

# Tema 3

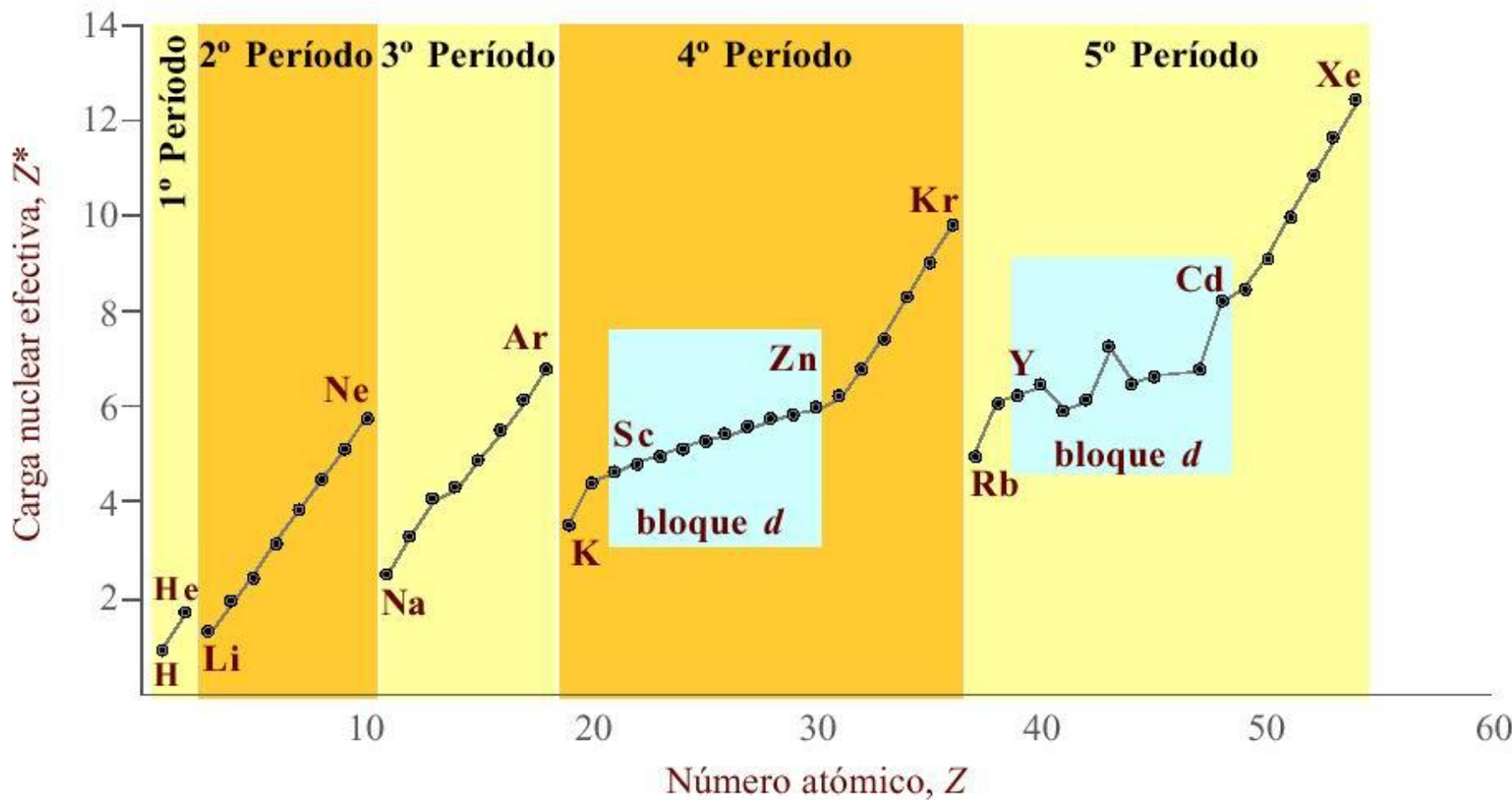
## La tabla periódica

- La tabla periódica: descripción general.
- Propiedades periódicas: radio atómico, energía de ionización, afinidad electrónica, electronegatividad.

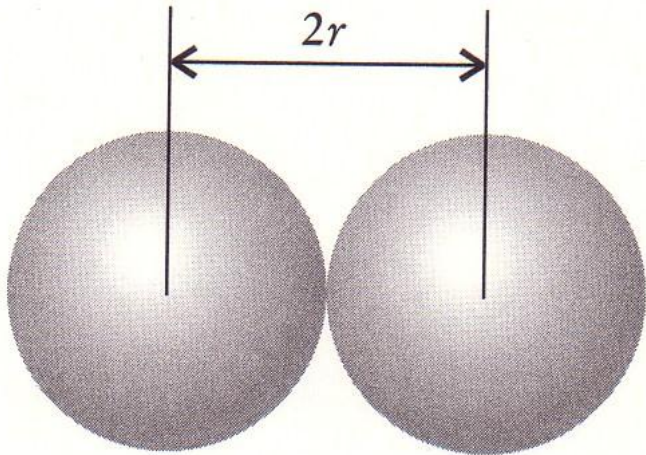
## La Tabla Periódica moderna

		Group number																																													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18																												
Hydrogen and <i>s</i> -Block elements		H																	He																												
		Li	Be											B	C	N	O	F	Ne																												
		Na	Mg											Al	Si	P	S	Cl	Ar																												
		K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr																												
		Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe																												
		Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn																												
		Fr	Ra	Ac																																											
Lanthanoids	<table><tr><td>Ce</td><td>Pr</td><td>Nd</td><td>Pm</td><td>Sm</td><td>Eu</td><td>Gd</td><td>Tb</td><td>Dy</td><td>Ho</td><td>Er</td><td>Tm</td><td>Yb</td><td>Lu</td></tr><tr><td>Th</td><td>Pa</td><td>U</td><td>Np</td><td>Pu</td><td>Am</td><td>Cm</td><td>Bk</td><td>Cf</td><td>Es</td><td>Fm</td><td>Md</td><td>No</td><td>Lr</td></tr></table>																			Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu																																		
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr																																		
Actinoids																																															
		<i>f</i> -Block elements																																													

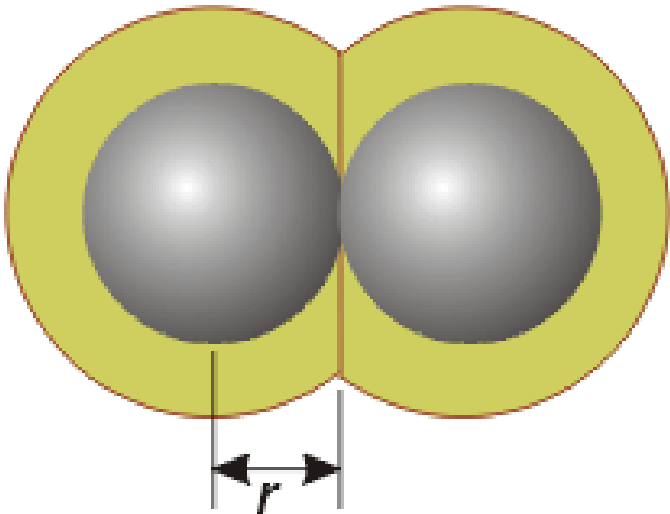
# Carga nuclear efectiva frente a número atómico



