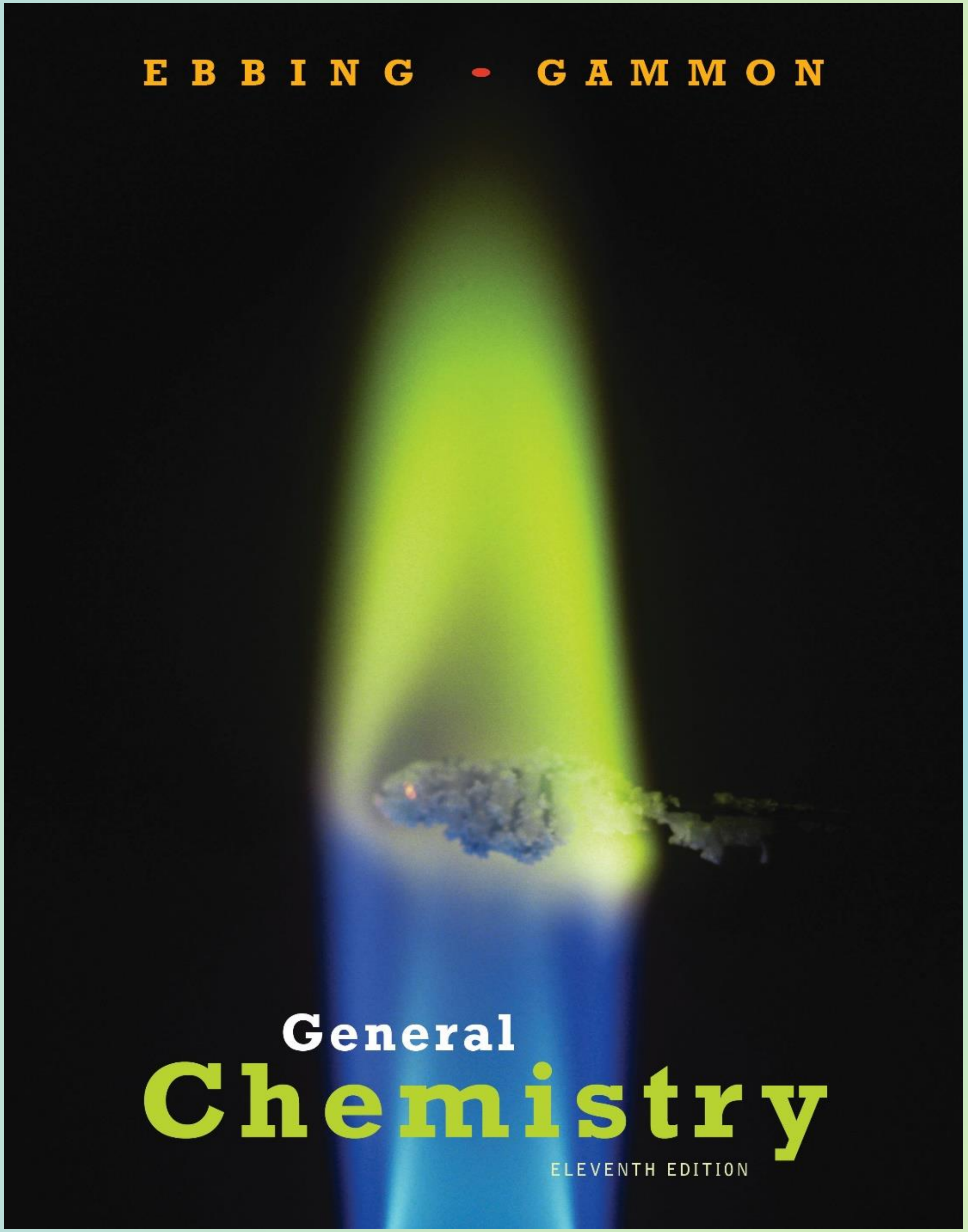


اللهم صلّ وسلّم على نبينا محمد وعلى آله وصحبه أجمعين

Electron Configurations and Periodicity

8.1 Electron Spin and Pauli Exclusion Principle
8.2 Building-Up Principle and the Periodic Table
8.3 Writing Electron Configurations Using the Periodic Table
8.4 Orbital Diagrams of Atoms, Hund’s Rule
8.6 Some Periodic Properties.

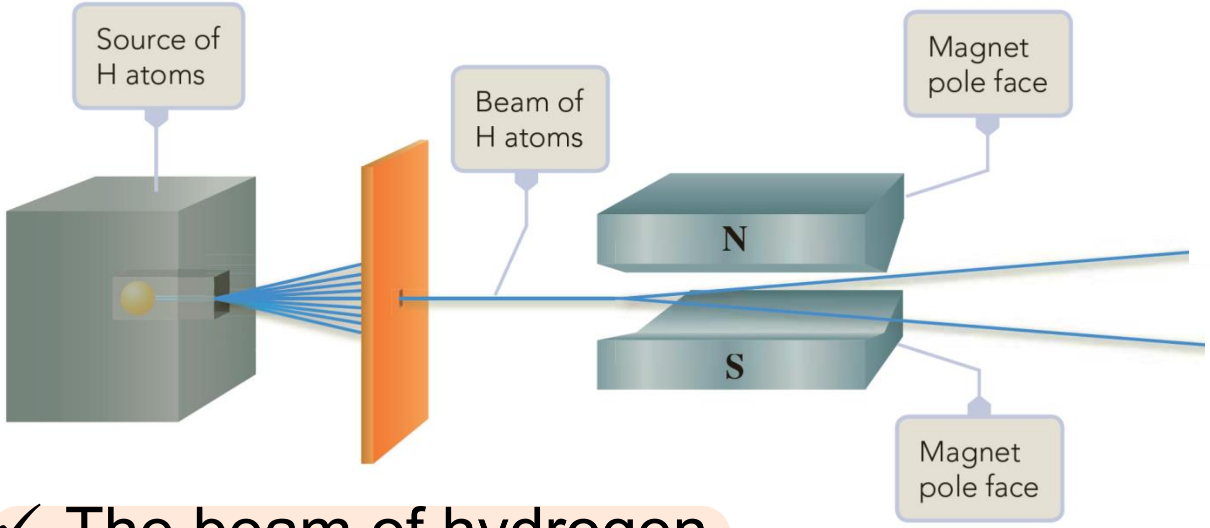
***Excluded sections*: 8.5, 8.7**

✓ **8.5 Mendeleev’s Predictions from the Periodic Table**
✓ **8.7 Periodicity in the Main-Group Elements**

الإستبعاد

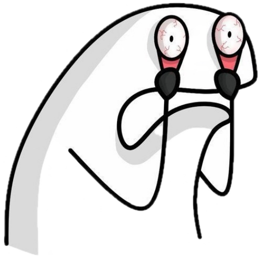
8.1 Electron Spin and the Pauli Exclusion Principle

The Stern–Gerlach experiment

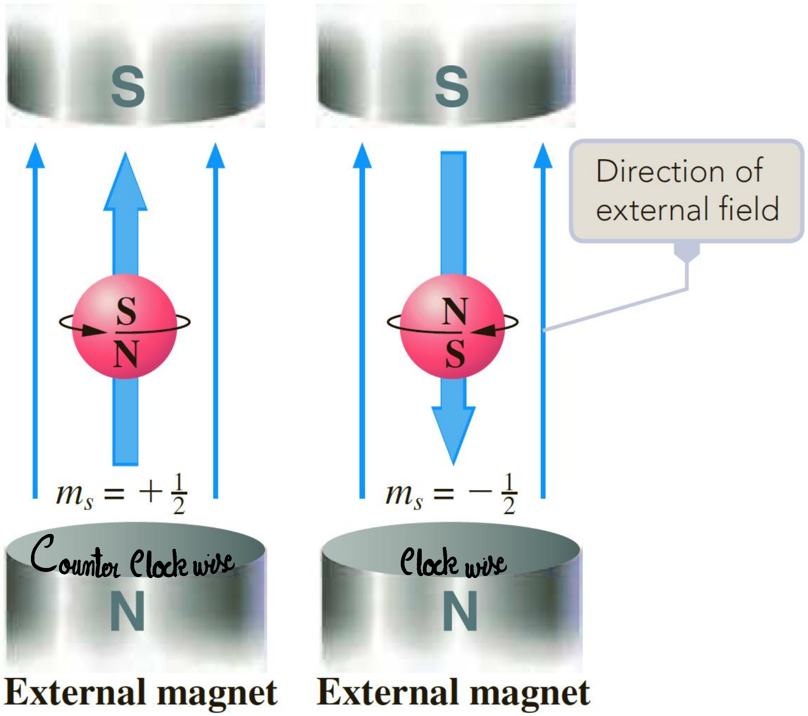


m_s= +1/2 للأعلى

m_s= -1/2 للأسفل

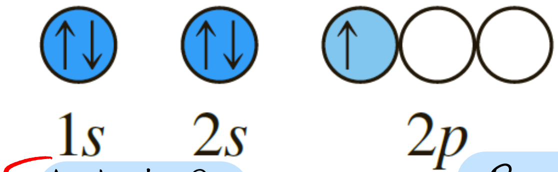


- ✓ The beam of hydrogen atoms is split into two by the magnetic field.
- ☑ Half of the atoms are bent in one direction and half in the other.
- ✓ The fact that the atoms are affected by the external magnet shows that they themselves act as magnets.



