Química
Propriedades Periódicas

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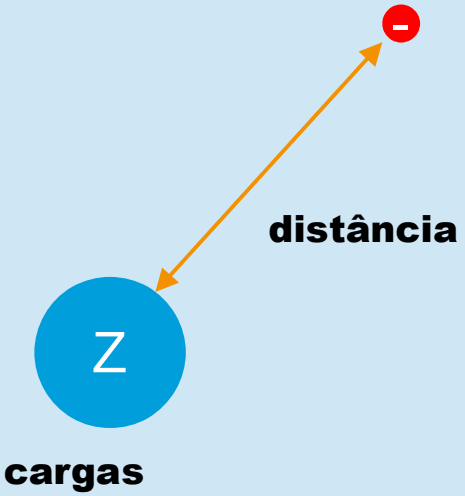
Elétrons de valência

- Como vimos, há dois tipos de elétrons:
  - Elétrons do caroço (configuração de gás nobre);
  - Elétrons de valência (todos os outros).
- A força de atração entre elétrons de valência e o núcleo determina muitas das propriedades dos elementos, inclusive o grau e o tipo de reatividade;
- Sendo uma força eletrostática, ela depende de dois fatores:
  - Da **distância** média dos elétrons de valência ao núcleo;
  - Da **carga** que efetivamente os elétrons de valência sentem ao interagir com o núcleo.
- Através desses dois fatores também podemos entender e fazer previsões com os padrões evidenciados pela tabela periódica: as chamadas propriedades periódicas.



CARGA NUCLEAR EFETIVA

- EM ÁTOMOS COM 1 ELÉTRON A ENERGIA SÓ DEPENDE DE n E Z, O NÚMERO DE PRÓTONS (CARGAS POSITIVAS) NO NÚCLEO:

$$E = -\frac{13{,}6\,eV \cdot Z^2}{n^2}$$

EM ÁTOMOS COM MAIS DE UM ELÉTRON A PRESENÇA DE ELÉTRONS MAIS PRÓXIMOS DO NÚCLEO BLINDA-O DOS MAIS DISTANTES

ASSIM, ESSES ELÉTRONS "SENTEM" UMA CARGA Z_{ef} EFETIVA MENOR QUE Z:

$$E = -\frac{13{,}6\,eV \cdot Z_{ef}^2}{n^2}$$

- ESSA BLINDAGEM SE DEVE A PENETRAÇÃO DE SUBNÍVEIS EM UM MESMO NÍVEL, E A ELÉTRONS EM ORBITAIS COM MENOR ENERGIA QUE A DO ELÉTRON NO ORBITAL MAIS DISTANTE
- ELÉTRONS DO CAROÇO BLINDAM FORTEMENTE O NÚCLEO. DOS ELÉTRONS DE VALÊNCIA. EM CERTO NÍVEL DE APROXIMAÇÃO PODEMOS DIZER QUE A CARGA NUCLEAR É SUBTRAÍDA DA CARGA DOS ELÉTRONS DO CAROÇO PARA OS ELÉTRONS DE VALÊNCIA: OU SEJA, EQUIVALE A UM ÁTOMO HIDRÓGENOIDE COM CARGA NUCLEAR Z_{ef} AO INVÉS DE Z:

ELÉTRONS DO CAROÇO

ELÉTRONS DE VALÊNCIA

CHAMADA DE APROXIMAÇÃO ORBITAL

$$Z_{ef} \cong Z - C$$

Ex.: Li ($Z = 3$): $1s^2$ | $2s^1$ (C | V)