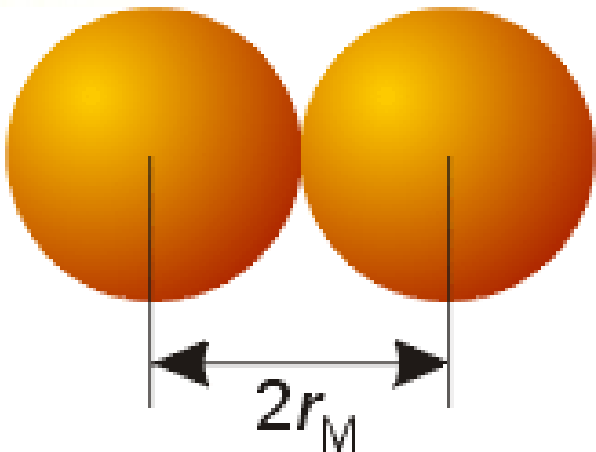
Radio atómico



15 Radio atómico

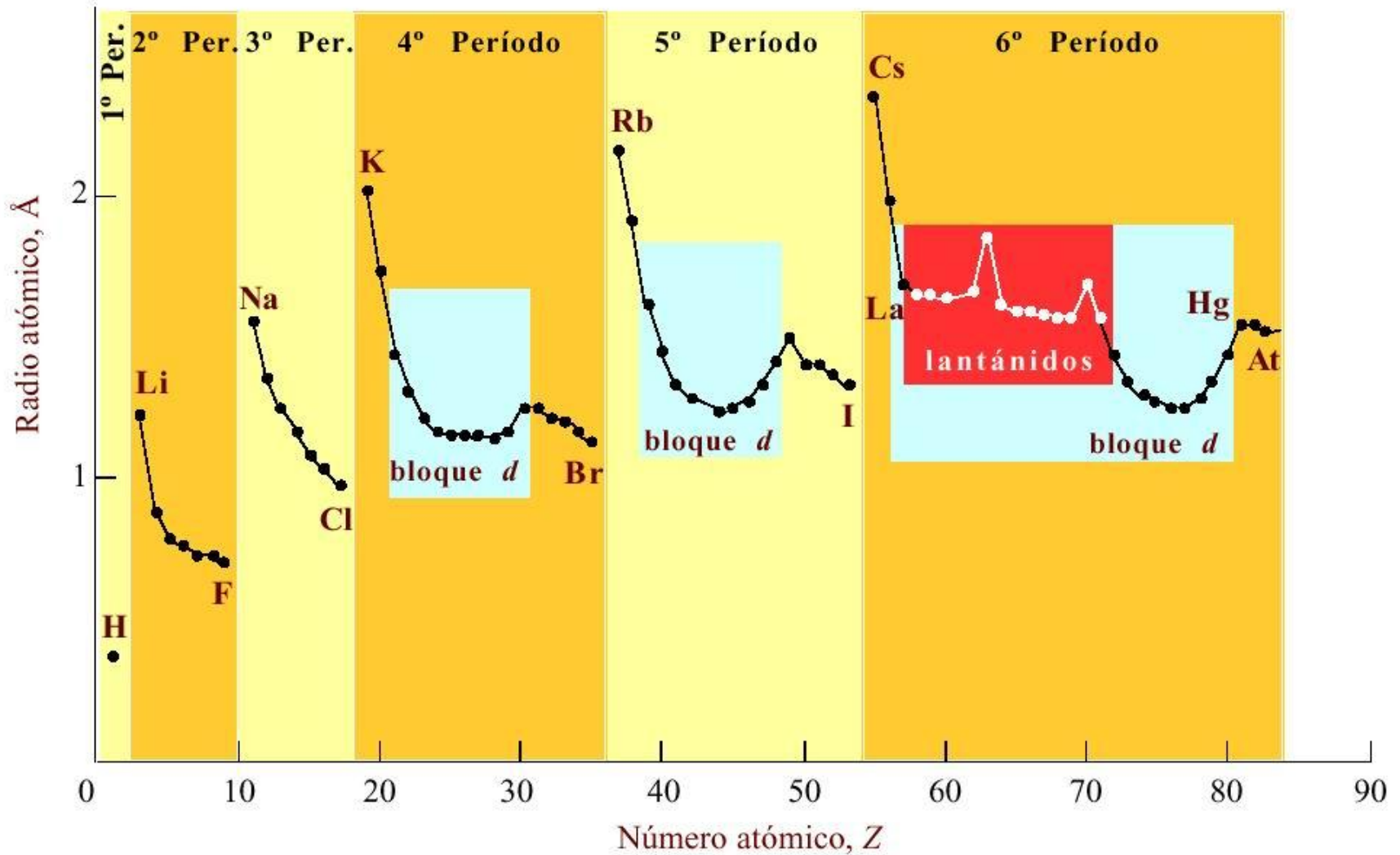


2 Covalent radius



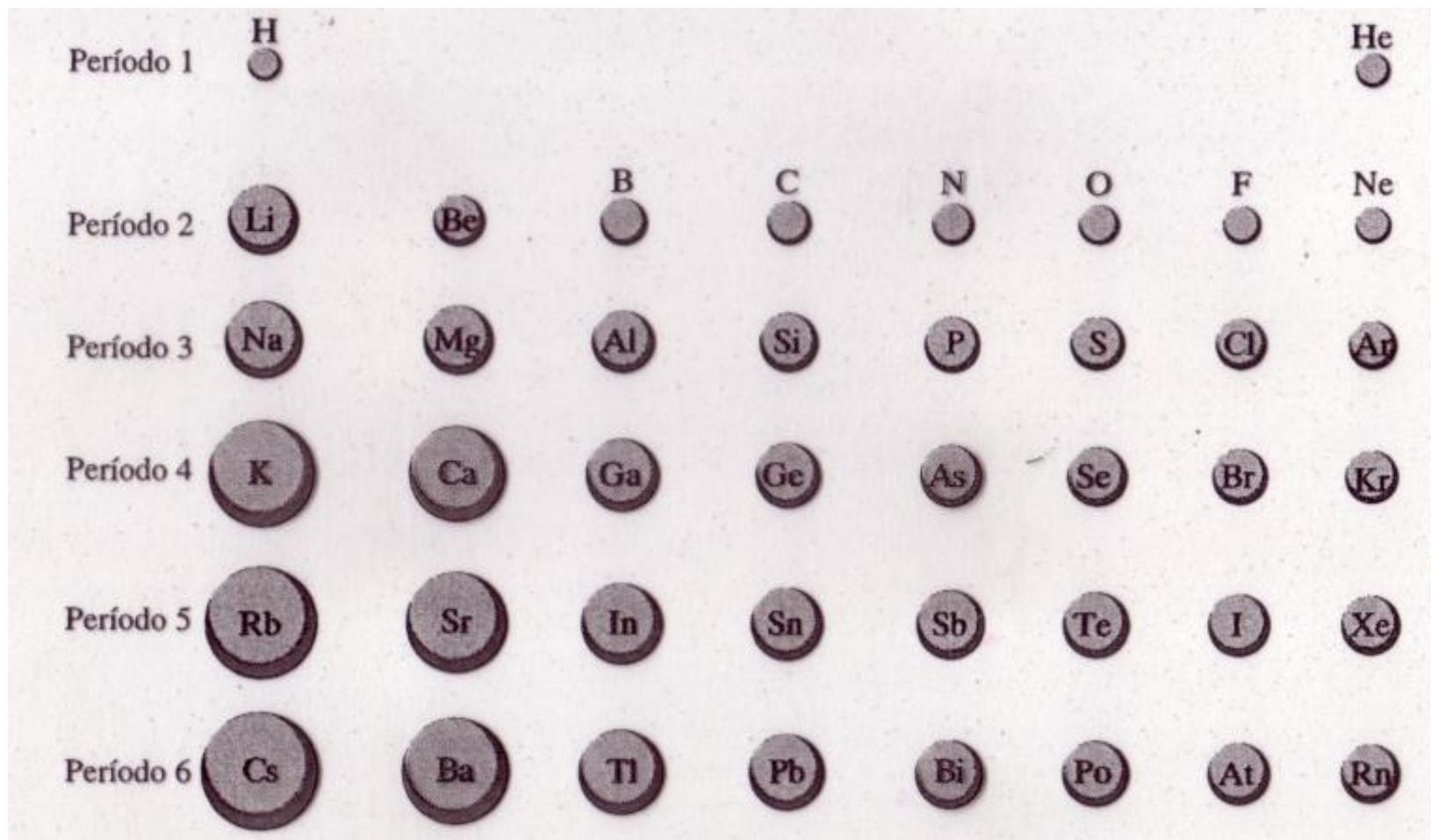
1 Metallic radius

## Radio atómico frente a número atómico



## Propiedades periódicas: radio atómico

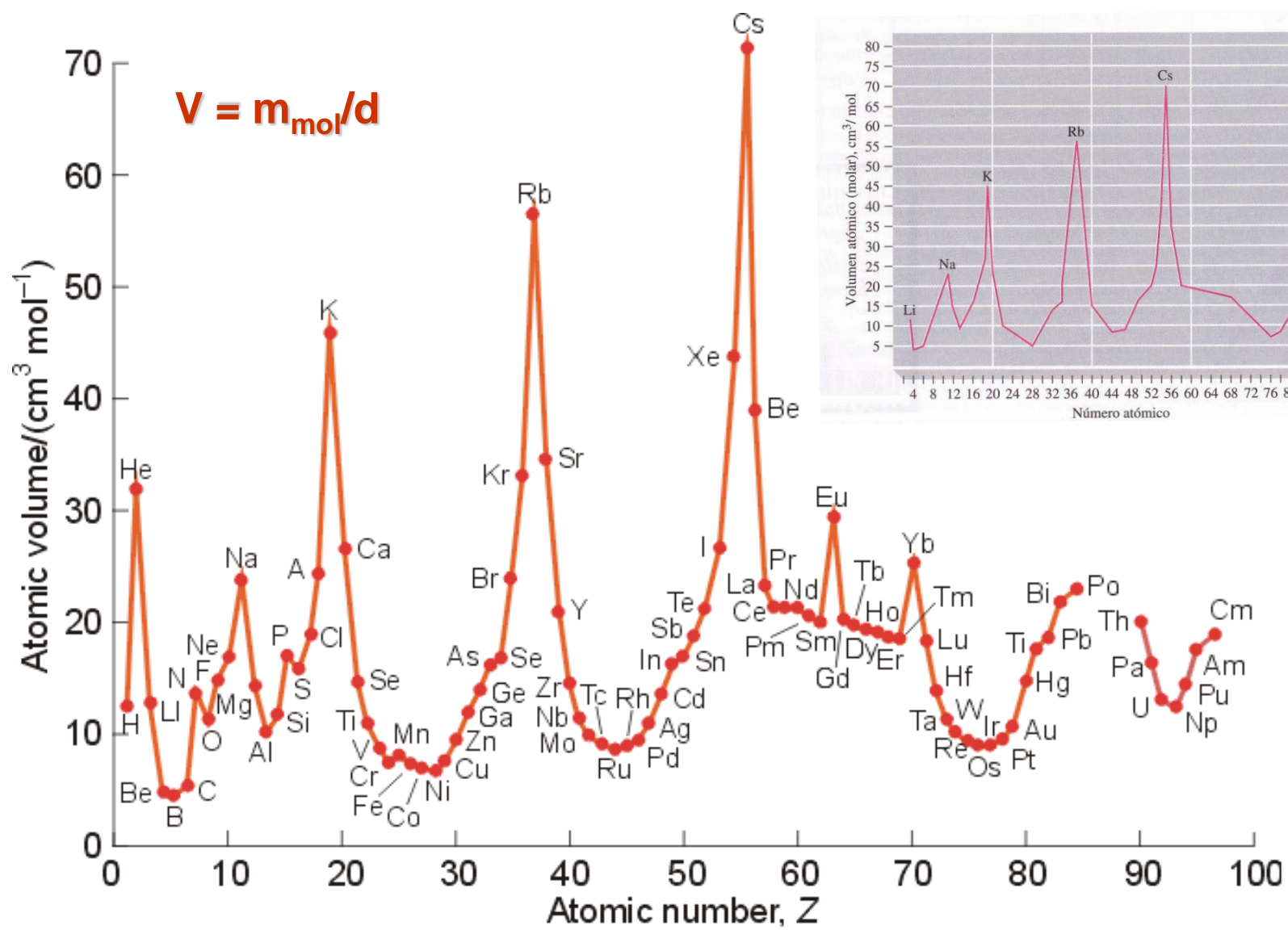
### Radio atómico: evolución periódica



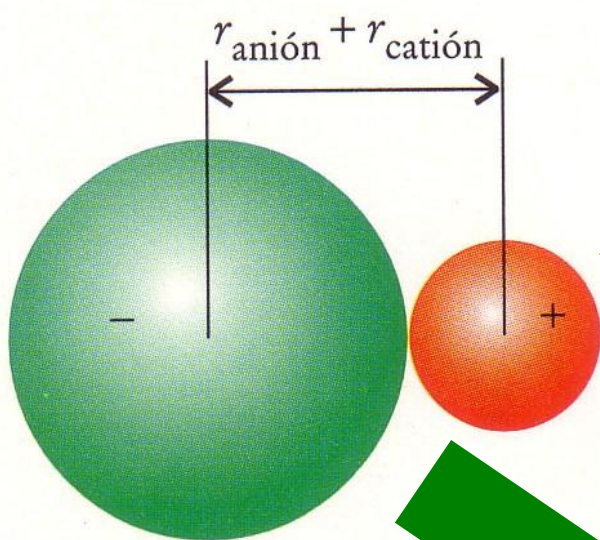
Período 1	H							He
Período 2	Li	Be	B	C	N	O	F	Ne
Período 3	Na	Mg	Al	Si	P	S	Cl	Ar
Período 4	K	Ca	Ga	Ge	As	Se	Br	Kr
Período 5	Rb	Sr	In	Sn	Sb	Te	I	Xe
Período 6	Cs	Ba	Tl	Pb	Bi	Po	At	Rn