Electron Configurations and Orbital Diagrams

- An **electron configuration** of an atom is *a particular distribution of electrons among the available subshells.*
- A subshell consists of a group of orbitals having the same *n* and *l* quantum numbers but different m_l values.
- $_5B: 1s^2 2s^2 2p^1$
- An electron in an orbital is shown by an arrow; the arrow points up when m_s = +1/2 and down when m_s = -1/2.
- The orbital diagram of B is:



مابتقدر هون أحطه لأنو
كلهم نفس الطاقة

1 orbital = 2e−

3 orbitals = 6e−

مالو دخل بال Filling

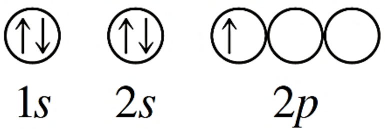
Pauli Exclusion Principle

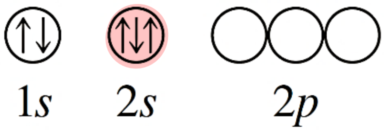
No two electrons in an atom can have the same four quantum numbers. (Always differ in Ms quantum number either $(+\frac{1}{2})$ or $(-\frac{1}{2})$) #

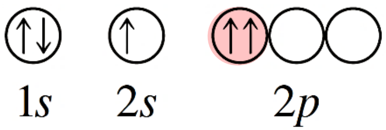
S Orbital → 2e-
P Orbital → 6e-
d Orbital → 10e-
f Orbital → 14e-

(Q) Which of the following orbital diagrams or electron configurations are possible and which are impossible, according to the Pauli exclusion principle? Explain

Example 8.1

a.


b.


c.


d. $1s^3 2s^1$

e. $1s^2 2s^1 2p^7$

f. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^8 4s^2$

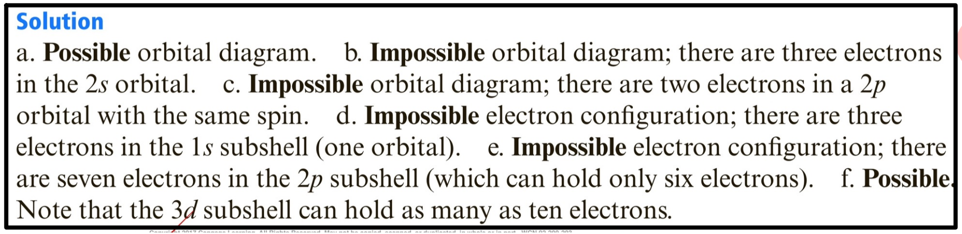
If 2e have the same 4 quantum number this consider wrong depend on Pauli principle

➢ Building-Up Principle (Aufbau Principle)

✓ *lowest energy orbitals are filled first* : 1s, then 2s, then 2p, then 3s, then 3p, etc.

✓ Following this principle, you obtain the electron configuration of an atom by successively filling subshells in the following order:

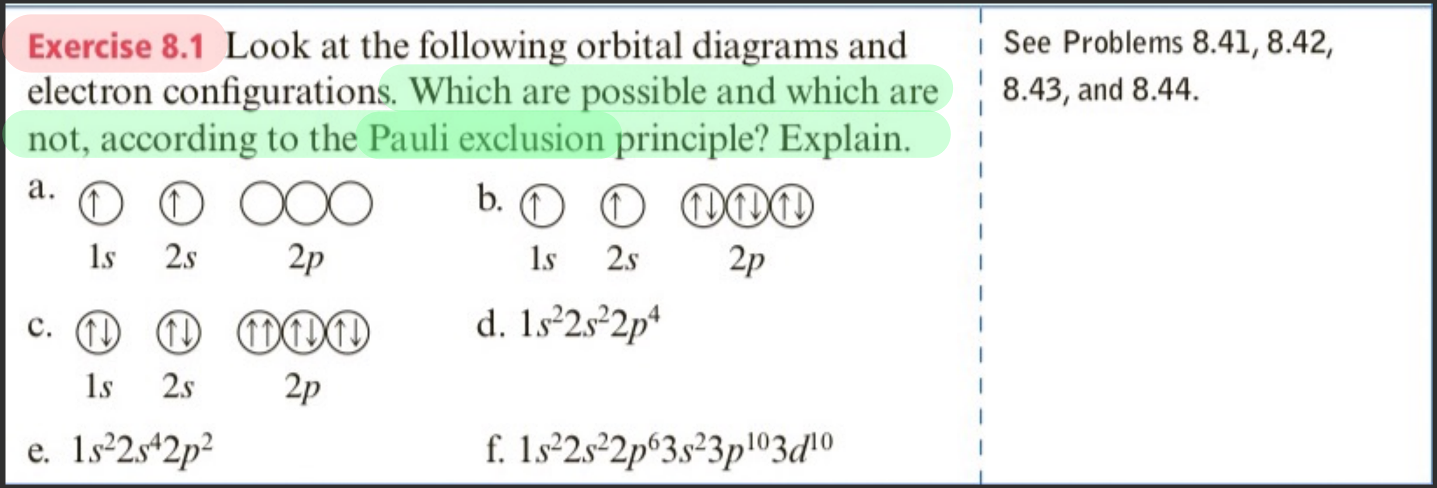
1s, 2s, 2p, 3s, 3p, ***4s*****,** ***3d****, 4p,* ***5s*****,** ***4d****, 5p, 6s, 4f, 5d, 6p, 7s, 5f.*



Solution

a. **Possible** orbital diagram. b. **Impossible** orbital diagram; there are three electrons in the 2*s* orbital. c. **Impossible** orbital diagram; there are two electrons in a 2*p* orbital with the same spin. d. **Impossible** electron configuration; there are three electrons in the 1*s* subshell (one orbital). e. **Impossible** electron configuration; there are seven electrons in the 2*p* subshell (which can hold only six electrons). f. **Possible.** Note that the 3*d* subshell can hold as many as ten electrons.

Example 8.1



Exercise 8.1 Look at the following orbital diagrams and electron configurations. Which are possible and which are not, according to the Pauli exclusion principle? Explain.

a. (↑) (↑) ( )( )( )
1s 2s 2p

b. (↑) (↑) (↑↓)(↑↓)(↑↓)
1s 2s 2p

c. (↑↓) (↑↓) (↑↑)(↑↓)(↑↓)
1s 2s 2p

d. $1s^22s^22p^4$

e. $1s^22s^42p^2$

f. $1s^22s^22p^63s^23p^{10}3d^{10}$

See Problems 8.41, 8.42, 8.43, and 8.44.

