}_{\text{valence}}$ — ·Be·

ex: $_{13}Al$ $\underbrace{1s^2 2s^2 2p^6}_{\text{core}} \underbrace{3s^2 3p^1}_{\text{valence}}$ — ·Al·

$_{6}C$ $\underbrace{1s^2}_{\text{core}} \underbrace{2s^2 2p^2}_{\text{valence}}$ — ·Ċ·

$_{7}N$ $1s^2 \underbrace{2s^2 2p^3}_{\text{valence}}$ — ·N:

$_{8}O$ $1s^2 \underbrace{2s^2 2p^4}$ — :Ö:

Group # (1-8A) = # valence e⁻s.

except: He: 2 valence e⁻s

e⁻ config: $1s^2$ ↑↓ (1s)

IA IIA IIIA IVA VA VIA VIIA VIIIA

H·

Li· ·Be· ··· ·B· ·C· ·N: :O: :F:

Na· ·Mg: ·Al· ·Si· ·P:

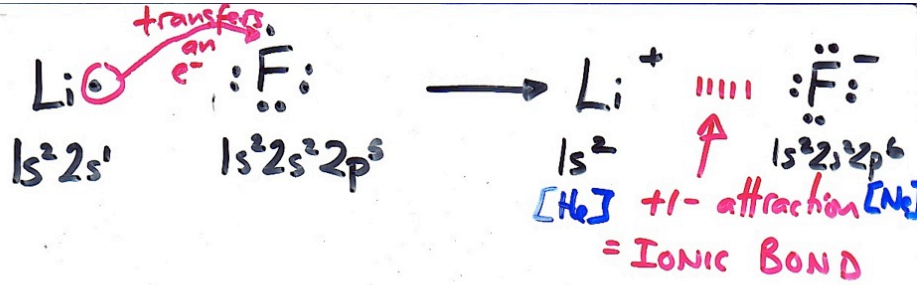
K· ·Ca·

The Ionic Bond

+/− attraction (often Metals + Non-Metals)

ex: lithium fluoride: LiF = Li^+F^-

1 1A	2 2A	3 3B	4 4B	5 5B	6 6B	7 7B	8	9 8B	10	11 1B	12 2B	13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
·H																	He:
·Li	·Be·											·B·	·C·	·N·	·O·	:F·	:Ne:
·Na	·Mg·											·Al·	·Si·	·P·	·S·	:Cl·	:Ar:
·K	·Ca·											·Ga·	·Ge·	·As·	·Se·	:Br·	:Kr:
·Rb	·Sr·											·In·	·Sn·	·Sb·	·Te·	:I·	:Xe:
·Cs	·Ba·											·Tl·	·Pb·	·Bi·	·Po·	:At·	:Rn:
·Fr	·Ra·																



ex: Calcium chloride : $CaCl_2$

= $Ca^{2+}\ Cl^-\ Cl^-$

Ca : lost e⁻s : OX

Cl : gained e⁻s RED

[Ne]3s²3p⁶
=
[Ar]

OIL RIG / LEO goes GER