



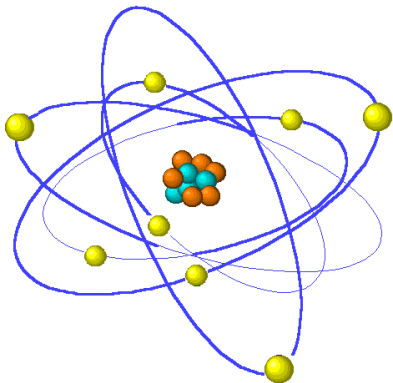
Universidad Nacional de Misiones



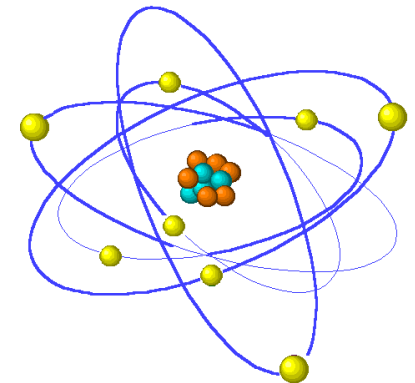
Facultad de Ingeniería  
OBERA

## ELECTRONICA GENERAL

# SEMICONDUCTORES

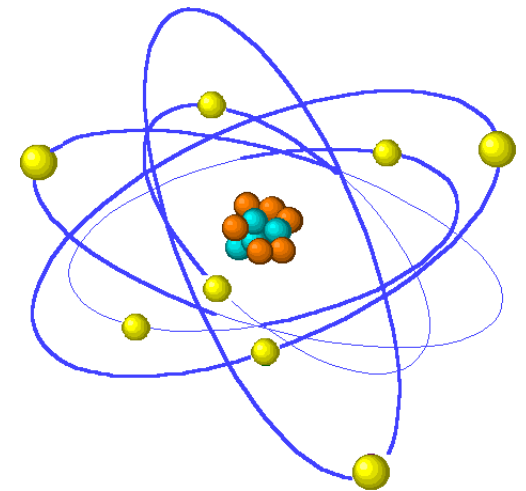
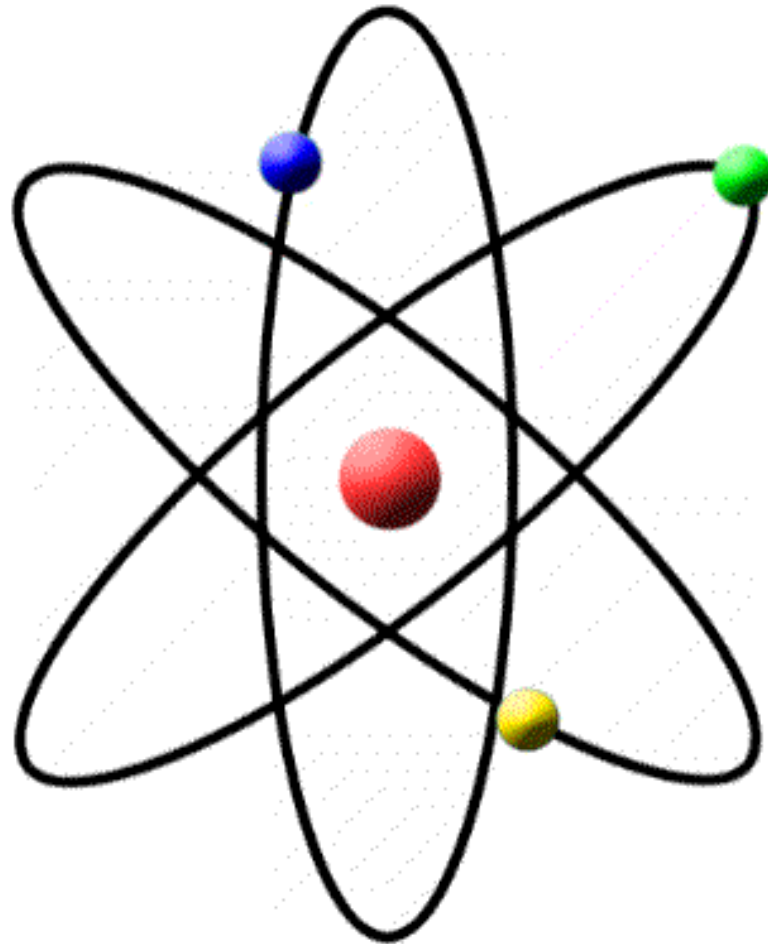