A. Possible.

B. possible.

C. NoT. Possible, There are two (e-) in a 2p Orbital with the Same spin.

D. Possible.

E. NoT - possible, Only (2e-) are allowed in (S) Sub shell.

F. NoT - possible, Only (6e-) are allowed in (P) Sub shell.

➢ Electron Configurations and the Periodic Table

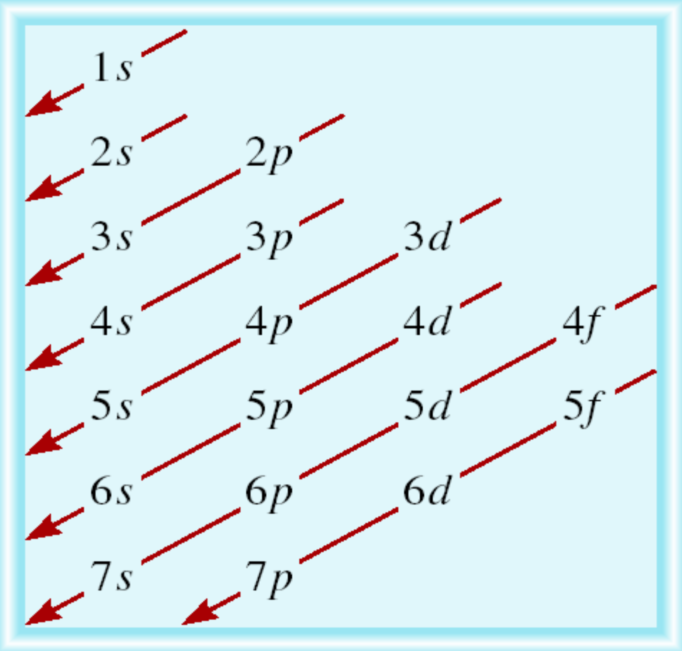
helium	$1s^2$
neon	$1s^2 2s^2 2p^6$
argon	$1s^2 2s^2 2p^6 3s^2 3p^6$
krypton	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6$ #

بصير أقل Energy لما ال (d)orbital يكتمل ...

الـ (d) بدخل :
بـ Valance electrons
← Transition metal

beryllium	$1s^2 2s^2$	or	$[He]2s^2$
magnesium	$1s^2 2s^2 2p^6 3s^2$	or	$[Ne]3s^2$
calcium	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$	or	$[Ar]4s^2$

Order of orbitals (filling) in multi-electron atom



Core

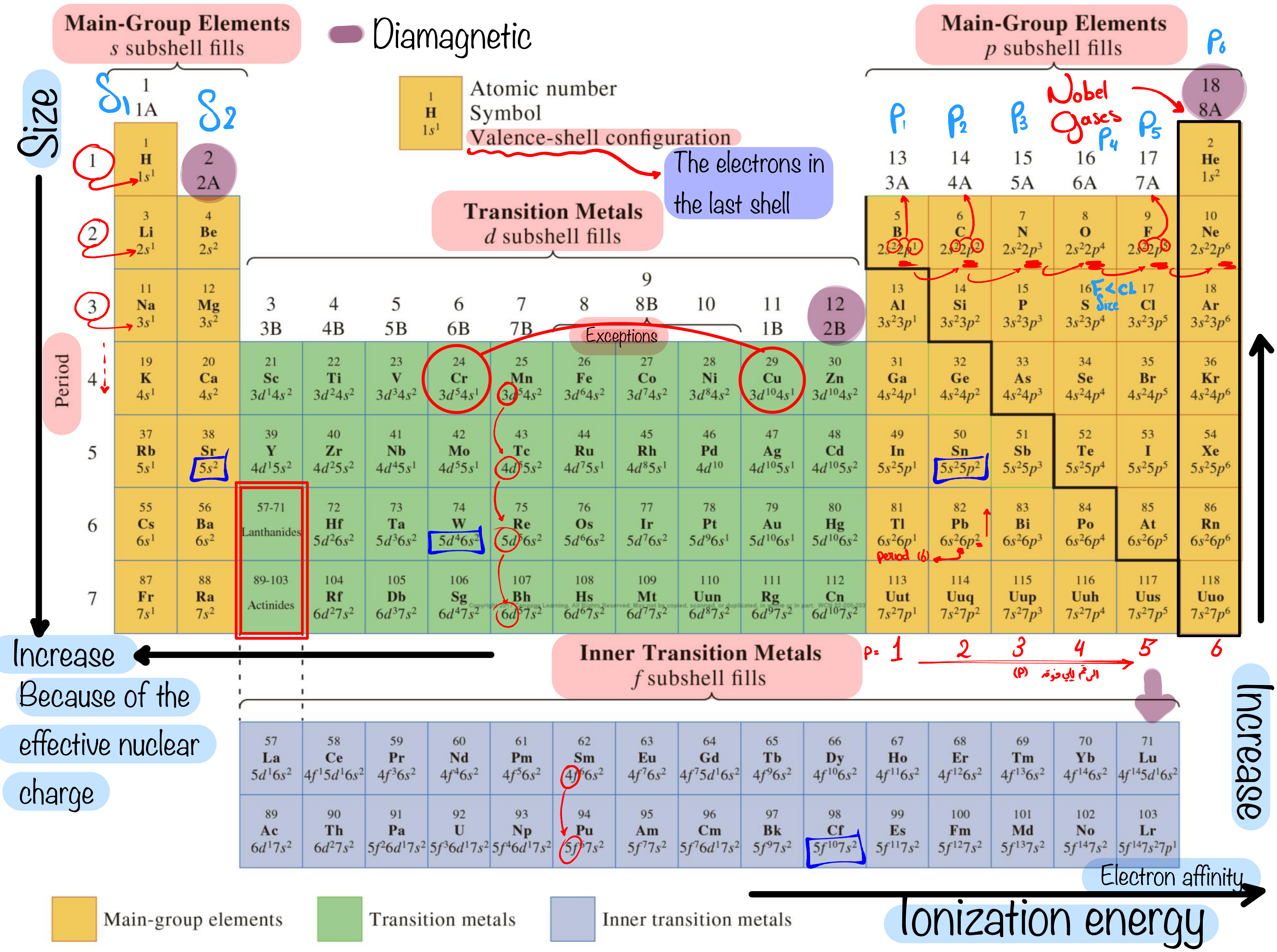
Valance

boron	$1s^2 2s^2 2p^1$	or	$[He]2s^2 2p^1$
aluminium	$1s^2 2s^2 2p^6 3s^2 3p^1$	or	$[Ne]3s^2 3p^1$
gallium	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^1$	or	$[Ar]3d^{10} 4s^2 4p^1$

🟦 pseudo-noble-gas core
🟨 noble-gas core
🟪 valence electron

✓ **noble-gas core:** *an inner-shell configuration corresponding to one of the noble gases.* Core-elektrons

✓ **valence electron:** *An electron in an atom outside the noble-gas or pseudo-noble-gas core.* إلكترونات المدار الأخير