Li ($Z = 3$): $1s^2 2s^1$

Be ($Z = 4$): $1s^2 2s^2$

Na ($Z = 11$): $1s^2 2s^2 2p^6 3s^1$

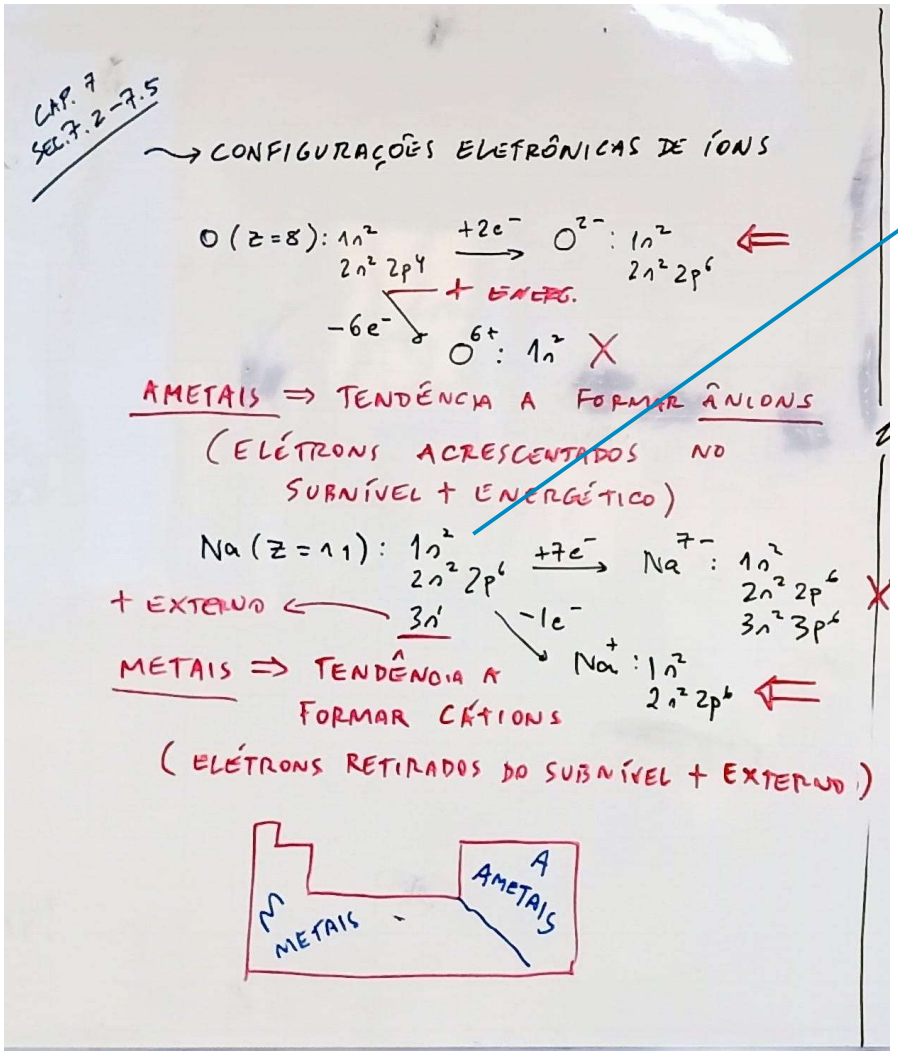
Z_{ef} AUMENTA

n EXT ~ CONSTANTE

FORÇA DIMINUI

FORÇA AUMENTA

$Z_{ef} \propto \frac{1}{r}$

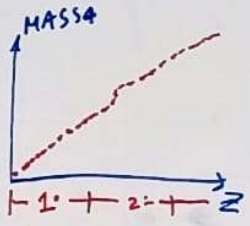


Usar exemplo do Fe

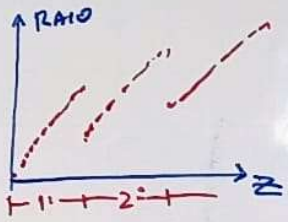
TABLE 1.4 Characteristics of Metals and Nonmetals

Metals	Nonmetals
Physical properties	
good conductors of electricity	poor conductors of electricity
malleable	not malleable
ductile	not ductile
lustrous	not lustrous
typically: solid; high melting point;	typically: solid, liquid, or gas; low melting
good conductors of heat	point; poor conductors of heat
Chemical properties	
react with acids	do not react with acids
form basic oxides (which react with acids)	form acidic oxides (which react with bases)
form cations	form anions
form ionic halides	form covalent halides

✳ PROPRIEDADES PERIÓDICAS



NÃO PERIÓDICA
(INDEPENDE DO PERÍODO)



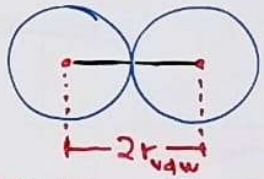
PERIÓDICA
(DEPENDE DO PERÍODO)

- **RAIO ATÔMICO**: OBTIDO A PARTIR DA DISTÂNCIA ENTRE NÚCLEOS, A DEPENDER DO TIPO DE LIGAÇÃO ENTRE OS ÁTOMOS

— ÁTOMOS NEUTROS

↝ NÃO LIGADOS

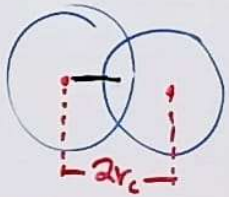
GASES NOBRES



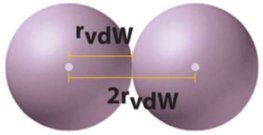
RAIO DE VAN DER WAALS

↝ LIGADOS

AMETAIS

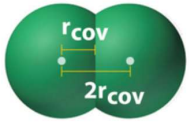


RAIO COVALENTE



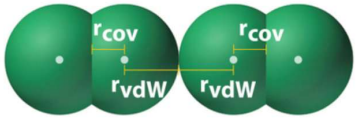
2Ar(s)