***DOPADO***

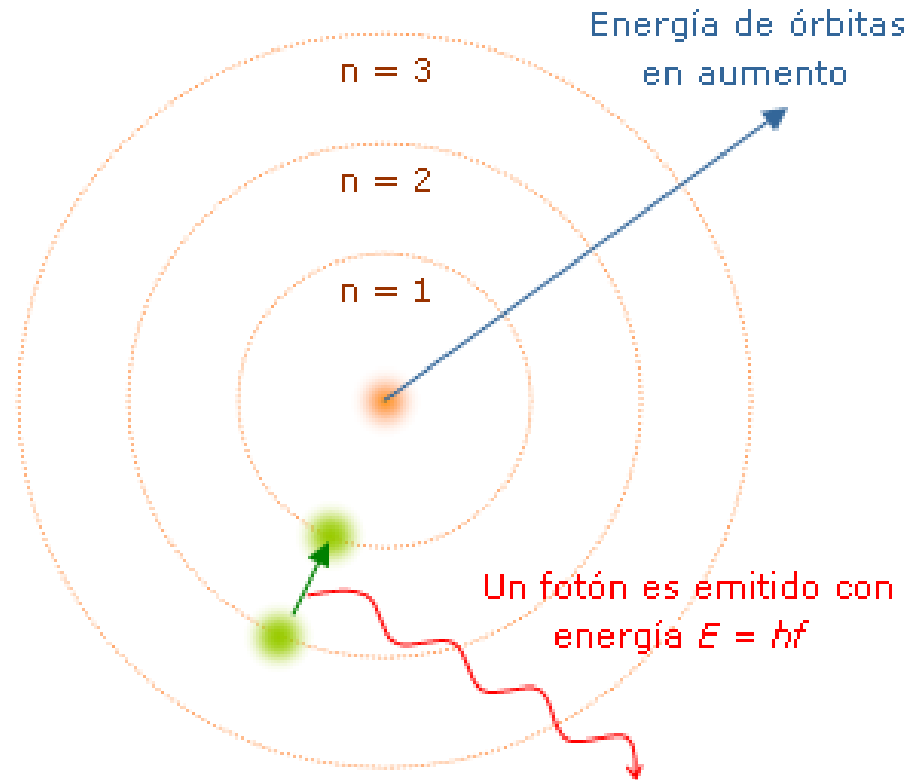


**Mgtr. Ing. Victor Hugo Kurtz**

# MODELO ATÓMICO DE RUTHERFORD



# Modelo Atómico de Bohr



Referencia:

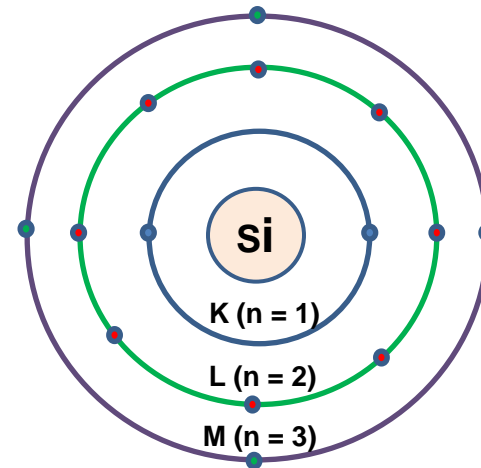
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# NUMERO ATOMICO

- El **Número Atómico** en un **ELEMENTO QUIMICO**, es el número total de protones que tiene cada átomo de ese elemento.
- *Para un ATOMO NEUTRO, el numero de **PROTONES** coincide con el número de **ELECTRONES**.*
- Átomo neutro: Nro. **Protones** = Nro. **Electrones**
- Se representa con la letra Z. >