Main-Group Elements
s subshell fills

Diamagnetic

Main-Group Elements
p subshell fills

1
H
$1s^1$
Atomic number
Symbol
Valence-shell configuration

The electrons in the last shell

Transition Metals
d subshell fills

Exceptions

Size

Period

Nobel gases

F<Cl
Size

	1 1A S1	2 2A S2	3 3B	4 4B	5 5B	6 6B	7 7B	8	9 8B	10	11 1B	12 2B	13 3A P1	14 4A P2	15 5A P3	16 6A P4	17 7A P5	18 8A P6
1	1 H $1s^1$																	2 He $1s^2$
2	3 Li $2s^1$	4 Be $2s^2$											5 B $2s^22p^1$	6 C $2s^22p^2$	7 N $2s^22p^3$	8 O $2s^22p^4$	9 F $2s^22p^5$	10 Ne $2s^22p^6$
3	11 Na $3s^1$	12 Mg $3s^2$											13 Al $3s^23p^1$	14 Si $3s^23p^2$	15 P $3s^23p^3$	16 S $3s^23p^4$	17 Cl $3s^23p^5$	18 Ar $3s^23p^6$
4	19 K $4s^1$	20 Ca $4s^2$	21 Sc $3d^14s^2$	22 Ti $3d^24s^2$	23 V $3d^34s^2$	24 Cr $3d^54s^1$	25 Mn $3d^54s^2$	26 Fe $3d^64s^2$	27 Co $3d^74s^2$	28 Ni $3d^84s^2$	29 Cu $3d^{10}4s^1$	30 Zn $3d^{10}4s^2$	31 Ga $4s^24p^1$	32 Ge $4s^24p^2$	33 As $4s^24p^3$	34 Se $4s^24p^4$	35 Br $4s^24p^5$	36 Kr $4s^24p^6$
5	37 Rb $5s^1$	38 Sr $5s^2$	39 Y $4d^15s^2$	40 Zr $4d^25s^2$	41 Nb $4d^45s^1$	42 Mo $4d^55s^1$	43 Tc $4d^55s^2$	44 Ru $4d^75s^1$	45 Rh $4d^85s^1$	46 Pd $4d^{10}$	47 Ag $4d^{10}5s^1$	48 Cd $4d^{10}5s^2$	49 In $5s^25p^1$	50 Sn $5s^25p^2$	51 Sb $5s^25p^3$	52 Te $5s^25p^4$	53 I $5s^25p^5$	54 Xe $5s^25p^6$
6	55 Cs $6s^1$	56 Ba $6s^2$	57-71 Lanthanides	72 Hf $5d^26s^2$	73 Ta $5d^36s^2$	74 W $5d^46s^2$	75 Re $5d^56s^2$	76 Os $5d^66s^2$	77 Ir $5d^76s^2$	78 Pt $5d^96s^1$	79 Au $5d^{10}6s^1$	80 Hg $5d^{10}6s^2$	81 Tl $6s^26p^1$	82 Pb $6s^26p^2$	83 Bi $6s^26p^3$	84 Po $6s^26p^4$	85 At $6s^26p^5$	86 Rn $6s^26p^6$
7	87 Fr $7s^1$	88 Ra $7s^2$	89-103 Actinides	104 Rf $6d^27s^2$	105 Db $6d^37s^2$	106 Sg $6d^47s^2$	107 Bh $6d^57s^2$	108 Hs $6d^67s^2$	109 Mt $6d^77s^2$	110 Uun $6d^87s^2$	111 Rg $6d^97s^2$	112 Cn $6d^{10}7s^2$	113 Uut $7s^27p^1$	114 Uuq $7s^27p^2$	115 Uup $7s^27p^3$	116 Uuh $7s^27p^4$	117 Uus $7s^27p^5$	118 Uuo $7s^27p^6$

period (6)

P= 1 2 3 4 5 6

الرقم يلي فوقه (P)

Increase
Because of the effective nuclear charge

Inner Transition Metals
f subshell fills

57 La $5d^16s^2$	58 Ce $4f^15d^16s^2$	59 Pr $4f^36s^2$	60 Nd $4f^46s^2$	61 Pm $4f^56s^2$	62 Sm $4f^66s^2$	63 Eu $4f^76s^2$	64 Gd $4f^75d^16s^2$	65 Tb $4f^96s^2$	66 Dy $4f^{10}6s^2$	67 Ho $4f^{11}6s^2$	68 Er $4f^{12}6s^2$	69 Tm $4f^{13}6s^2$	70 Yb $4f^{14}6s^2$	71 Lu $4f^{14}5d^16s^2$
89 Ac $6d^17s^2$	90 Th $6d^27s^2$	91 Pa $5f^26d^17s^2$	92 U $5f^36d^17s^2$	93 Np $5f^46d^17s^2$	94 Pu $5f^67s^2$	95 Am $5f^77s^2$	96 Cm $5f^76d^17s^2$	97 Bk $5f^97s^2$	98 Cf $5f^{10}7s^2$	99 Es $5f^{11}7s^2$	100 Fm $5f^{12}7s^2$	101 Md $5f^{13}7s^2$	102 No $5f^{14}7s^2$	103 Lr $5f^{14}7s^27p^1$

Increase

Electron affinity

Ionization energy

🟨	Main-group elements
🟩	Transition metals
🟦	Inner transition metals

➢ Exceptions to the Building-Up Principle

* Full - half Full → Stable ...

Not Full ← → Full

chromium (Cr)(Z =24): [Ar]$3d^{4}4s^{2}$ **expected**

[Ar]$3d^{\boxed{5}}4s^{\boxed{1}}$ **experimental** More stable

half full ← → half Full

Not Full ← → Full

copper (Cu)(Z =29): [Ar]$3d^{9}4s^{2}$ **expected**

[Ar]$3d^{\boxed{10}}4s^{\boxed{1}}$ **experimental** More stable

Full ← → half Full

✓ 8.3 Writing Electron Configurations Using the Periodic Table

Kr(36): [Ar]$4s^{2}3d^{10}4p^{6}$ or [Ar]$3d^{10}4s^{2}4p^{6}$

Nb(41): [Kr]$5S^{2}4d^{3}$

Sb(51): [Kr]$5s^{2}4d^{10}5p^{3}$

Fe : [Ar]$4s^{2}3d^{6}$

→

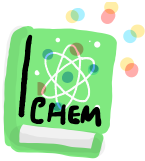
[Ar]$3d^{6}4s^{2}$

Fe^{+2} : [Ar] $3d^{6}$

Fe^{+3} : [Ar] $3d^{5}$

Exercise 8.2 Use the building-up principle to obtain the electron configuration for the ground state of the manganese atom (Z = 25).

See Problems 8.47, 8.48, 8.49, and 8.50.



$1s^{2}2s^{2}2p^{6}3s^{2}3p^{6}\underline{3d}^{5}4s^{2}$ → more Stable Less Energy

(Q) Use the building-up principle to obtain the configuration for the ground state of the gallium atom (Z = 31). Give the configuration in complete form (do not abbreviate for the core). What is the valence-shell configuration? Example 8.2

$$\boxed{1s^22s^22p^63s^23p^64s^23d^{10}4p^1 \rightarrow \mathbf{1s^22s^22p^63s^23p^63d^{10}4s^24p^1}}$$

→ The valence-shell configuration is $\mathbf{4s^24p^1}$

(Q) What are the configurations for the outer electrons of: Example 8.3

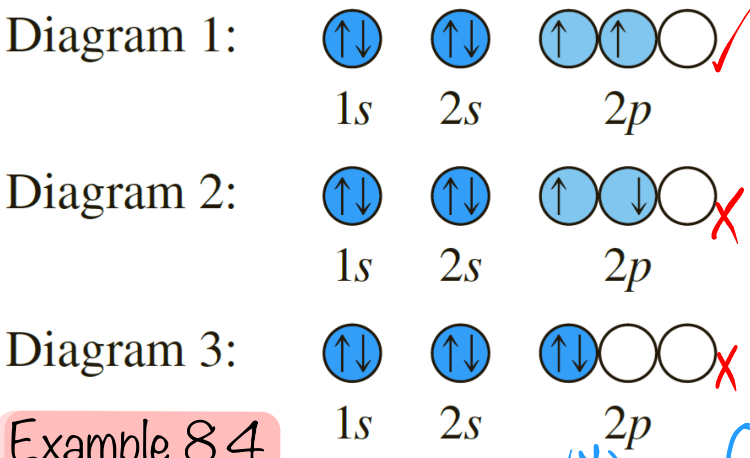
a. tellurium, Z = 52, and b. nickel, Z = 28?

Te : [Kr]$5s^24d^{10}5p^4$ → [Kr] $4d^{10}5s^25p^4$ → $5s^25p^4$

Ni : [Ar]$4s^23d^8$ → $4s^23d^8$

Exercise 8.4 The atom (X) has the ground-state configuration [Xe]$4f^{14}5d^{10}6s^26p^2$. Find the period and group for this element. From its position in the periodic table, would you classify lead as a main-group element, a transition element, or an inner transition element? Group (4-A) / Period 6 / main Group Element

8.4 Orbital Diagrams of Atoms; Hund's Rule

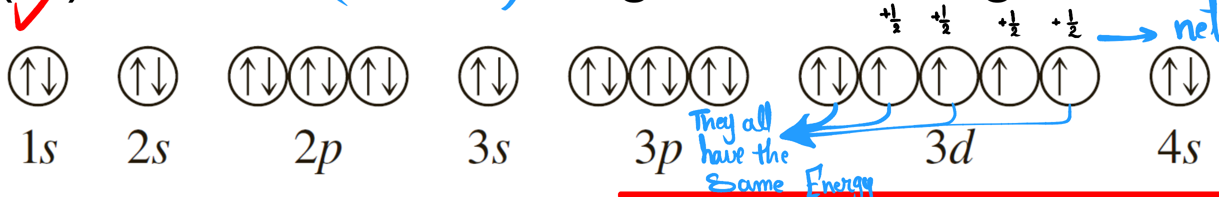


Hund's rule states that *the lowest energy arrangement of electrons in a subshell is obtained by putting electrons into separate orbitals of the subshell with the same spin before pairing electrons*

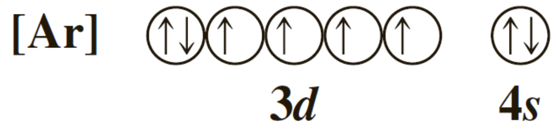
Example 8.4

(Hi) — Orbit(n)

(Q)Write an (orbital) diagram for the ground state of the iron atom

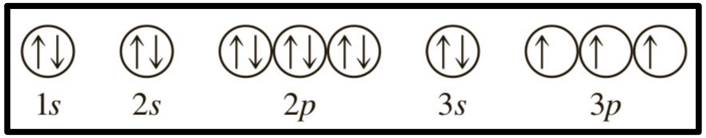


→ net ms = (2) have magnatic properties



Exercise 8.5 Write an orbital diagram for the ground state of the phosphorus atom ($Z = 15$). Write all orbitals.