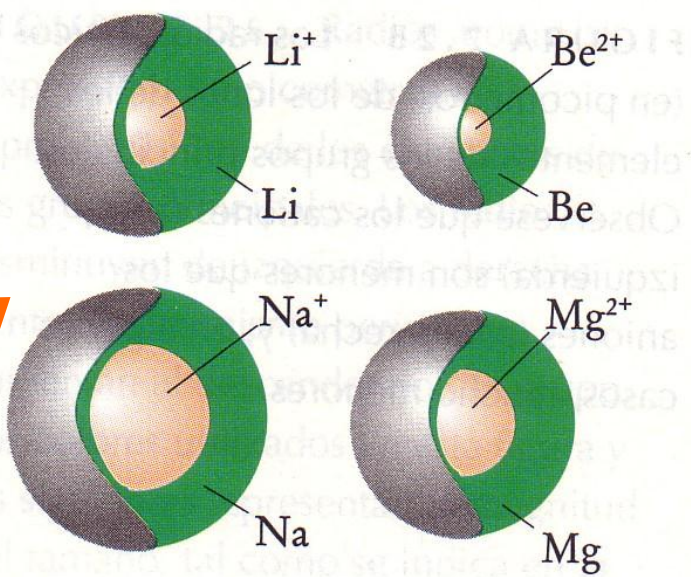
Volumen atómico frente a número atómico



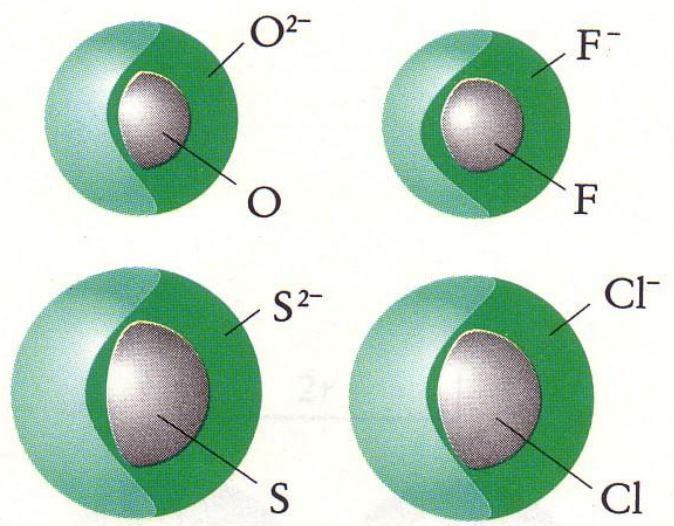
Radio iónico



16 Radio iónico

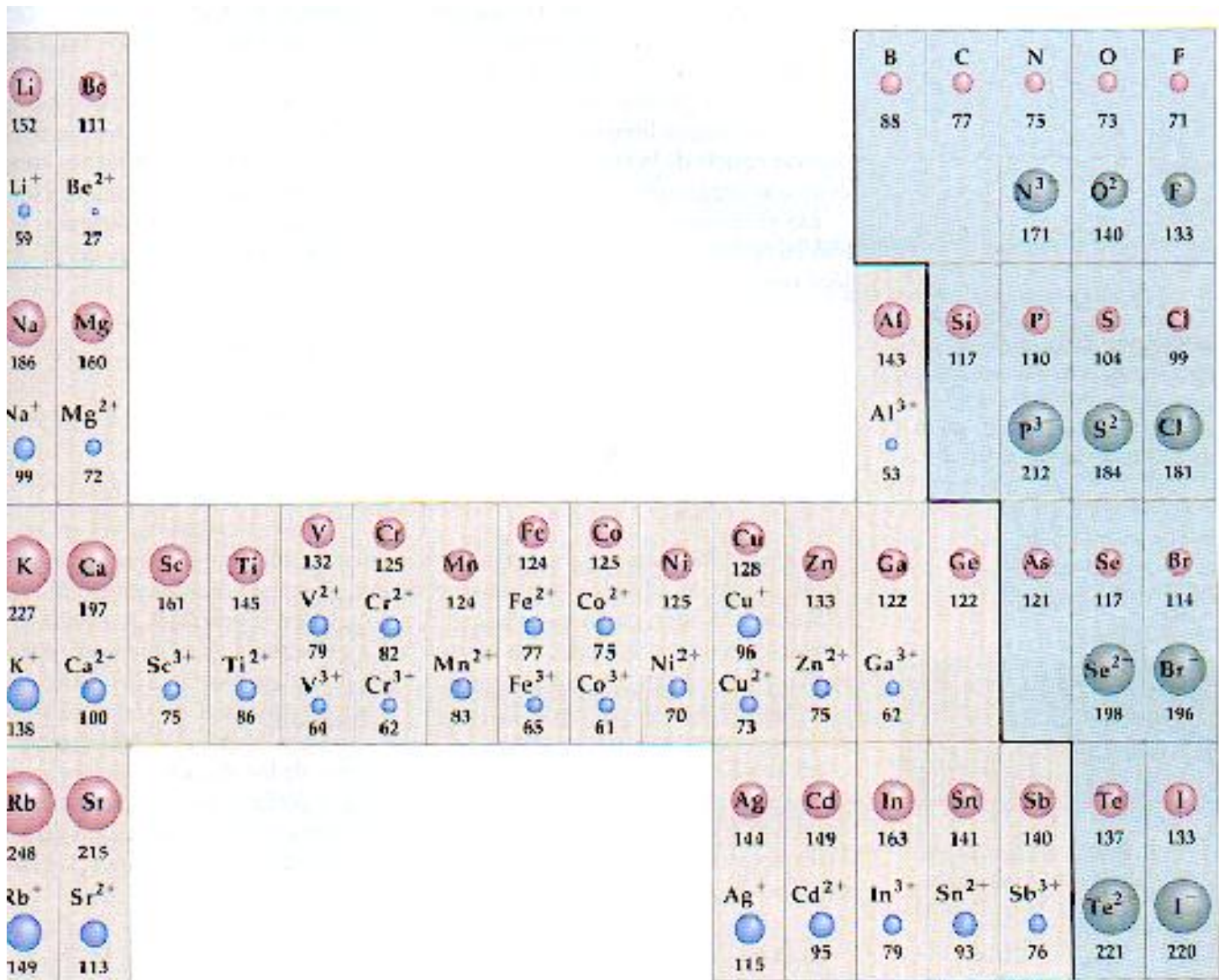