# CAPA ELECTRONICA

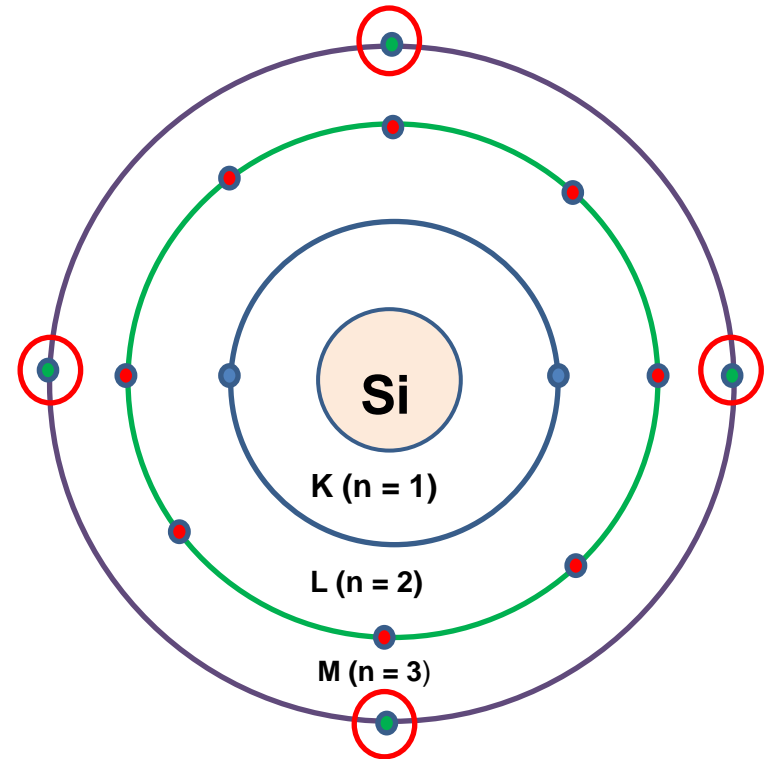
- Distribución orbital de electrones alrededor del núcleo (Bohr).
- Cada capa u orbita, puede alojar un numero máximo de electrones.
- Las capas se denominan alfabéticamente desde la letra “K”.
- Nro. de Electrones por capa =  $2n^2$   
Donde n = Capa (nivel).