See Problems 8.57 and 8.58.



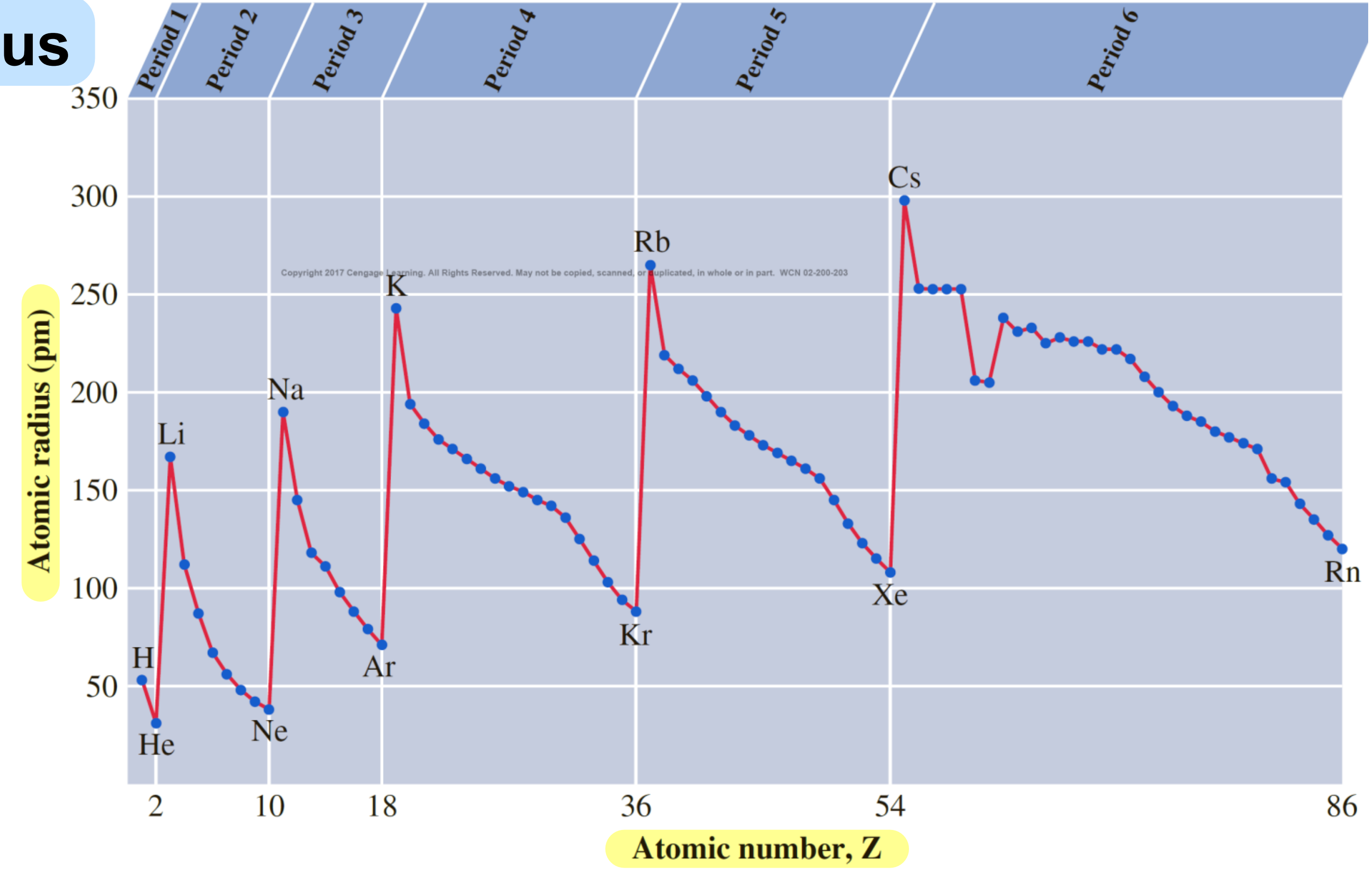
✓ Magnetic Properties of Atoms

paramagnetic substance	**diamagnetic substance**
At least one unpaired electron	All electrons are paired

➢ Atomic Radius

Size

The 3 properties are studied in the gaseous state



1. Within each period (horizontal row), the atomic radius tends to **decrease** with increasing atomic number (nuclear charge).

* بتزيد البروتونات بالنواة فبتزيد جذبها لإلكترونات المدار الأخير فيقل الحجم

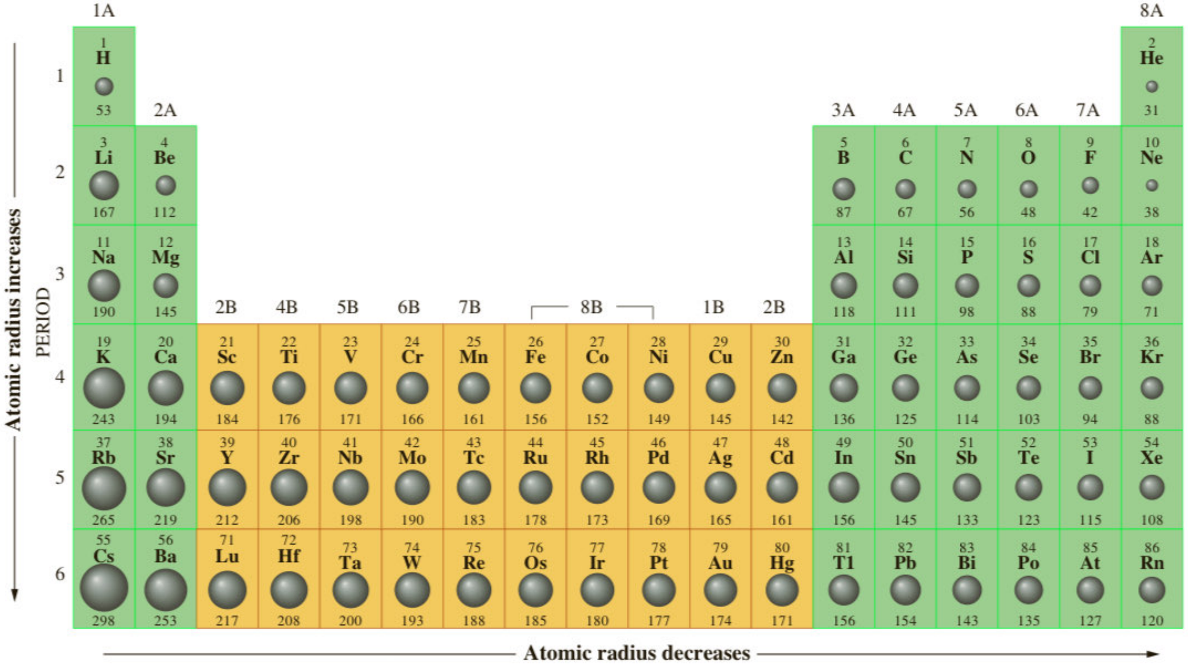
2. Within each group (vertical column), the atomic radius tends to **increase** with the period number.