(c) van der Waals radius, r_{vdW}



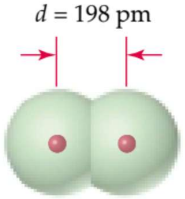
$Cl_2(g)$

(a) Covalent radius, r_{cov}

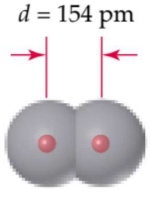


$2Cl_2(s)$

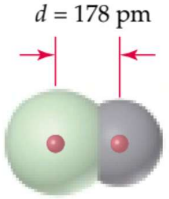
(d) Covalent vs. vdW radii



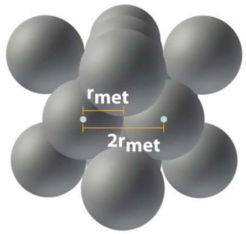
$\frac{d}{2}$ = 99 pm



$\frac{d}{2}$ = 77 pm

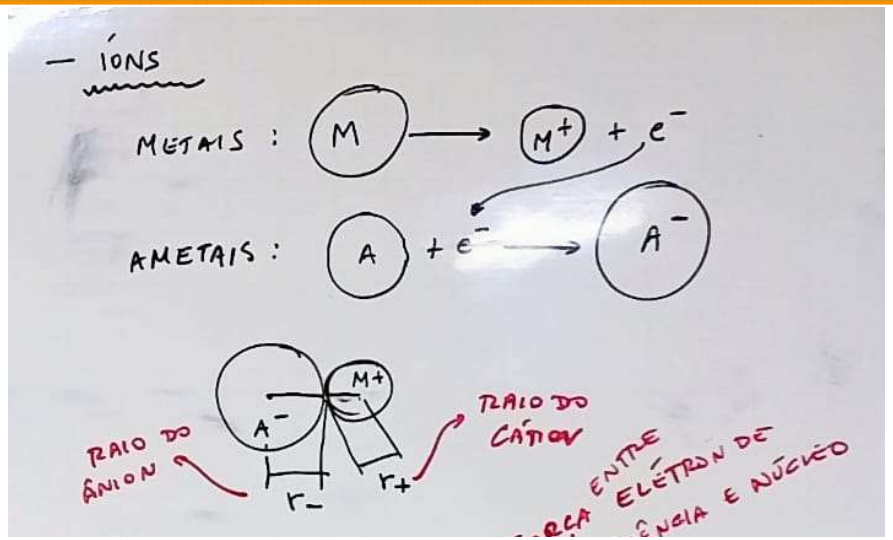


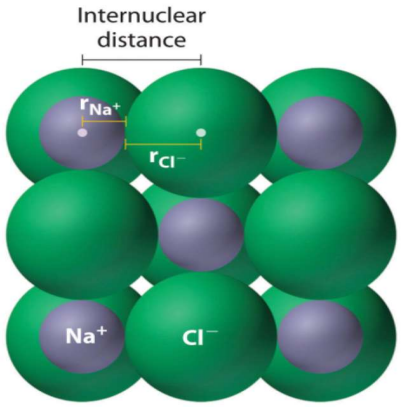
(99 pm + 77 pm = 176 pm) predicted



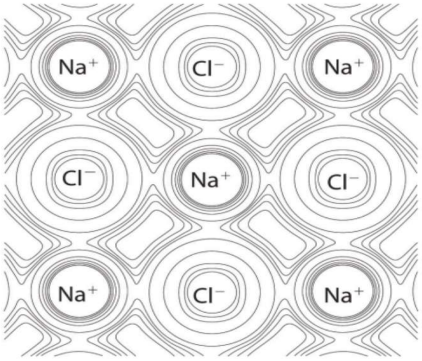
Al(s)