# DISTRIBUCION DE ELECTRONES

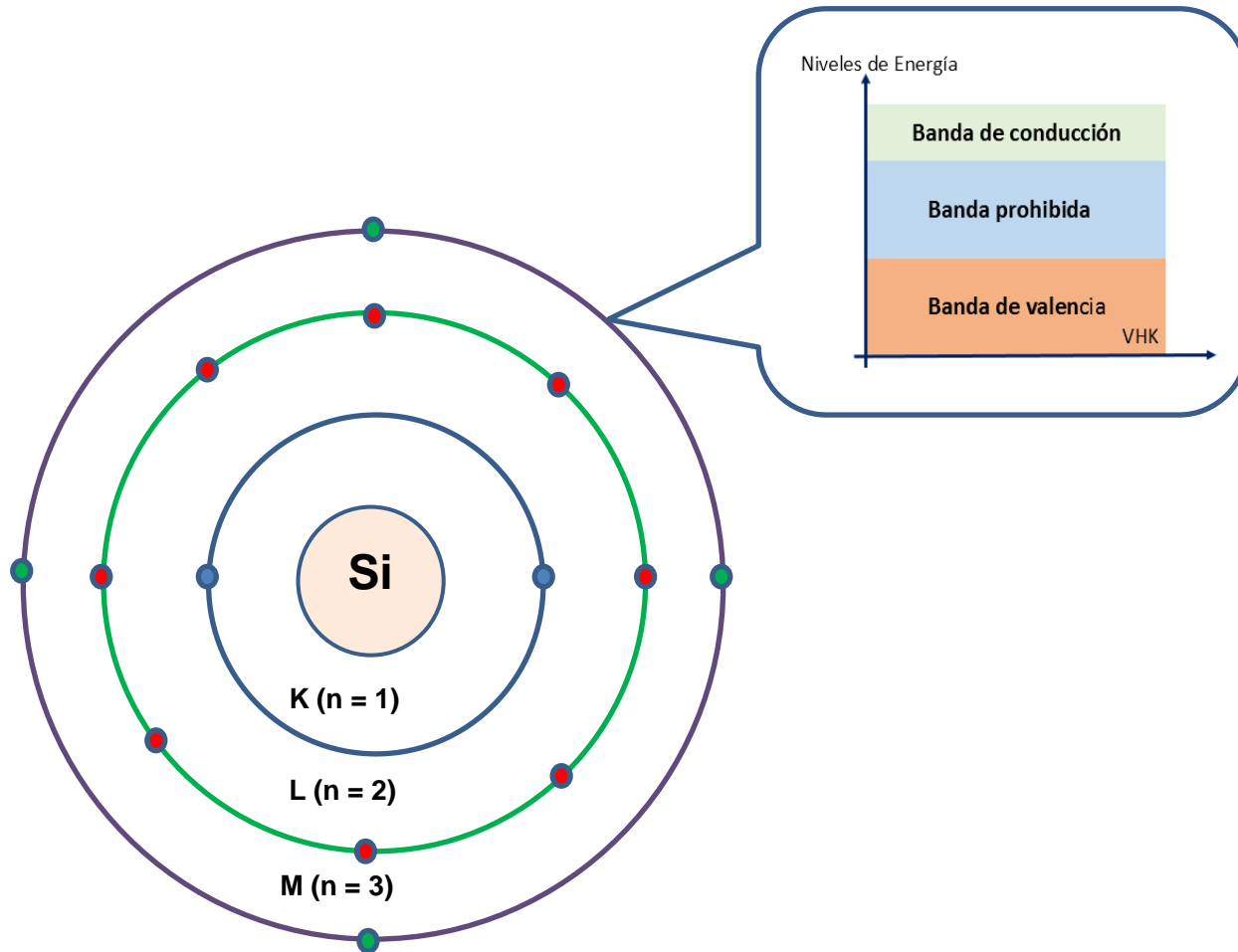
$$2n^2$$

- K ( $n = 1$ ) ; Hasta  $2 e^-$   
L ( $n = 2$ ) ; Hasta  $8 e^-$   
M ( $n = 3$ ) ; Hasta  $18 e^-$
- Supongamos **Silicio**  
Nro. Atómico 14.
- **K = 2 electrones.**  
**L = 8 electrones.**  
**M = 4 electrones.**
- Ultima capa:  $14 - 2 - 8 = 4$