100 pm



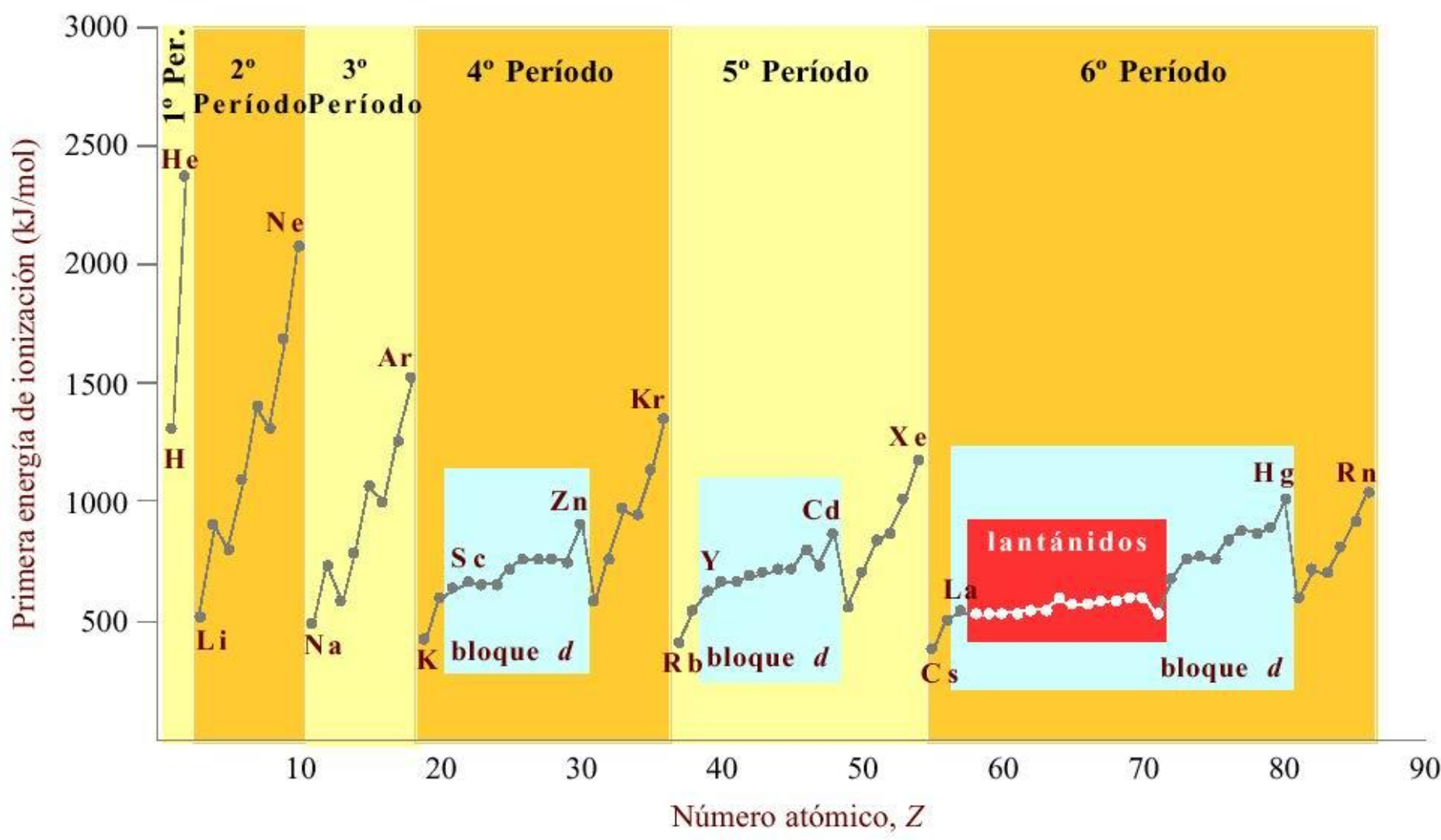


Radio iónicos: evolución periódica

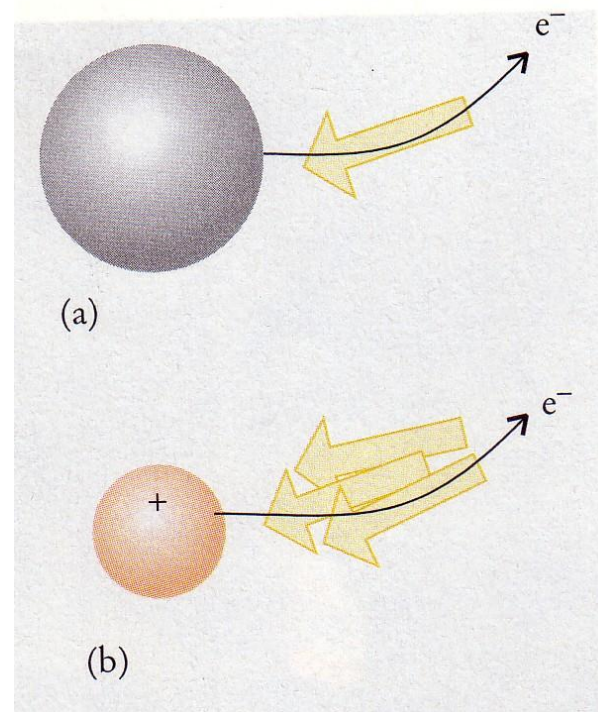
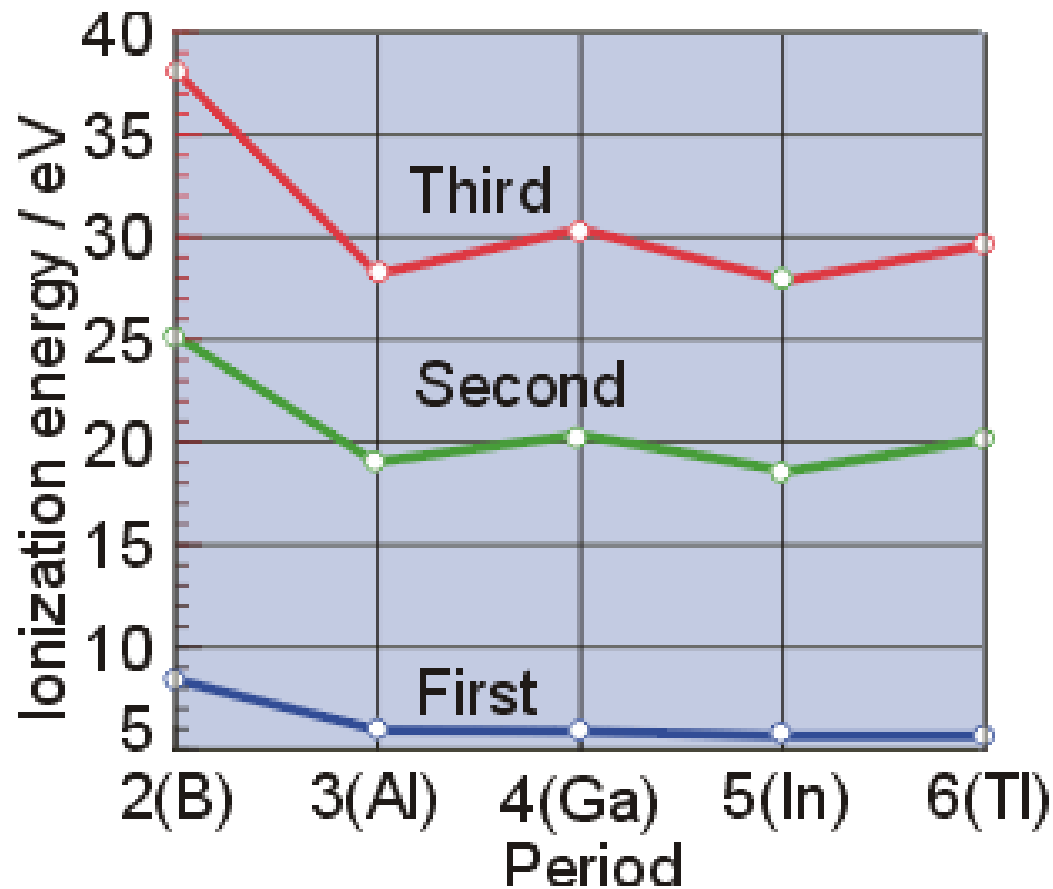