(b) Metallic radius, r_{met}



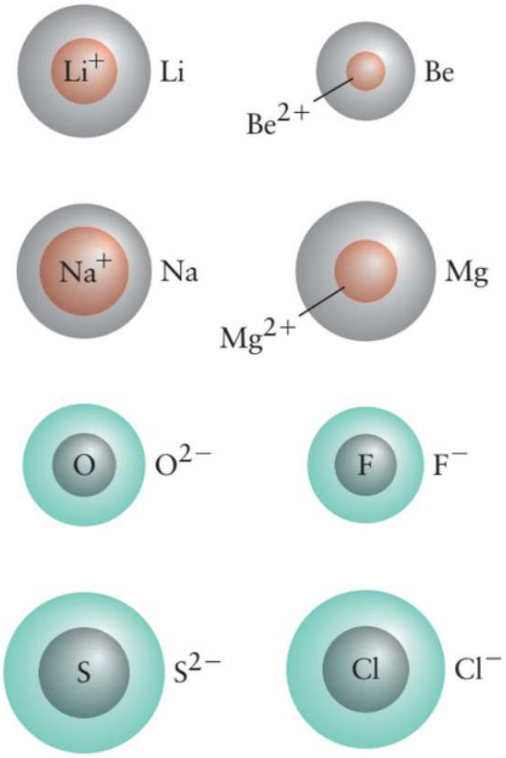


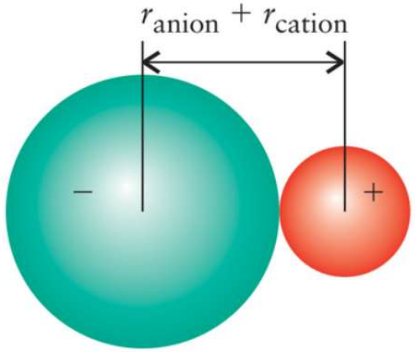
(a)



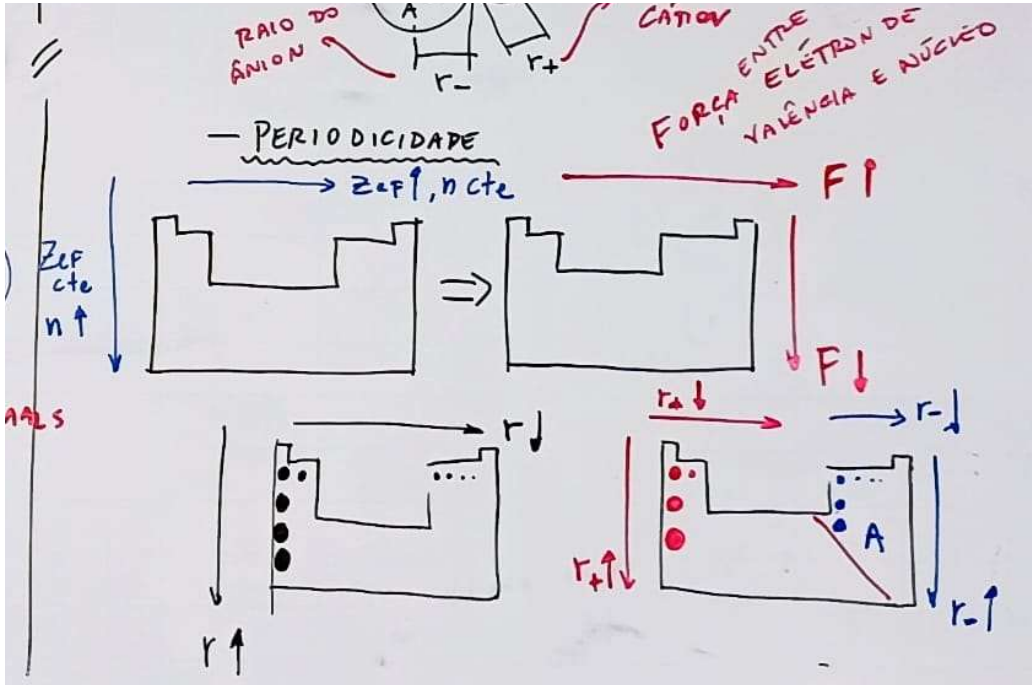
(b)

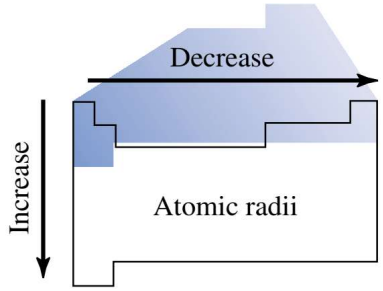
(a) The internuclear distance is apportioned between adjacent cations and anions in the ionic structure, as shown