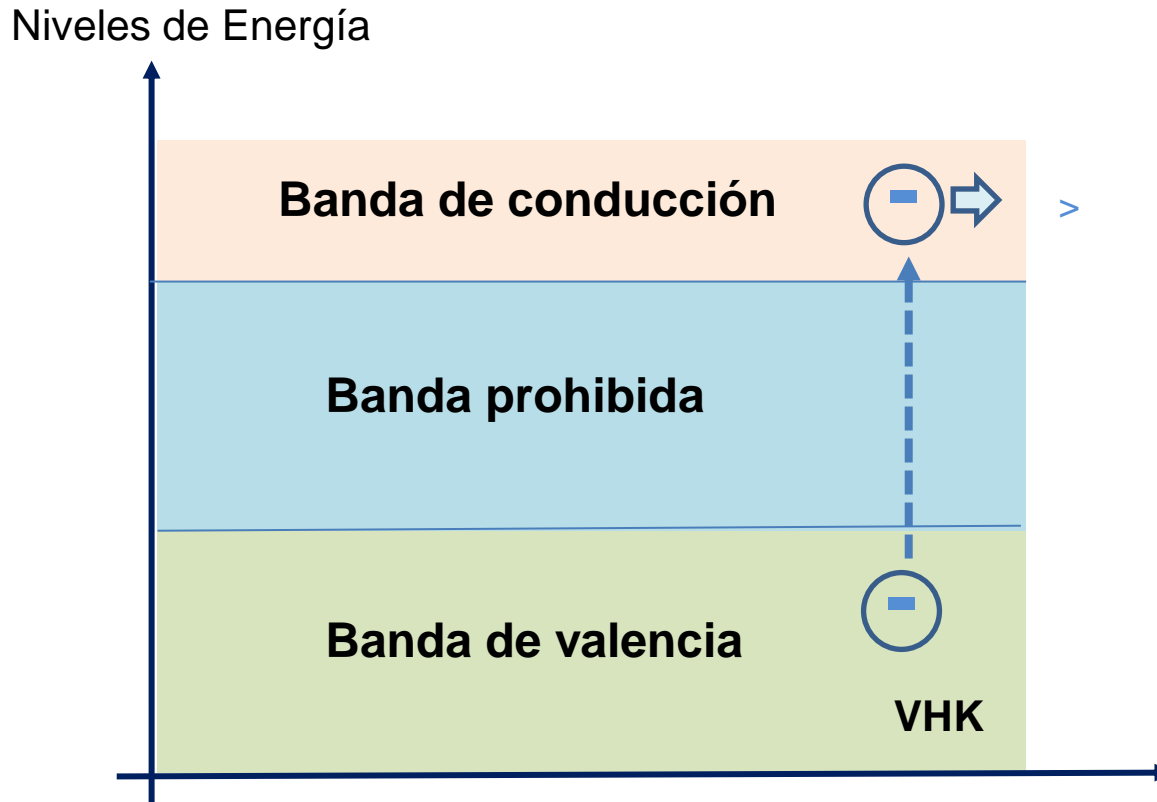


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# NIVELES DE ENERGÍA



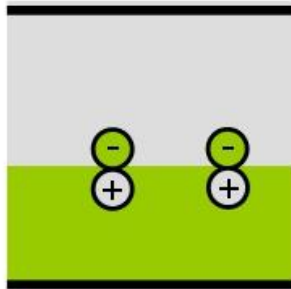
# NIVELES DE ENERGÍA



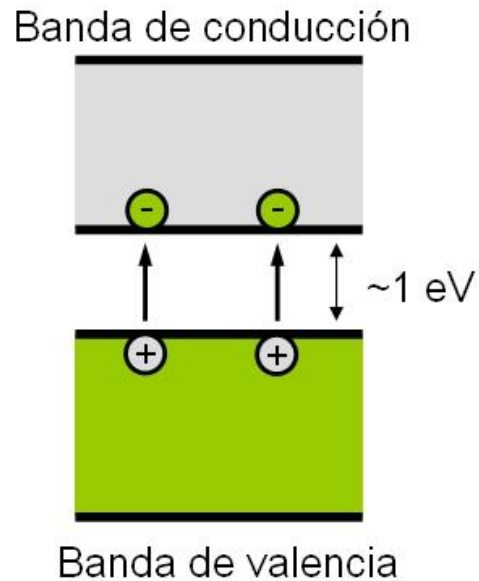


# NIVELES DE ENERGÍA

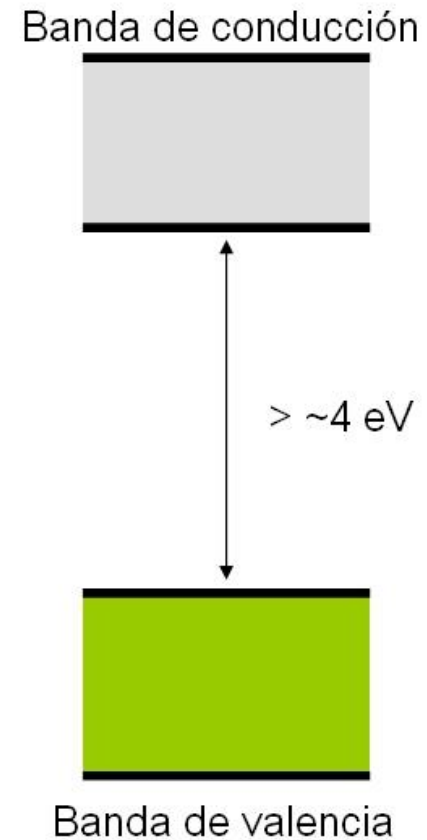
Conductor



Semiconductor



Aislante



Fuente: wix.com

# TABLA PERIODICA DE LOS ELEMENTOS

## Tabla periódica de los elementos



Fuente: De Attribution: 2012rcEdit (Translation to Spanish) by The Photographer - File:Periodic\_table\_large-es.svg, CC BY 3.0, <https://commons.wikimedia.org/w/index.php?curid=68732033>

# Grupo



13 IIIA	14 IVA	15 VA	VIA	VIIA	4.22 0.93	31.8 1s
<b>5</b> 10,811 <b>B</b> Boro 3 2.34 1.026 2365 2.04 4275 801 0.82 4.6 [He]2s <sup>2</sup> 2p <sup>1</sup>	<b>6</b> 12,0107 <b>C</b> Carbono 3 -4.24 0.710 2.26 2.55 4100 2.55 5100 1087 0.77 4.6 [He]2s <sup>2</sup> 2p <sup>2</sup>	<b>7</b> 14,00674 <b>N</b> Nitrógeno 3 3.2,3,4,5 1.04 2.251 3.04 3.15 1402 7.35 17.3 0.75 [He]2s <sup>2</sup> 2p <sup>3</sup>	<b>8</b> 15,9994 <b>O</b> Oxígeno 2 -2 0.92 1.429 3.44 54.8 1314 90.18 14.0 0.73 [He]2s <sup>2</sup> 2p <sup>4</sup>	<b>9</b> 18,998403 <b>F</b> Flúor 2 -1 0.824 1.696 3.98 53.48 1681 84.95 17.1 0.72 [He]2s <sup>2</sup> 2p <sup>5</sup>	<b>10</b> 20,1797 <b>Ne</b> Neón - 1.03 0.900 - 24.55 2081 27.1 16.7 0.71 [He]2s <sup>2</sup> 2p <sup>6</sup>	