Propiedades periódicas: energía de ionización

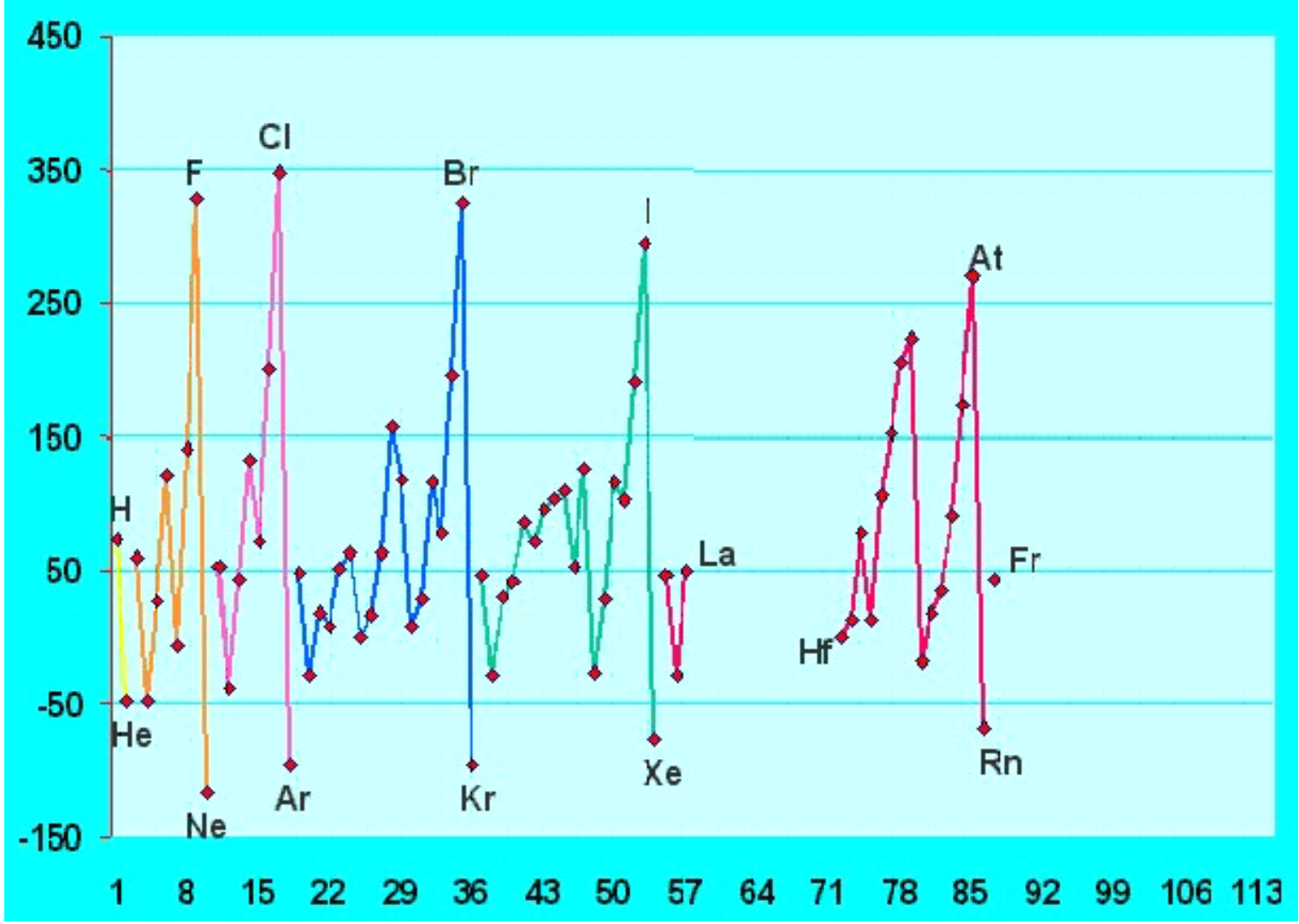
Primera energía de ionización frente al número atómico



**Primer, segundo y tercer potencial de ionización**

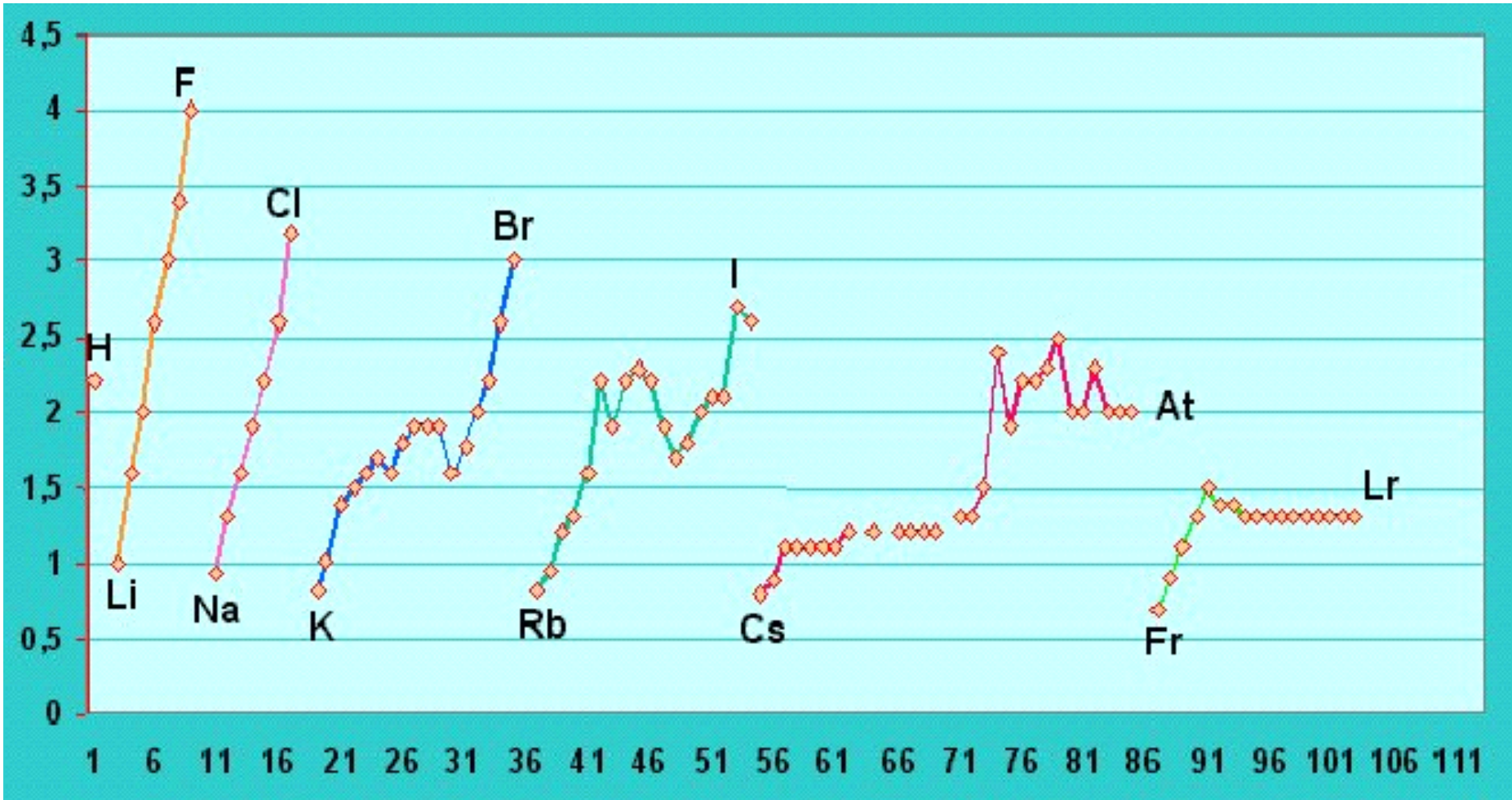


Afinidad electrónica frente al número atómico





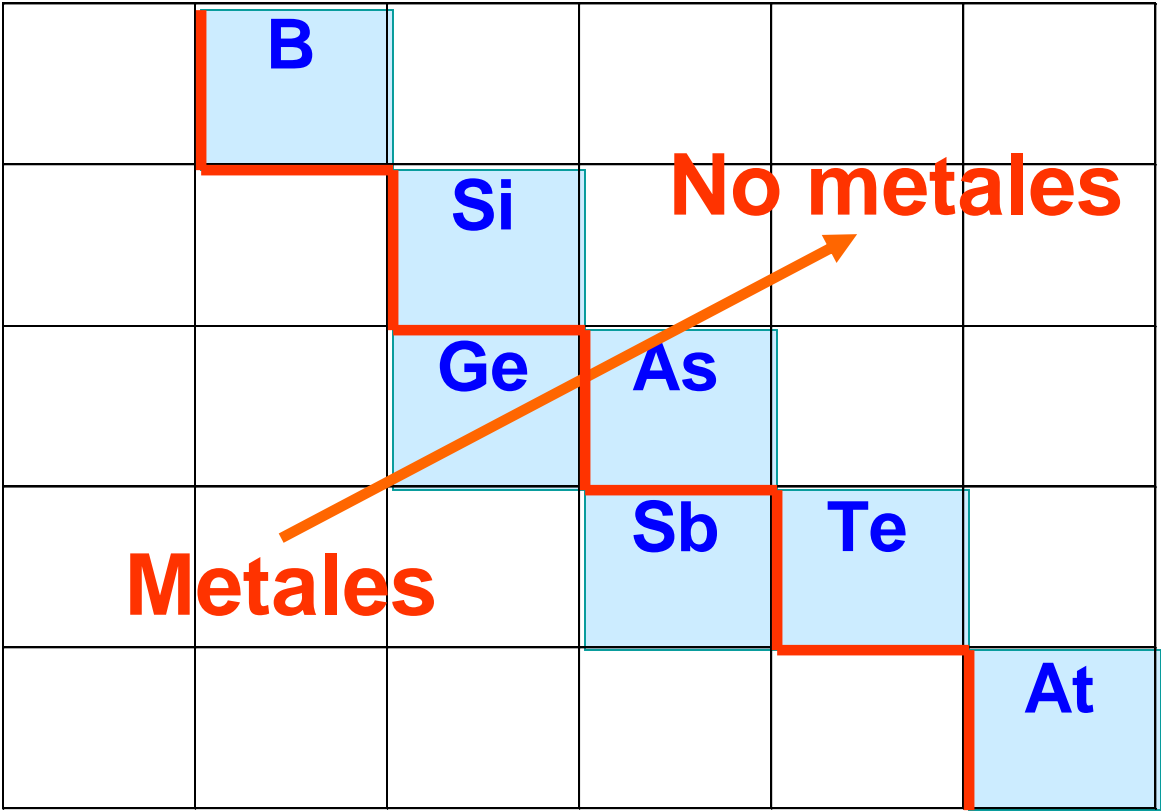
Electronegatividad de Pauling frente al número atómico