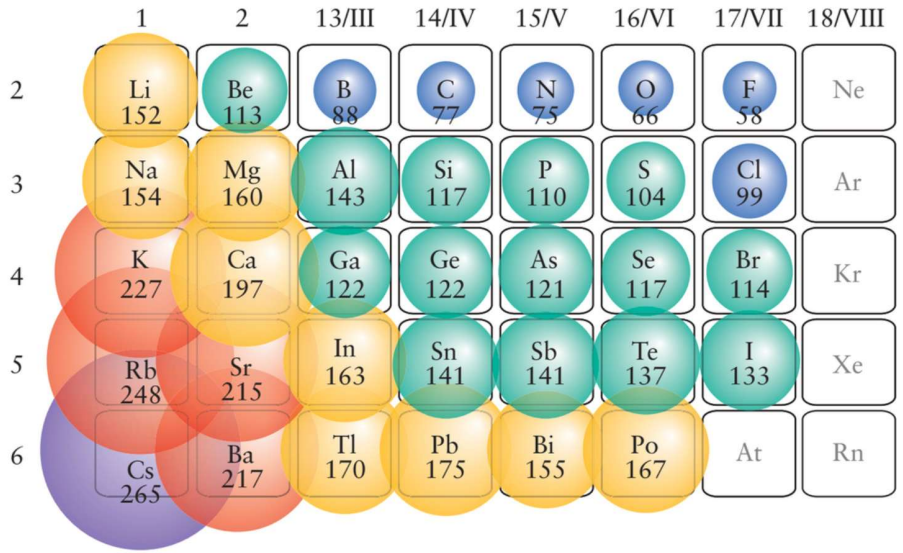


12 Ionic radius





General trends in atomic radii of A group elements with position in the periodic table.



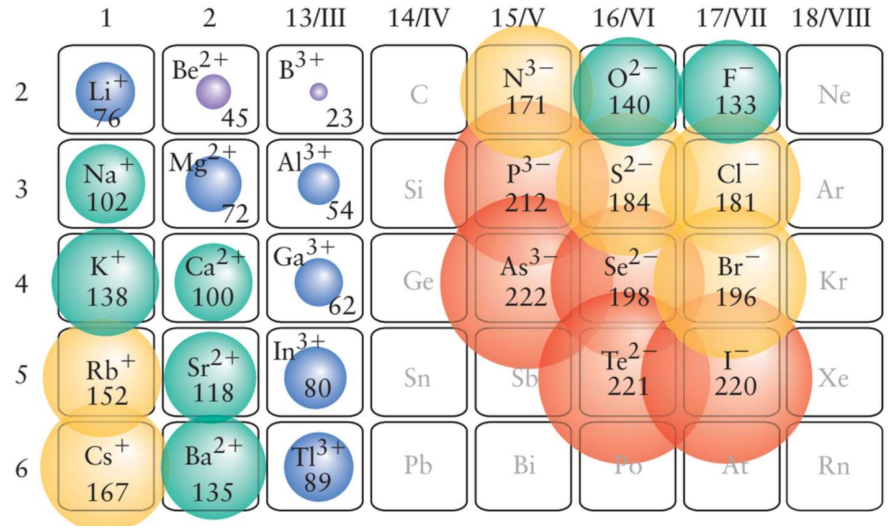
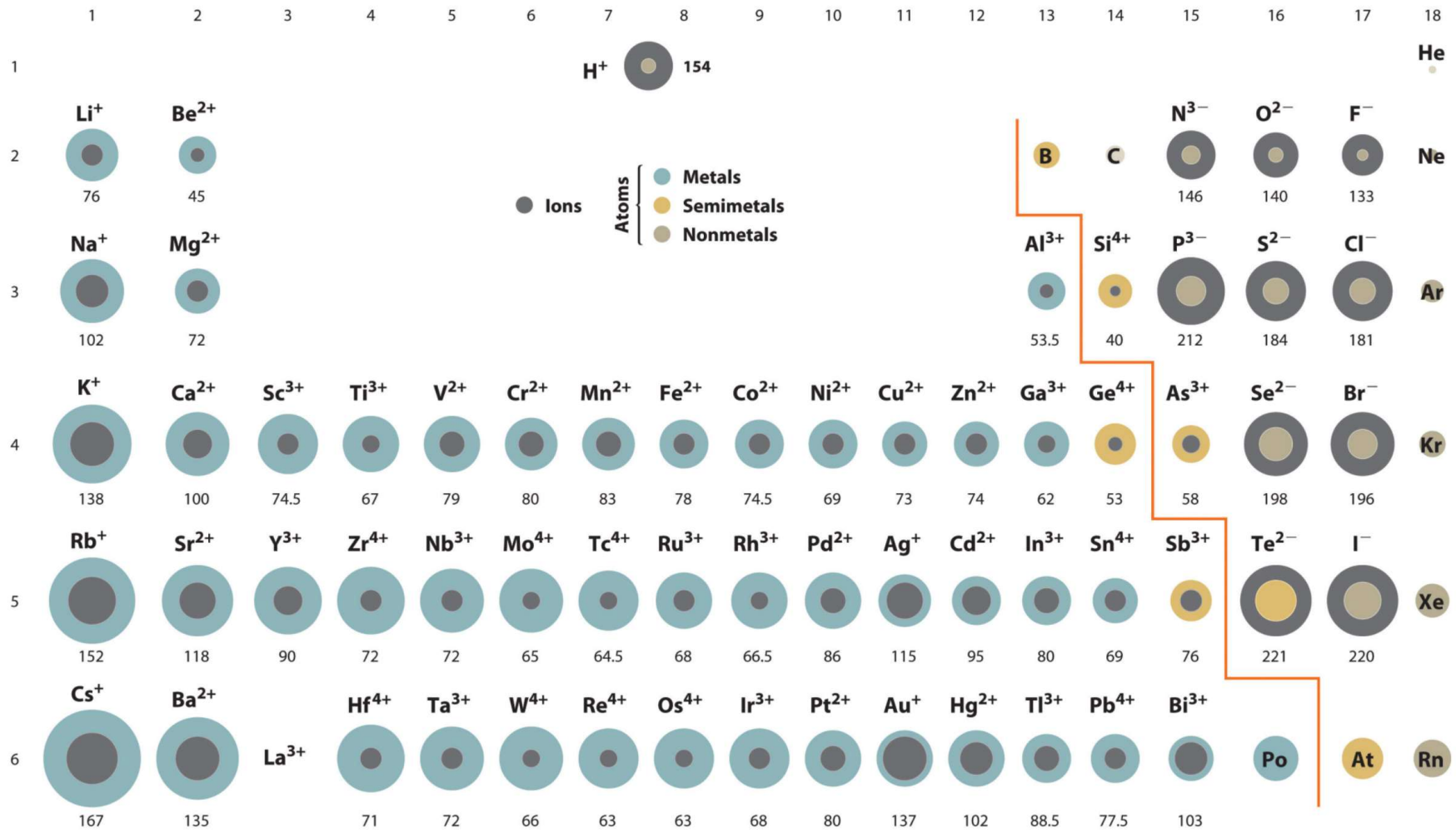