<b>13</b> 26,981538 <b>Al</b> Aluminio 3 2.70 0.904 933.5 1.61 2793 578 1.18 10.0 [Ne]3s <sup>2</sup> 3p <sup>1</sup>	<b>14</b> 28,0855 <b>Si</b> Silicio 4 2.33 0.712 1683 1.9 3540 787 1.11 12.1 [Ne]3s <sup>2</sup> 3p <sup>2</sup>	<b>15</b> 30,973761 <b>P</b> Fósforo 3 3.3,4,5 0.770 0.82 2.19 17.3 1012 50 17.0 0.06 [Ne]3s <sup>2</sup> 3p <sup>3</sup>	<b>16</b> 32,066 <b>S</b> Azufre 3 -2,2,4,6 0.705 2.07 2.58 388.4 1000 717.8 15.5 1.02 [Ne]3s <sup>2</sup> 3p <sup>4</sup>	<b>17</b> 35,4527 <b>Cl</b> Cloro 3 -1,1,3,5,7 0.478 3.214 3.16 172.2 1251 239.1 18.7 0.99 [Ne]3s <sup>2</sup> 3p <sup>5</sup>	<b>18</b> 39,948 <b>Ar</b> Argón - 0.52 1.784 - 83.8 1521 87.3 24.2 0.98 [Ne]3s <sup>2</sup> 3p <sup>6</sup>	
<b>31</b> 69,723 <b>Ga</b> Galio 3 5.91 0.371 302.9 1.81 2478 579 1.26 11.8 [Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>1</sup>	<b>32</b> 72,61 <b>Ge</b> Germanio 4 5.32 0.322 1211.5 2.01 762 13.6 1.22 [Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>2</sup>	<b>33</b> 74,92160 <b>As</b> Arsénico 4 3.3,5 0.328 2.72 2.18 090 (3sAtm) 947 86 (Sublim) 13.1 0.20 [Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>3</sup>	<b>34</b> 78,96 <b>Se</b> Selenio 4 -2,4,6 0.321 4.79 2.55 494 941 958 16.5 1.16 [Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>4</sup>	<b>35</b> 79,904 <b>Br</b> Bromo 4 -1,1,5 0.473 3.12 2.96 265.9 1140 332.2 23.5 1.14 [Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>5</sup>	<b>36</b> 83,8 <b>Kr</b> Kriptón - 0.248 3.7 - 115.8 1351 119.8 32.2 1.12 [Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>6</sup>	
<b>48</b> 114,818 <b>In</b> Indio 3 7.31 0.233 429.8 1.78 2346 558 1.44 15.7 [Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>1</sup>	<b>50</b> 118,71 <b>Sn</b> Estaño 4 2.4 0.228 7.31 1.96 505.1 709 2876 16.3 1.41 [Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>2</sup>	<b>51</b> 121,760 <b>Sb</b> Antimonio 4 3.3,5 0.207 3.69 2.05 104 834 860 18.4 0.40 [Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>3</sup>	<b>52</b> 127,60 <b>Te</b> Teluro 4 -2,4,6 0.201 6.24 2.1 722.7 869 1261 20.5 1.36 [Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>4</sup>	<b>53</b> 126,90447 <b>I</b> Yodo 4 -1,1,5,7 0.214 4.93 2.66 386.7 1008 458.4 25.7 1.33 [Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>5</sup>	<b>54</b> 131,29 <b>Xe</b> Xenón - 0.158 5.9 2.6 161.4 1170 165.1 42.9 1.31 [Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>6</sup>	