*Clasificación de los elementos*

**Carácter metálico**



### Características de los metales y de los no metales

Metales	No metales
<p><b><u>Propiedades físicas</u></b></p> <p>Buenos conductores del calor y la electricidad</p> <p>Brillantes, maleables, dúctiles,</p> <p>De ordinario son:</p> <p>sólidos de alto punto de fusión y de baja volatilidad</p>	<p>Malos conductores del calor y la electricidad</p> <p>No brillantes, ni dúctiles, ni maleables</p> <p>Sólidos, líquidos o gaseosos, de bajo punto de fusión y volátiles.</p>
<p><b><u>Propiedades químicas</u></b></p> <p>Forman cationes</p> <p>Reaccionan con ácidos</p> <p>Forman óxidos básicos</p> <p>Forman haluros iónicos</p>	<p>Forman aniones</p> <p>No reaccionan con ácidos</p> <p>Forman óxidos ácidos</p> <p>Forman haluros covalentes</p>

Estado físico de los elementos

PERIODIC TABLE

Atomic Properties of the Elements

Group

1

IA

1

H

<sup>1</sup>S<sub>1/2</sub>

Hydrogen

1.00794

1s

13.5984

2

IIA

3

Li

<sup>2</sup>S<sub>1/2</sub>

Lithium

6.941

1s<sup>2</sup>2s

5.3917

4

Be

<sup>1</sup>S<sub>1/2</sub>

Beryllium

9.012182

1s<sup>2</sup>2s<sup>2</sup>

9.3227

11

Na

<sup>3</sup>S<sub>1/2</sub>

Sodium

22.989770

[Ne]3s<sup>1</sup>

5.1391

12

Mg

<sup>1</sup>S<sub>1/2</sub>

Magnesium

24.3050

[Ne]3s<sup>2</sup>

7.6462

19

K

<sup>4</sup>S<sub>1/2</sub>

Potassium

39.0983

[Ar]4s

4.3407

20

Ca

<sup>1</sup>S<sub>1/2</sub>

Calcium

40.078

[Ar]4s<sup>2</sup>

6.1132

21

Sc

<sup>3</sup>D<sub>3/2</sub>

Scandium

44.955910

[Ar]3d<sup>1</sup>4s<sup>2</sup>

6.5615

22

Ti

<sup>3</sup>F<sub>2</sub>

Titanium

47.887

[Ar]3d<sup>2</sup>4s<sup>2</sup>

6.8281

23

V

<sup>3</sup>F<sub>2</sub>

Vanadium

50.9415

[Ar]3d<sup>3</sup>4s<sup>2</sup>

6.7462

24

Cr

<sup>5</sup>S<sub>3/2</sub>

Chromium

51.9961

[Ar]3d<sup>5</sup>4s<sup>1</sup>

6.7695

25

Mn

<sup>6</sup>S<sub>5/2</sub>

Manganese

54.938049

[Ar]3d<sup>5</sup>4s<sup>2</sup>

7.4340

26

Fe

<sup>5</sup>D<sub>4</sub>

Iron

55.845

[Ar]3d<sup>6</sup>4s<sup>2</sup>

7.8810

27

Co

<sup>5</sup>D<sub>3/2</sub>

Cobalt

58.933200

[Ar]3d<sup>7</sup>4s<sup>2</sup>

7.8398

28

Ni

<sup>3</sup>F<sub>4</sub>

Nickel

58.6934

[Ar]3d<sup>8</sup>4s<sup>2</sup>

7.8398

29

Cu

<sup>1</sup>S<sub>1/2</sub>

Copper

63.546

[Ar]3d<sup>10</sup>4s<sup>1</sup>

9.3942

30

Zn

<sup>1</sup>S<sub>1/2</sub>

Zinc

65.409

[Ar]3d<sup>10</sup>4s<sup>2</sup>

9.3942

31

Ga

<sup>2</sup>P<sub>1/2</sub>

Gallium

69.723

[Ar]3d<sup>10</sup>4s<sup>2</sup>4p<sup>1</sup>

9.5958

32

Ge

<sup>3</sup>P<sub>3/2</sub>

Germanium

72.64

[Ar]3d<sup>10</sup>4s<sup>2</sup>4p<sup>2</sup>

8.1517

33

As

<sup>3</sup>S<sub>3/2</sub>

Arsenic

74.92160

[Ar]3d<sup>10</sup>4s<sup>2</sup>4p<sup>3</sup>

9.7894

34

Se

<sup>3</sup>P<sub>2</sub>

Selenium

78.96

[Ar]3d<sup>10</sup>4s<sup>2</sup>4p<sup>4</sup>

9.7524

35

Br

<sup>2</sup>P<sub>3/2</sub>

Bromine

79.904

[Ar]3d<sup>10</sup>4s<sup>2</sup>4p<sup>5</sup>

11.8138

36

Kr

<sup>1</sup>S<sub>1/2</sub>

Krypton

83.798

[Ar]3d<sup>10</sup>4s<sup>2</sup>4p<sup>6</sup>

13.9996

37

Rb

<sup>5</sup>S<sub>1/2</sub>

Rubidium

85.4678

[Kr]5s

4.1771

38

Sr

<sup>1</sup>S<sub>1/2</sub>

Strontium

87.62

[Kr]5s<sup>2</sup>

5.6949

39

Y

<sup>2</sup>D<sub>3/2</sub>

Yttrium

88.90585

[Kr]4d<sup>1</sup>5s<sup>2</sup>

6.2173

40

Zr

<sup>2</sup>F<sub>7/2</sub>

Zirconium

91.224

[Kr]4d<sup>2</sup>5s<sup>2</sup>

6.6339

41

Nb

<sup>2</sup>D<sub>3/2</sub>

Niobium

92.90638

[Kr]4d<sup>4</sup>5s

6.7589

42

Mo

<sup>5</sup>S<sub>3/2</sub>

Molybdenum

95.94

[Kr]4d<sup>5</sup>5s<sup>1</sup>

7.0924

43

Tc

<sup>5</sup>S<sub>3/2</sub>

Technetium

98.9062

[Kr]4d<sup>5</sup>5s

7.28

44

Ru

<sup>5</sup>F<sub>5</sub>

Ruthenium

101.07

[Kr]4d<sup>7</sup>5s<sup>1</sup>

7.3605

45

Rh

<sup>5</sup>D<sub>4</sub>

Rhodium

102.90550

[Kr]4d<sup>8</sup>5s<sup>1</sup>

7.4589

46

Pd

<sup>1</sup>S<sub>1/2</sub>

Palladium

106.42

[Kr]4d<sup>10</sup>

7.5762

47

Ag

<sup>1</sup>S<sub>1/2</sub>

Silver

107.8682

[Kr]4d<sup>10</sup>5s<sup>1</sup>

8.9938

48

Cd

<sup>1</sup>S<sub>1/2</sub>

Cadmium

112.411

[Kr]4d<sup>10</sup>5s<sup>2</sup>

9.3942

49

In

<sup>2</sup>P<sub>1/2</sub>

Indium

114.818

[Kr]4d<sup>10</sup>5s<sup>2</sup>5p<sup>1</sup>

10.4375

50

Sn

<sup>3</sup>P<sub>3/2</sub>

Tin

118.710

[Kr]4d<sup>10</sup>5s<sup>2</sup>5p<sup>2</sup>

7.3439

51

Sb

<sup>3</sup>S<sub>3/2</sub>

Antimony

121.757

[Kr]4d<sup>10</sup>5s<sup>2</sup>5p<sup>3</sup>