Figure 7.9 *Ionic Radii (in Picometers) of the Most Common Oxidation States of the s-, p-, and d-Block Elements*



- ENERGIA DE IONIZAÇÃO { POSITIVA, FORMAÇÃO DE CÁTIONS

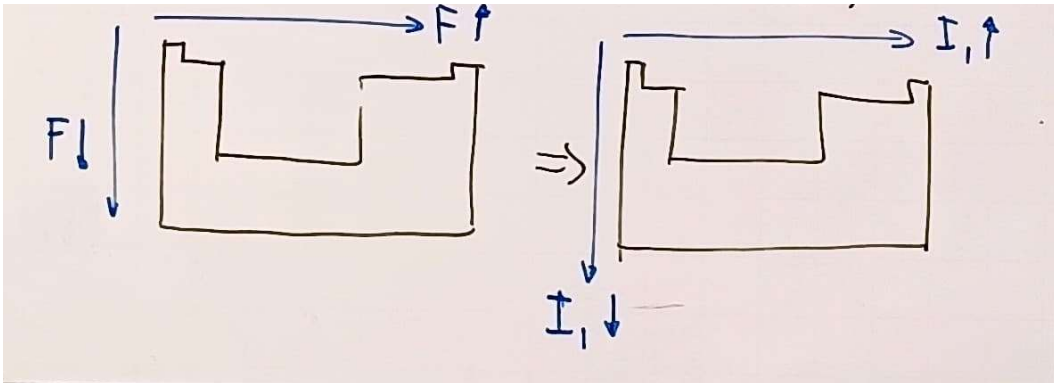
  - ENERGIA P/ RETIRAR e^- DO ÁTOMO NA FASE GASOSA

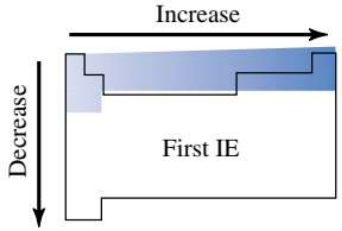
ÁTOMO ⟶ CÁTION + e^-	I

$Mg: 1s^2\ 2s^2\ 2p^6\ 3s^2 \xrightarrow{I_1} Mg^+: 1s^2\ 2s^2\ 2p^6\ 3s^1 \xrightarrow{I_2} Mg^{2+}: 1s^2\ 2s^2\ 2p^6 \xrightarrow{I_3} Mg^{3+}: 1s^2\ 2s^2\ 2p^5$

$I_3 \gg I_2 > I_1$

I_3: ELÉTRONS DO CAROÇO





General trends in first ionization energies of A group elements with position in the periodic table. Exceptions occur at Groups IIIA and VIA.