لأنه بزيد الـ (Shell) (n) فيزداد الحجم

(Q) Arrange the following in order of increasing atomic radius:

✓ (1) Al, C, Si. **C < Si < Al** Example 8.5

(2) Na, Be, Mg **Be < Mg < Na** Exercise 8.6

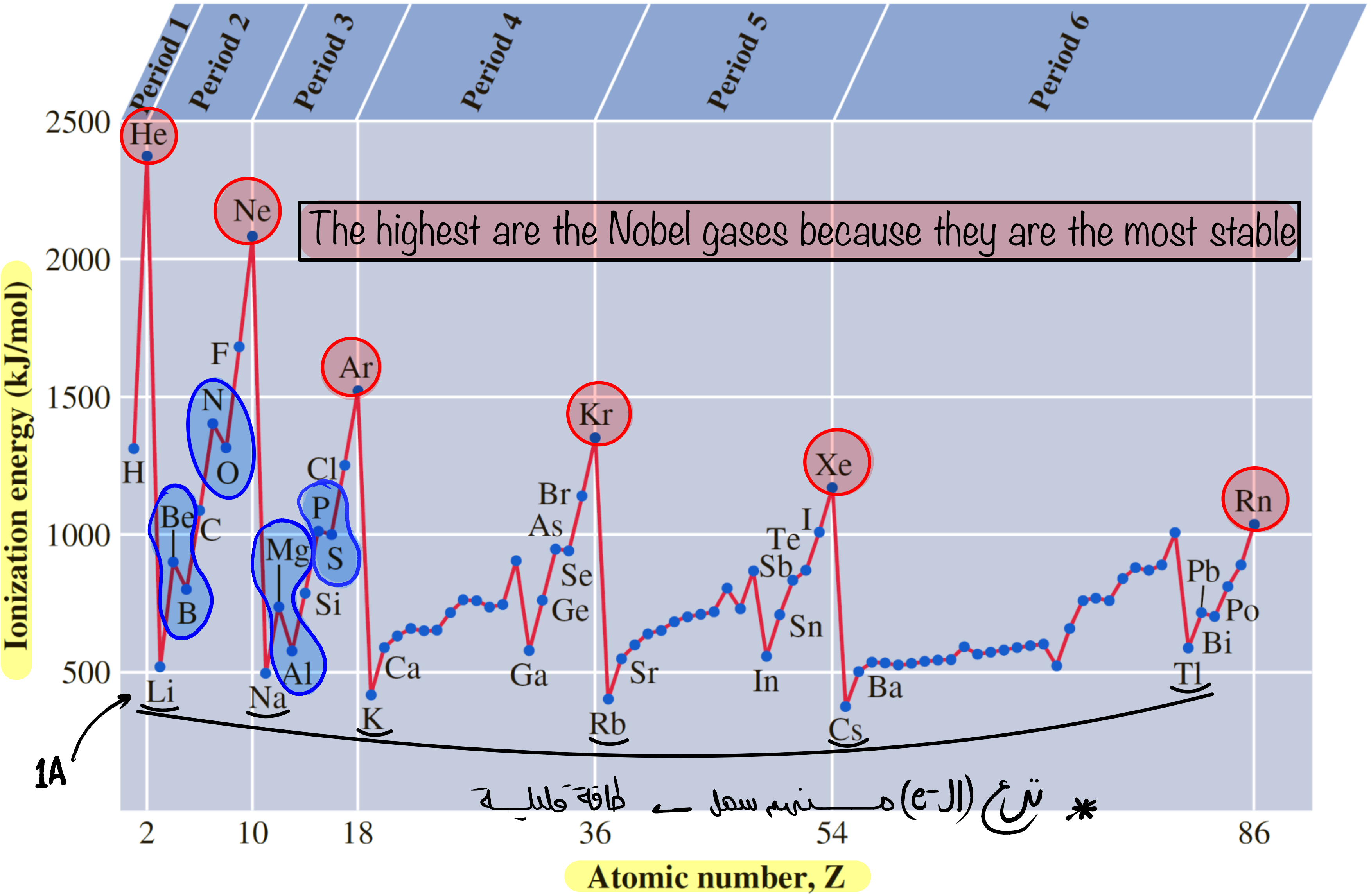

1A
8A
2A
3A
4A
5A
6A
7A
2B
4B
5B
6B
7B
8B
1B
2B
PERIOD
1
2
3
4
5
6
Atomic radius increases
Atomic radius decreases
1 H 53
2 He 31
3 Li 167
4 Be 112
5 B 87
6 C 67
7 N 56
8 O 48
9 F 42
10 Ne 38
11 Na 190
12 Mg 145
13 Al 118
14 Si 111
15 P 98
16 S 88
17 Cl 79
18 Ar 71
19 K 243
20 Ca 194
21 Sc 184
22 Ti 176
23 V 171
24 Cr 166
25 Mn 161
26 Fe 156
27 Co 152
28 Ni 149
29 Cu 145
30 Zn 142
31 Ga 136
32 Ge 125
33 As 114
34 Se 103
35 Br 94
36 Kr 88
37 Rb 265
38 Sr 219
39 Y 212
40 Zr 206
41 Nb 198
42 Mo 190
43 Tc 183
44 Ru 178
45 Rh 173
46 Pd 169
47 Ag 165
48 Cd 161
49 In 156
50 Sn 145
51 Sb 133
52 Te 123
53 I 115
54 Xe 108
55 Cs 298
56 Ba 253
71 Lu 217
72 Hf 208
73 Ta 200
74 W 193
75 Re 188
76 Os 185
77 Ir 180
78 Pt 177
79 Au 174
80 Hg 171
81 Tl 156
82 Pb 154
83 Bi 143
84 Po 135
85 At 127
86 Rn 120

➢ Ionization Energy

الطاقة اللازمة لــنزع الـ(e-) من الذرة ..

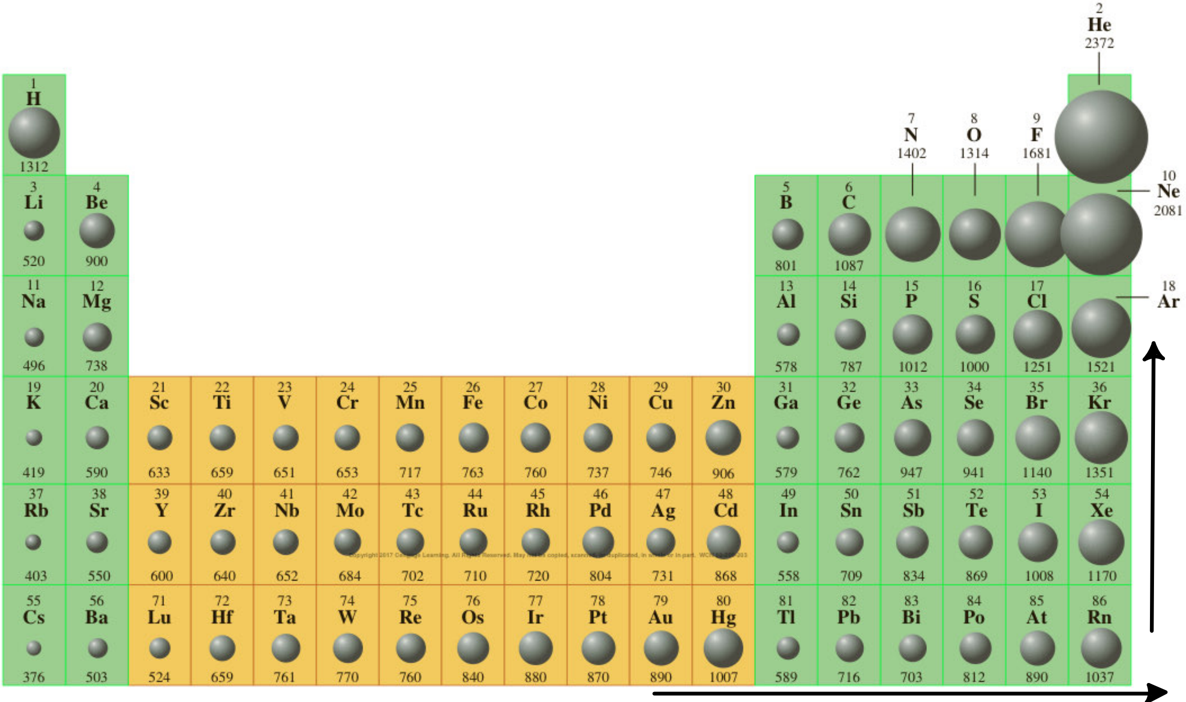
$Li \rightarrow Li^+ + e^-$ First ionization energy = 520 kJ/mol