8.6084

52

Te

<sup>3</sup>P<sub>2</sub>

Tellurium

127.60

[Kr]4d<sup>10</sup>5s<sup>2</sup>5p<sup>4</sup>

9.0096

53

I

<sup>5</sup>S<sub>1/2</sub>

Iodine

126.90447

[Kr]4d<sup>10</sup>5s<sup>2</sup>5p<sup>5</sup>

10.4513

54

Xe

<sup>1</sup>S<sub>1/2</sub>

Xenon

131.293

[Kr]4d<sup>10</sup>5s<sup>2</sup>5p<sup>6</sup>

12.1298

55

Cs

<sup>2</sup>S<sub>1/2</sub>

Cesium

132.90545

[Xe]6s

3.8939

56

Ba

<sup>1</sup>S<sub>1/2</sub>

Barium

137.327

[Xe]6s<sup>2</sup>

5.2117

57

La

<sup>2</sup>D<sub>3/2</sub>

Lanthanum

138.9055

[Xe]5d<sup>1</sup>6s<sup>2</sup>

6.8251

58

Ce

<sup>1</sup>G<sub>4</sub>

Cerium

140.116

[Xe]4f<sup>1</sup>5d<sup>1</sup>6s<sup>2</sup>

7.5496

59

Pr

<sup>3</sup>F<sub>4</sub>

Praseodymium

140.90765

[Xe]4f<sup>3</sup>6s<sup>2</sup>

5.5387

60

Nd

<sup>3</sup>F<sub>4</sub>

Neodymium

144.24

[Xe]4f<sup>4</sup>6s<sup>2</sup>

5.5250

61

Pm

<sup>5</sup>G<sub>5/2</sub>

Promethium

144.9127

[Xe]4f<sup>5</sup>6s<sup>2</sup>

5.582

62

Sm

<sup>3</sup>F<sub>4</sub>

Samarium

151.964

[Xe]4f<sup>6</sup>6s<sup>2</sup>

5.6704

63

Eu

<sup>5</sup>S<sub>5/2</sub>

Europium

151.964

[Xe]4f<sup>7</sup>6s<sup>2</sup>

5.6704

64

Gd

<sup>7</sup>D<sub>5/2</sub>

Gadolinium

157.25

[Xe]4f<sup>7</sup>5d<sup>1</sup>6s<sup>2</sup>

6.1496

65

Tb

<sup>6</sup>F<sub>5/2</sub>

Terbium

158.92534

[Xe]4f<sup>9</sup>6s<sup>2</sup>

5.8638

66

Dy

<sup>7</sup>F<sub>7/2</sub>

Dysprosium

162.500

[Xe]4f<sup>10</sup>6s<sup>2</sup>

5.9389

67

Ho

<sup>7</sup>F<sub>7/2</sub>

Holmium

164.93032

[Xe]4f<sup>11</sup>6s<sup>2</sup>

6.0215

68

Er

<sup>7</sup>H<sub>6</sub>

Erbium

167.259

[Xe]4f<sup>12</sup>6s<sup>2</sup>

6.1077

69

Tm

<sup>3</sup>F<sub>4</sub>

Thulium

168.93421

[Xe]4f<sup>13</sup>6s<sup>2</sup>

6.1843

70

Yb

<sup>1</sup>S<sub>1/2</sub>

Ytterbium

173.04

[Xe]4f<sup>14</sup>6s<sup>2</sup>

6.2542

71

Lu

<sup>2</sup>D<sub>3/2</sub>

Lutetium

174.967

[Xe]4f<sup>14</sup>5d<sup>1</sup>6s<sup>2</sup>

5.4259

89

Ac

<sup>2</sup>D<sub>3/2</sub>

Actinium

227

[Rn]5f<sup>1</sup>6s<sup>2</sup>

5.17

90

Th

<sup>3</sup>F<sub>4</sub>

Thorium

232.0381

[Rn]6d<sup>2</sup>7s<sup>2</sup>

6.3087

91

Pa

<sup>3</sup>K<sub>1/2</sub>

Protactinium

231.03688

[Rn]5f<sup>2</sup>6d<sup>1</sup>7s<sup>2</sup>

5.89

92

U

<sup>3</sup>L<sub>1/2</sub>

Uranium

238.02891

[Rn]5f<sup>3</sup>6d<sup>1</sup>7s<sup>2</sup>

6.1941

93

Np

<sup>5</sup>L<sub>1/2</sub>

Neptunium

237

[Rn]5f<sup>4</sup>6d<sup>1</sup>7s<sup>2</sup>

6.2657

94

Pu

<sup>3</sup>F<sub>4</sub>

Plutonium

244

[Rn]5f<sup>6</sup>7s<sup>2</sup>

6.0260

95

Am

<sup>5</sup>S<sub>5/2</sub>

Americium

243

[Rn]5f<sup>7</sup>7s<sup>2</sup>

5.9738

96

Cm

<sup>3</sup>D<sub>5/2</sub>

Curium

247

[Rn]5f<sup>8</sup>7s<sup>2</sup>

5.9914

97

Bk

<sup>7</sup>F<sub>7/2</sub>

Berkelium

247

[Rn]5f<sup>9</sup>7s<sup>2</sup>

6.1979

98

Cf

<sup>1</sup>I<sub>1/2</sub>

Californium

251

[Rn]5f<sup>10</sup>7s<sup>2</sup>

6.2817

99

Es

<sup>3</sup>F<sub>4</sub>

Einsteinium

252

[Rn]5f<sup>11</sup>7s<sup>2</sup>

6.42

100

Fm

<sup>3</sup>H<sub>6</sub>

Fermium

257

[Rn]5f<sup>12</sup>7s<sup>2</sup>

6.50

101

Md

<sup>7</sup>F<sub>7/2</sub>

Mendelevium

258

[Rn]5f<sup>13</sup>7s<sup>2</sup>

6.58

102

No

<sup>3</sup>F<sub>4</sub>

Nobelium

259

[Rn]5f<sup>14</sup>7s<sup>2</sup>

6.65

103

Lr

<sup>2</sup>P<sub>1/2</sub>

Lawrencium

262

[Rn]5f<sup>14</sup>7s<sup>2</sup>7p<sup>1</sup>

4.9

18

VIIIA

19

VIIA

20

VIIA

21

VIIA

22

VIIA

23

VIIA

24

VIIA

25

VIIA

26

VIIA

27

VIIA

28

VIIA

29

VIIA

30

VIIA

31

VIIA

32

VIIA

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VIIA

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VIIA

85

VIIA

86

VIIA

87

VIIA

88

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89

VIIA

90

VIIA

91

VIIA

92

VIIA

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VIIA

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VIIA

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VIIA

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VIIA

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VIIA

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VIIA

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VIIA

100

VIIA

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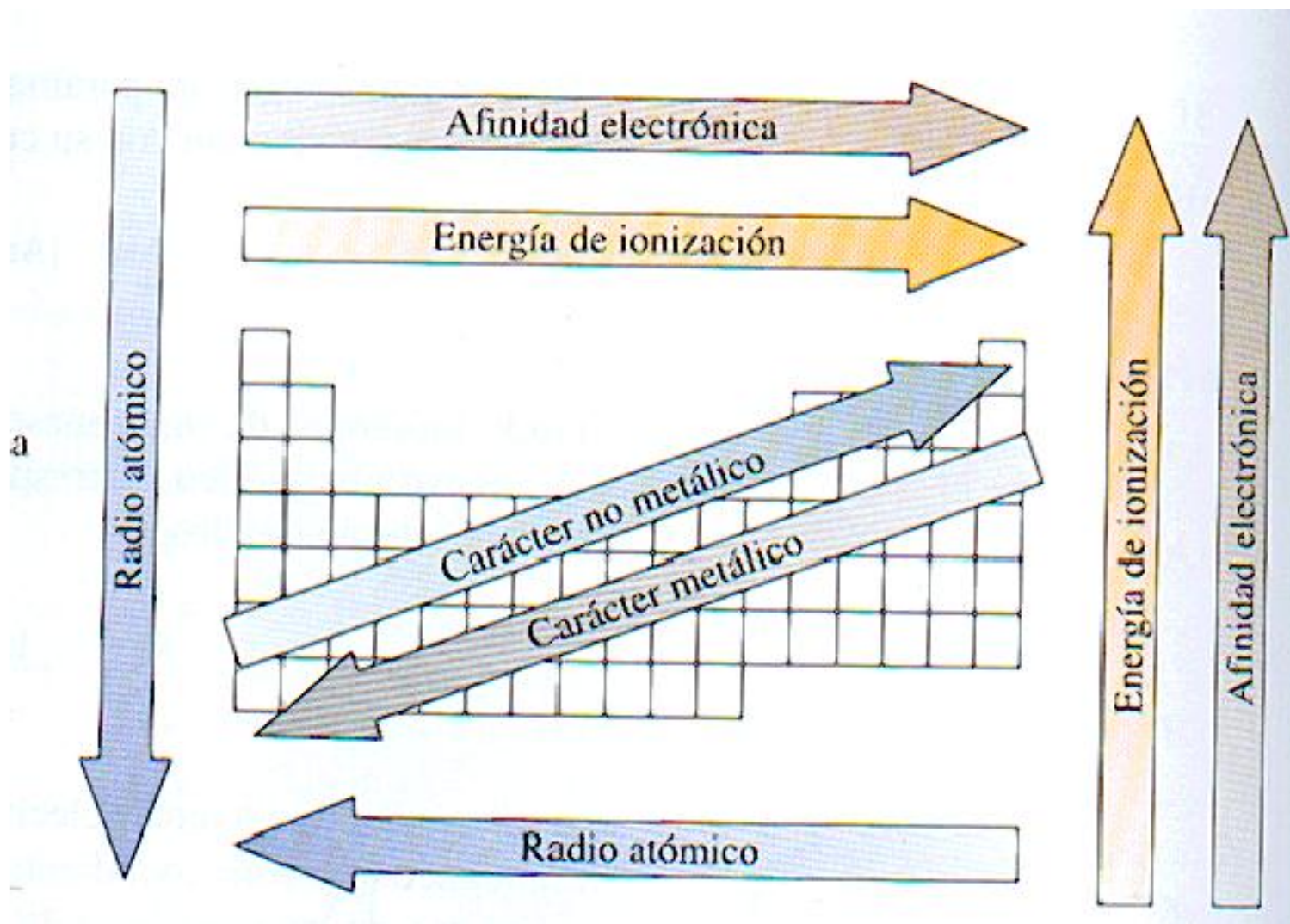
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## Tendencias de las propiedades periódicas