É PRECISO MAIS ENERGIA P/ RETIRAR e^- DE AMETAIS QUE DE METAIS: METAIS = I_1 BAIXO; AMETAIS = I_1 ALTO

TABLE 6-1 *First Ionization Energies (kJ/mol of atoms) of Some Elements*

H 1312																	He 2372
Li 520	Be 899											B 801	C 1086	N 1402	O 1314	F 1681	Ne 2081
Na 496	Mg 738											Al 578	Si 786	P 1012	S 1000	Cl 1251	Ar 1521
K 419	Ca 599	Sc 631	Ti 658	V 650	Cr 652	Mn 717	Fe 759	Co 758	Ni 757	Cu 745	Zn 906	Ga 579	Ge 762	As 947	Se 941	Br 1140	Kr 1351
Rb 403	Sr 550	Y 617	Zr 661	Nb 664	Mo 685	Tc 702	Ru 711	Rh 720	Pd 804	Ag 731	Cd 868	In 558	Sn 709	Sb 834	Te 869	I 1008	Xe 1170
Cs 377	Ba 503	La 538	Hf 681	Ta 761	W 770	Re 760	Os 840	Ir 880	Pt 870	Au 890	Hg 1007	Tl 589	Pb 715	Bi 703	Po 812	At 890	Rn 1037

É PRECISO MAIS ENERGIA P/ RETIRAR e^- DE AMETAIS QUE DE METAIS: METAIS = I_1 BAIXO; AMETAIS = I_1 ALTO

- AFINIDADE ELETRÔNICA
  - NEGATIVA (GERALMENTE)
  - FORMAÇÃO DE ÂNIONS

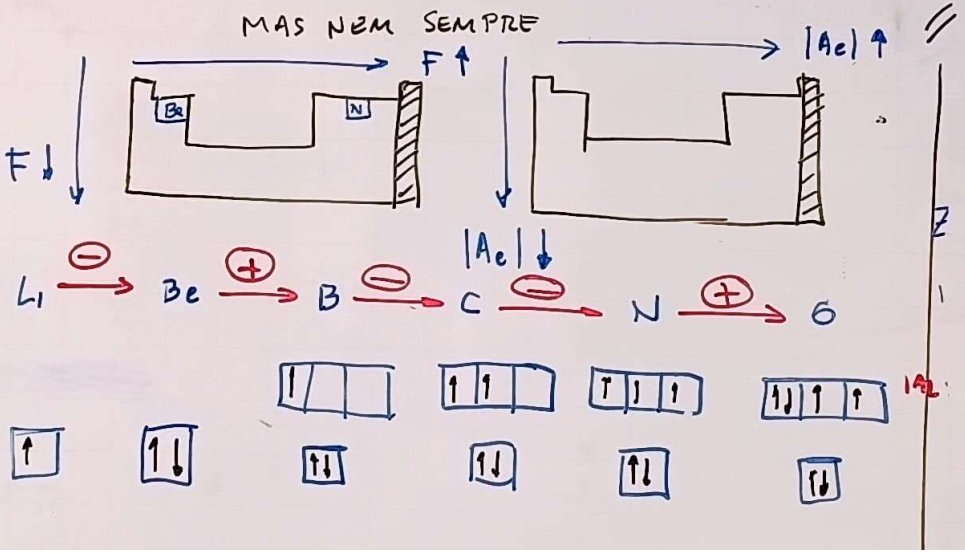
– ENERGIA ASSOCIADA À ADIÇÃO DE 1e^- A UM ÁTOMO

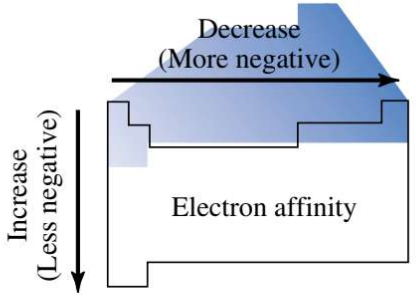
ÁTOMO + e^- ⟶ ÂNION

A_e

– NORMALMENTE $A_e < 0$ (PROCESSO ESPONTÂNEO)