= 5.39 eV (1eV = 96.5 kJ/mol)



The highest are the Nobel gases because they are the most stable

* نزع (الـe-) ســهل ← طاقة قليلــة


1 H 1312
2 He 2372
3 Li 520
4 Be 900
5 B 801
6 C 1087
7 N 1402
8 O 1314
9 F 1681
10 Ne 2081
11 Na 496
12 Mg 738
13 Al 578
14 Si 787
15 P 1012
16 S 1000
17 Cl 1251
18 Ar 1521
19 K 419
20 Ca 590
21 Sc 633
22 Ti 659
23 V 651
24 Cr 653
25 Mn 717
26 Fe 763
27 Co 760
28 Ni 737
29 Cu 746
30 Zn 906
31 Ga 579
32 Ge 762
33 As 947
34 Se 941
35 Br 1140
36 Kr 1351
37 Rb 403
38 Sr 550
39 Y 600
40 Zr 640
41 Nb 652
42 Mo 684
43 Tc 702
44 Ru 710
45 Rh 720
46 Pd 804
47 Ag 731
48 Cd 868
49 In 558
50 Sn 709
51 Sb 834
52 Te 869
53 I 1008
54 Xe 1170
55 Cs 376
56 Ba 503
71 Lu 524
72 Hf 659
73 Ta 761
74 W 770
75 Re 760
76 Os 840
77 Ir 880
78 Pt 870
79 Au 890
80 Hg 1007
81 Tl 589
82 Pb 716
83 Bi 703
84 Po 812
85 At 890
86 Rn 1037

- high values of *first ionization energy* associated with the noble gases
- very low values of *first ionization energy* associated with the group 1 elements;
- general increase in values of *first ionization energy* as a given period is crossed
- Ionization energies tend to decrease going down any column. This is because atomic size increases going down the column.

Exceptions:

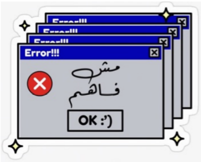
less stable not filled So it's easier to lose Electron

- (B<Be) 3A element (B)(ns^2np^1) has smaller ionization energy than the preceding 2A element (Be)(ns^2). Or (Al < Mg)
- (O<N)6A element (O)(ns^2np^4) has smaller ionization energy than the preceding 5A element (N) (ns^2np^3) . Or (S < P)

As a result of electron repulsion

* لما نفصل الـ Core بصير صعب
كثير الفقد لل(e^-) ...

لنص ممتلىء يعني أكثر
استقرار فبده طاقة أعلى...
↑ ↑ ↑



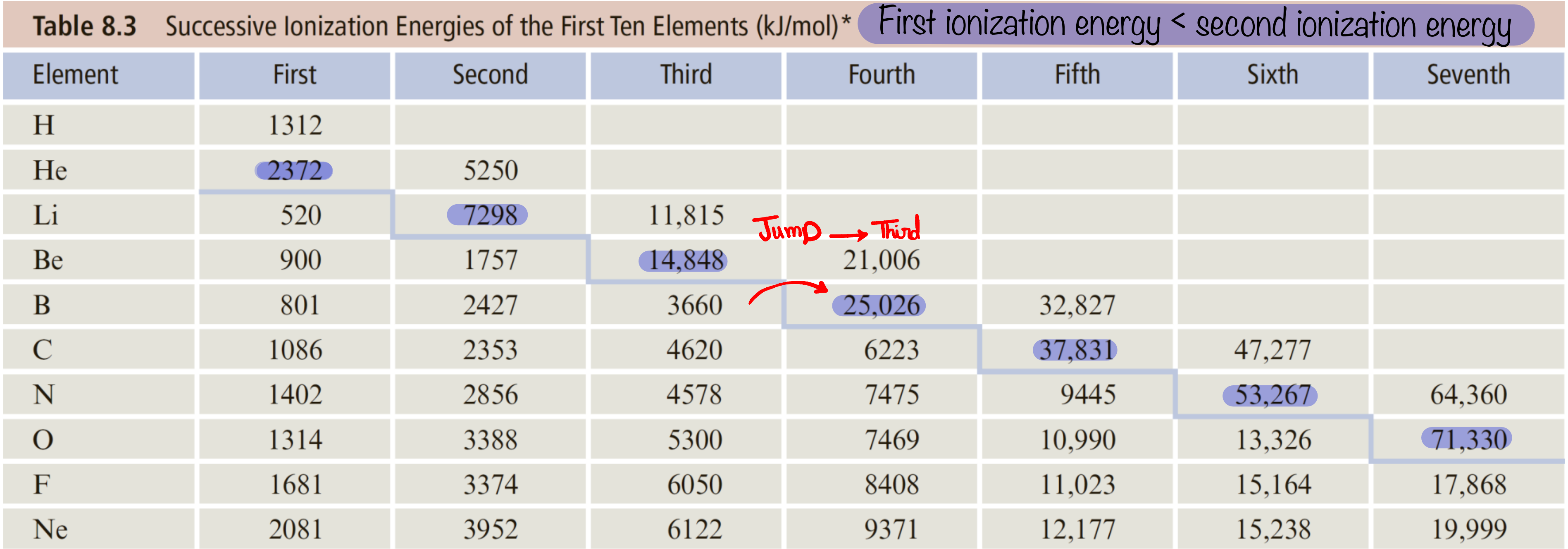


Table 8.3 Successive Ionization Energies of the First Ten Elements (kJ/mol)*

First ionization energy < second ionization energy

Element	First	Second	Third	Fourth	Fifth	Sixth	Seventh
H	1312						
He	2372	5250					
Li	520	7298	11,815				
Be	900	1757	14,848	21,006			
B	801	2427	3660	25,026	32,827		
C	1086	2353	4620	6223	37,831	47,277	
N	1402	2856	4578	7475	9445	53,267	64,360
O	1314	3388	5300	7469	10,990	13,326	71,330
F	1681	3374	6050	8408	11,023	15,164	17,868
Ne	2081	3952	6122	9371	12,177	15,238	19,999

Jump → Third

Exercise 8.7 The first ionization energy of the chlorine atom is 1251 kJ/mol. which of the following values would be the more likely ionization energy for the iodine atom. Explain.

a. 1000 kJ/mol.   b. 1400 kJ/mol.

* It is more likely that 1000 kJ/mol is the ionization energy for iodine because ionization energies tend to decrease as atomic number increases in a column.*

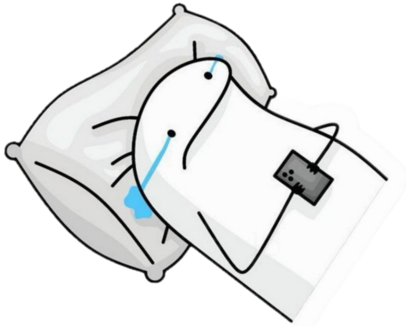
8.26 Which of the following atoms, designated by their electron configurations, has the *highest* ionization energy?

- a $[\mathrm{Ne}]3s^2 3p^2$
- b $[\mathrm{Ne}]3s^2 3p^3$
- c $[\mathrm{Ar}]3d^{10} 4s^2 4p^3$
- d $[\mathrm{Kr}]4d^{10} 5s^2 5p^3$
- e $[\mathrm{Xe}]4f^{14} 5d^{10} 6s^2 6p^3$

2A Jump ( )

8.27 When trying to remove electrons from Be, which of the following sets of ionization energy makes the most sense going from first to third ionization energy? Explain your answer.