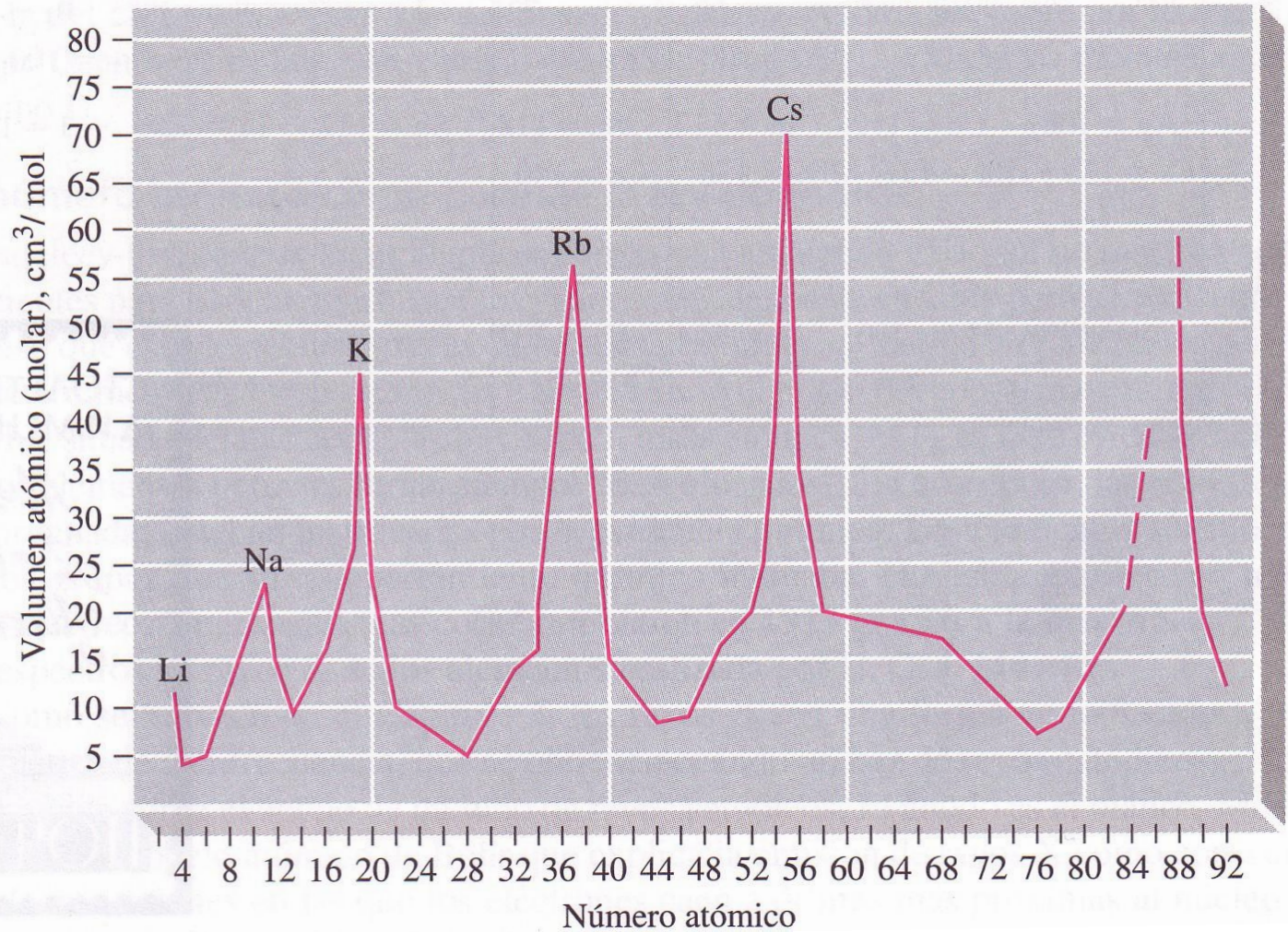






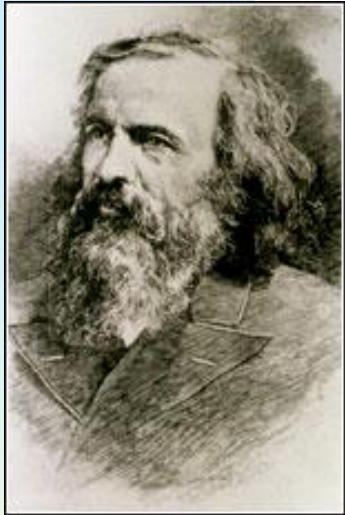
*Julius Lothar Meyer*  
(1830-1895)

## La ley periódica de Meyer, 1869





# La tabla periódica de Mendeleev, 1869



*Dimitri Ivanovich  
Mendeleev (1834-  
1907)*

Ueber die Beziehungen der Eigenschaften zu den Atomgewichten der Elemente. Von D. Mendelejeff. — Ordnet man Elemente nach zunehmenden Atomgewichten in verticale Reihen so, dass die Horizontalreihen analoge Elemente enthalten, wieder nach zunehmendem Atomgewicht geordnet, so erhält man folgende Zusammenstellung, aus der sich einige allgemeinere Folgerungen ableiten lassen.

			Ti = 50	Zr = 90	? = 180
			V = 51	Nb = 94	Ta = 182
			Cr = 52	Mo = 96	W = 186
			Mn = 55	Rh = 104,4	Pt = 197,4
			Fe = 56	Ru = 104,4	Ir = 198
		Ni = 59	Co = 59	Pd = 106,6	Os = 199
			Cu = 63,4	Ag = 108	Hg = 200
H = 1			Zn = 65,2	Cd = 112	
	Be = 9,4	Mg = 24	? = 68	Ur = 116	Au = 197?
	B = 11	Al = 27,4	? = 70	Sn = 118	
	C = 12	Si = 28	As = 75	Sb = 122	Bi = 210?
	N = 14	P = 31	Se = 79,4	Te = 128?	
	O = 16	S = 32	Br = 80	J = 127	
	F = 19	Cl = 35,5	Rb = 85,4	Cs = 133	Tl = 204
Li = 7	Na = 23	K = 39	Sr = 87,6	Ba = 137	Pb = 207
		Ca = 40	? = 45	Ce = 92	
		?Er = 56	La = 94		
		?Yt = 60	Di = 95		
		?In = 75,6	Th = 118?		

Zeitschrift für Chemie 12, 405-6 (1869)

# La tabla periódica de Mendeleev, 1872

Reihen	Gruppe I. — $R^2O$	Gruppe II. — $RO$	Gruppe III. — $R^2O^3$	Gruppe IV. $RH^4$ $RO^2$	Gruppe V. $RH^3$ $R^2O^5$	Gruppe VI. $RH^2$ $RO^3$	Gruppe VII. $RH$ $R^2O^7$	Gruppe VIII. — $RO^4$
1	H = 1							
2	Li = 7	Be = 9,4	B = 11	C = 12	N = 14	O = 16	F = 19	
3	Na = 23	Mg = 24	Al = 27,3	Si = 28	P = 31	S = 32	Cl = 35,5	Fe = 56, Co = 59,
4	K = 39	Ca = 40	— = 44	Ti = 48	V = 51	Cr = 52	Mn = 55	Ni = 59, Cu = 63,
5	(Cu = 63)	Zn = 65	— = 68	— = 72	As = 75	Se = 78	Br = 80	
6	Rb = 85	Sr = 87	?Yt = 88	Zr = 90	Nb = 94	Mo = 96	— = 100	Ru = 104, Rh = 104,
7	(Ag = 108)	Cd = 112	In = 113	Sn = 118	Sb = 122	Te = 125	J = 127	Pd = 106, Ag = 108.
8	Cs = 133	Ba = 137	?Di = 138	?Ce = 140	—	—	—	— — — —
9	(—)	—	—	—	—	—	—	—
10	—	—	?Er = 178	?La = 180	Ta = 182	W = 184	—	Os = 195, Ir = 197,
11	(Au = 199)	Hg = 200	Ti = 204	Pb = 207	Bi = 208	—	—	Pt = 198, Au = 199,
12	—	—	—	Th = 231	—	U = 240	—	— — — —

Eka-boro

Eka-silicio

Eka-aluminio

Escandio

Germanio

Galio

TABLA 10.1 Predicciones y valores experimentales de las propiedades del germanio

Propiedad	Predicción Eka-silicio (1871)	Observación Germanio (1886)
Masa atómica	72	72,6
Densidad, g/cm <sup>3</sup>	5,5	5,47
Color	gris sucio	blanco grisáceo
Densidad del óxido, g/cm <sup>3</sup>	EsO <sub>2</sub> : 4,7	GeO <sub>2</sub> : 4,703
Punto de ebullición del cloro	EsCl <sub>4</sub> : menos de 100 °C	GeCl <sub>4</sub> : 86 °C
Densidad del cloruro, g/cm <sup>3</sup>	EsCl <sub>4</sub> : 1,9	GeCl <sub>4</sub> : 1,887