MAS NEM SEMPRE

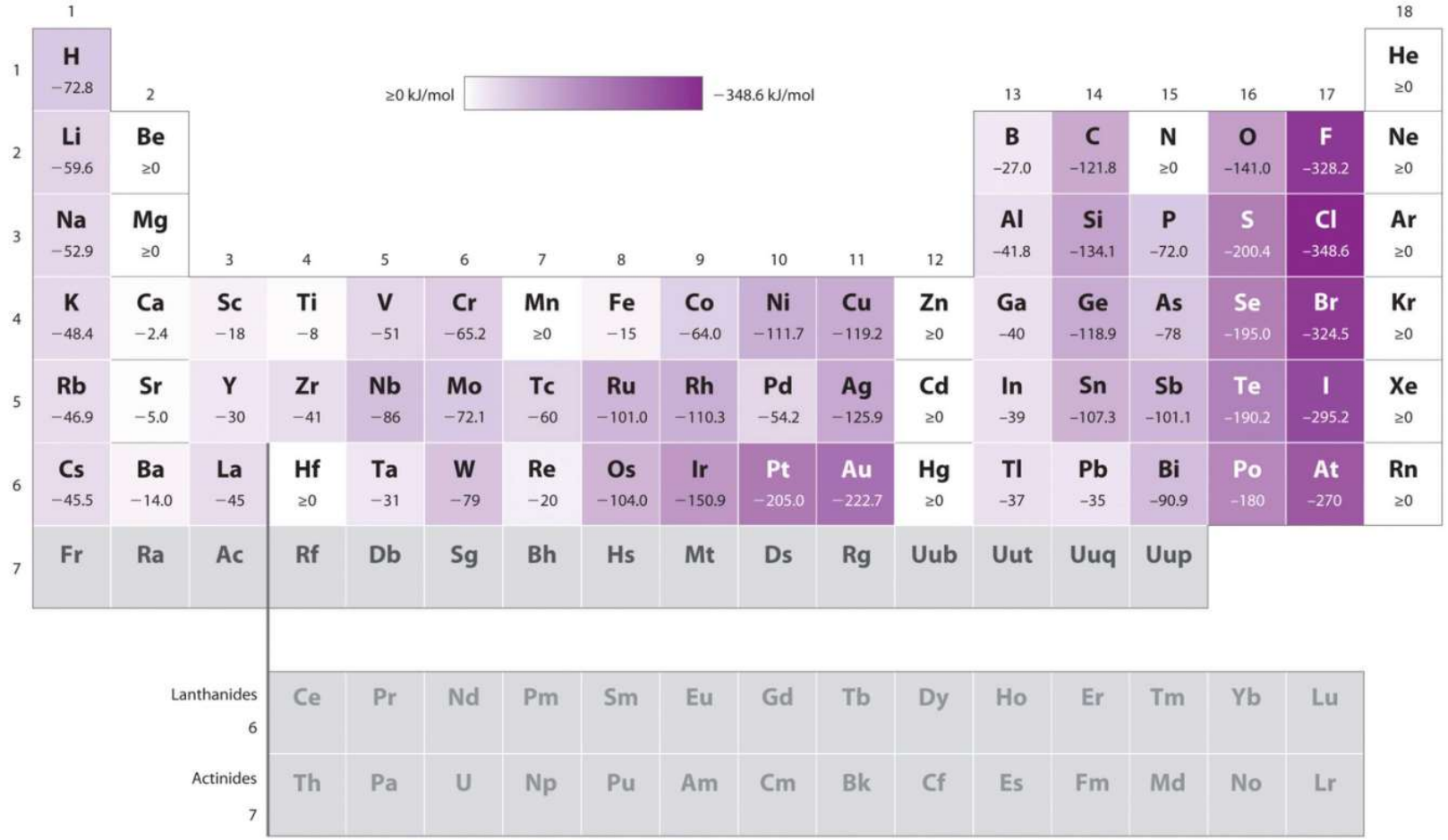




General trends in electron affinities of A group elements with position in the periodic table. There are many exceptions.

1	H −73																He 0
2	Li −60	Be (~0)										B −29	C −122	N 0	O −141	F −328	Ne 0
3	Na −53	Mg (~0)										Al −43	Si −134	P −72	S −200	Cl −349	Ar 0
4	K −48	Ca (~0)										Ga −29	Ge −119	As −78	Se −195	Br −324	Kr 0
5	Rb −47	Sr (~0)										In −29	Sn −107	Sb −101	Te −190	I −295	Xe 0
6	Cs −45	Ba (~0)										Tl −19	Pb −35	Bi −91			

Figure 7.13 *Electron Affinities (in kJ/mol) of the s-, p-, and d-Block Elements*



Bons estudos!