- a First IE 900 KJ/mol, second IE 1750 kJ/mol, third IE 15,000 kJ/mol
- X First IE 1750 KJ/mol, second IE 900 kJ/mol, third IE 15,000 kJ/mol — مستحيل يقل
- X First IE 15,000 KJ/mol, second IE 1750 kJ/mol, third IE 900 kJ/mol
- d First IE 900 KJ/mol, second IE 15,000 kJ/mol, third IE 22,000 kJ/mol → First group
- X First IE 900 KJ/mol, second IE 1750 kJ/mol, third IE 1850 kJ/mol



8.28 Consider the following orderings.

I. Al < Si < P < S

II. Be < Mg < Ca < Sr

III. I < Br < Cl < F

Which of these give(s) a correct trend in atomic size?

- a I only
- [✓ b II only]
- c III only
- d I and II only
- e II and III only

Example 8.6

Using a periodic table only, arrange the following elements in order of increasing ionization energy: Ar, Se, S.

Se < S < Ar

Exercise 8.8 Without looking at Table 8.4 but using the general comments in this section, decide which has the larger electron affinity, C or [✓ F].

See Problems 8.65 and 8.66.

➢ Electron Affinity

is defined as *the energy required to remove an electron from the atom's negative ion (in its ground state)*

$$\mathrm{Cl([Ne]3}s^2 3p^5) + e^- \longrightarrow \mathrm{Cl^-([Ne]3}s^2 3p^6);\ \Delta E = -349\ \mathrm{kJ/mol}$$

Change in the energy

Experimentally EA is determined by the following eqn.

$$\mathrm{Cl^-([Ne]3}s^2 3p^6) \longrightarrow \mathrm{Cl([Ne]3}s^2 3p^5) + e^-;\ \Delta E = 349\ \mathrm{kJ/mol}$$

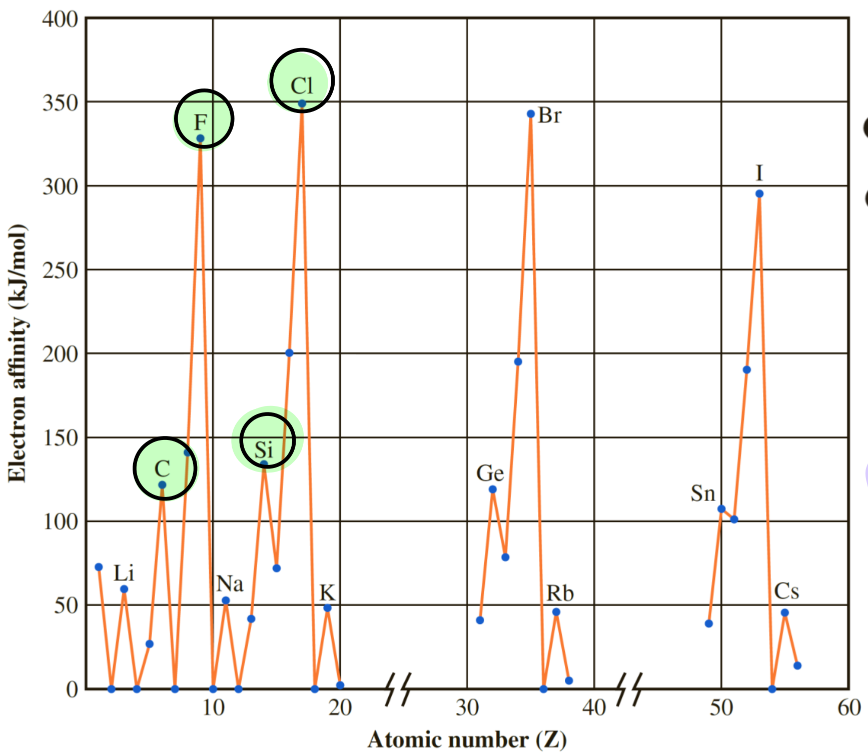
G4 > G5

Electron affinity

$$\mathrm{Ge([Ar]4}s^2 4p^2) + e^- \longrightarrow \mathrm{Ge^-([Ar]4}s^2 4p^3);\ \Delta E = -119\ \mathrm{kJ/mol}\ (\mathrm{EA} = +119\ \mathrm{kJ/mol})$$

$$\mathrm{As([Ar]4}s^2 4p^3) + e^- \longrightarrow \mathrm{As^-([Ar]4}s^2 4p^4);\ \Delta E = -78\ \mathrm{kJ/mol}\ (\mathrm{EA} = +78\ \mathrm{kJ/mol})$$

✓ In the Group 5A element (arsenic, As, in the above list), the added electron must pair up with one of the *np* electrons since all of the *np* orbitals have one electron, whereas in the preceding element the extra electron goes into an empty *np* orbital. This **pairing of electrons in an orbital requires some energy**, resulting in a smaller electron affinity for the Group 5A element compared with the preceding 4A element.



$Ga([Ar]4s^24p^1) + e^- \longrightarrow Ga^-([Ar]4s^24p^2); \Delta E = -41$ kJ/mol (

$Ge([Ar]4s^24p^2) + e^- \longrightarrow Ge^-([Ar]4s^24p^3); \Delta E = -119$ kJ/mol

$As([Ar]4s^24p^3) + e^- \longrightarrow As^-([Ar]4s^24p^4); \Delta E = -78$ kJ/mol (

$Se([Ar]4s^24p^4) + e^- \longrightarrow Se^-([Ar]4s^24p^5); \Delta E = -195$ kJ/mol

$Br([Ar]4s^24p^5) + e^- \longrightarrow Br^-([Ar]4s^24p^6); \Delta E = -325$ kJ/mol

Group 1 > 2
Group 4 > 5
Group 8 =zero
period 2 < 3

Exceptions

- ✓ In a given period, the electron affinity rises from the Group 1A element to the Group 7A element but with sharp drops in the Group 2A and Group 5A elements.
- ✓ Group 8A elements (noble gases) have zero or small negative values (indicating unstable negative ions)
- ✓ Group 6A and Group 7A elements have the largest electron affinities of any of the other main-group elements

Learning Objectives	Important Terms
8.1 Electron Spin and the Pauli Exclusion Principle	
■ Define *electron configuration* and *orbital diagram.* ■ State the Pauli exclusion principle. ■ Apply the Pauli exclusion principle. **Example 8.1**	**electron configuration** **orbital diagram** **Pauli exclusion principle**
8.2 Building-Up Principle and the Periodic Table	
■ Define *building-up principle.* ■ Define *noble-gas core, pseudo-noble-gas core,* and *valence electron.* ■ Define *main-group element* and *(d-block* and *f-block) transition element.*	**building-up (Aufbau) principle** **noble-gas core** **pseudo-noble-gas core** **valence electron**
8.3 Writing Electron Configurations Using the Periodic Table	
■ Determine the configuration of an atom using the building-up principle. **Example 8.2** ■ Determine the configuration of an atom using the period and group numbers. **Example 8.3**	
8.4 Orbital Diagrams of Atoms; Hund's Rule	
■ State Hund's rule. ■ Apply Hund's rule. **Example 8.4** ■ Define *paramagnetic substance* and *diamagnetic substance.*	**Hund's rule** **paramagnetic substance** **diamagnetic substance**
8.5 Mendeleev's Predictions from the Periodic Table	
■ Describe how Mendeleev predicted the properties of undiscovered elements.	
8.6 Some Periodic Properties	
■ State the periodic law. ■ State the general periodic trends in size of atomic radii. ■ Define *effective nuclear charge.* ■ Determine relative atomic sizes from periodic trends. **Example 8.5** ■ State the general periodic trends in ionization energy. ■ Define *first ionization energy.* ■ Determine relative ionization energies from periodic trends. **Example 8.6** ■ Define *electron affinity.* ■ State the broad general trend in electron affinity across any period.	**periodic law** **atomic radius** **effective nuclear charge** **first ionization energy (first ionization potential)** **electron affinity**
8.7 Periodicity in the Main-Group Elements	
■ Define *basic oxide, acidic oxide,* and *amphoteric oxide.* ■ State the main group corresponding to an *alkali metal,* an *alkaline earth metal,* a *chalcogen, a halogen,* and *a noble gas.* ■ Describe the change in metallic/nonmetallic character (or reactivities) in going through any main group of elements.	**basic oxide** **acidic oxide** **amphoteric oxide**

thank YOU so much

Done by: Joud Jaber