# Grupo

13

14

15

IIIa		IVa		Va		VIa		VIIa		4.22 0.93	31.8 1s
<b>5</b> 10,811 <b>B</b> Boro		<b>6</b> 12,0107 <b>C</b> Carbono		<b>7</b> 14,00674 <b>N</b> Nitrógeno		<b>8</b> 15,9994 <b>O</b> Oxígeno		<b>9</b> 18,998403 <b>F</b> Flúor		<b>10</b> 20,1797 <b>Ne</b> Neón	
3 2.34 2365 4275 0.82	1.026 2.04 801 4.6	-4.24 2.26 4100 5100 0.77	0.710 2.55 1087 4.6	-3.2.3.4.5 1.251 63.15 77.35 0.75	1.04 3.04 1402 17.3	-2 1.429 54.8 90.18 0.73	0.92 3.44 1314 14.0	-1 1.696 53.48 84.95 0.72	0.824 3.98 1681 17.1	- 0.900 24.55 27.1 0.71	1.03 - 2081 16.7
[He]2s <sup>2</sup> 2p <sup>1</sup>		[He]2s <sup>2</sup> 2p <sup>2</sup>		[He]2s <sup>2</sup> 2p <sup>3</sup>		[He]2s <sup>2</sup> 2p <sup>4</sup>		[He]2s <sup>2</sup> 2p <sup>5</sup>		[He]2s <sup>2</sup> 2p <sup>6</sup>	
<b>13</b> 26,981538 <b>Al</b> Aluminio		<b>14</b> 28,0855 <b>Si</b> Silicio		<b>15</b> 30,973761 <b>P</b> Fósforo		<b>16</b> 32,066 <b>S</b> Azufre		<b>17</b> 35,4527 <b>Cl</b> Cloro		<b>18</b> 39,948 <b>Ar</b> Argón	
3 2.70 933.5 2793 1.18	0.904 1.61 578 10.0	4 2.33 1683 3540 1.11	0.712 1.9 787 12.1	-3.3.4.5 1.82 317.3 550 1.06	0.770 2.19 1012 17.0	-2.2.4.6 2.07 388.4 717.8 1.02	0.705 2.58 1000 15.5	-1.1.3.5.7 3.214 172.2 239.1 0.99	0.478 3.16 1251 18.7	- 1.784 83.8 87.3 0.98	0.52 - 1521 24.2
[Ne]3s <sup>2</sup> 3p <sup>1</sup>		[Ne]3s <sup>2</sup> 3p <sup>2</sup>		[Ne]3s <sup>2</sup> 3p <sup>3</sup>		[Ne]3s <sup>2</sup> 3p <sup>4</sup>		[Ne]3s <sup>2</sup> 3p <sup>5</sup>		[Ne]3s <sup>2</sup> 3p <sup>6</sup>	
<b>31</b> 69,723 <b>Ga</b> Galio		<b>32</b> 72,61 <b>Ge</b> Germanio		<b>33</b> 74,92160 <b>As</b> Arsénico		<b>34</b> 78,96 <b>Se</b> Selenio		<b>35</b> 79,904 <b>Br</b> Bromo		<b>36</b> 83,8 <b>Kr</b> Kriptón	
3 5.91 302.9 2478 1.26	0.371 1.81 579 11.8	4 5.32 1211.5 3107 1.22	0.322 2.01 762 13.6	-3.3.5 5.72 1090 (35Atm) 386 (Sublim) 1.20	0.328 2.18 947 13.1	-2.4.6 4.79 494 958 1.16	0.321 2.55 941 16.5	-1.1.5 3.12 265.9 332.2 1.14	0.473 2.96 1140 23.5	- 3.7 115.8 119.8 1.12	0.248 - 1351 32.2
[Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>1</sup>		[Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>2</sup>		[Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>3</sup>		[Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>4</sup>		[Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>5</sup>		[Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>6</sup>	
<b>48</b> 114,818 <b>In</b> Indio		<b>50</b> 118,71 <b>Sn</b> Estaño		<b>51</b> 121,760 <b>Sb</b> Antimonio		<b>52</b> 127,60 <b>Te</b> Teluro		<b>53</b> 126,90447 <b>I</b> Yodo		<b>54</b> 131,29 <b>Xe</b> Xenón	
3 7.31 429.8 2346 1.44	0.233 1.78 558 15.7	2.4 7.31 505.1 2876 1.41	0.228 1.96 709 16.3	-3.3.5 6.69 904 1860 1.40	0.207 2.05 834 18.4	-2.4.6 6.24 722.7 1261 1.36	0.201 2.1 869 20.5	-1.1.5.7 4.93 386.7 458.4 1.33	0.214 2.66 1008 25.7	- 5.9 161.4 165.1 1.31	0.158 2.6 1170 42.9
[Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>1</sup>		[Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>2</sup>		[Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>3</sup>		[Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>4</sup>		[Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>5</sup>		[Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>6</sup>	

# Grupo

## 13

## 14

## 15

IIIa		IVa		Va		VIa		VIIa		4.22 0.93	31.8 1s
<b>5</b> 10,811 <b>B</b> Boro 3 2.34 2365 4275 0.82 [He]2s <sup>2</sup> 2p <sup>1</sup>	<b>6</b> 12,0107 <b>C</b> Carbono -4.2.4 2.26 4100 5100 0.77 0.710 2.55 1087 4.6 [He]2s <sup>2</sup> 2p <sup>2</sup>	<b>7</b> 14,00674 <b>N</b> Nitrógeno -3.2.3.4.5 1.251 63.15 77.35 0.75 1.04 3.04 1402 17.3 [He]2s <sup>2</sup> 2p <sup>3</sup>	<b>8</b> 15,9994 <b>O</b> Oxígeno -2 1.429 54.8 90.18 0.73 0.92 3.44 1314 14.0 [He]2s <sup>2</sup> 2p <sup>4</sup>	<b>9</b> 18,998403 <b>F</b> Flúor -1 1.696 53.48 84.95 0.72 0.824 3.98 1681 17.1 [He]2s <sup>2</sup> 2p <sup>5</sup>	<b>10</b> 20,1797 <b>Ne</b> Neón - 0.900 24.55 27.1 0.71 1.03 - 2081 16.7 [He]2s <sup>2</sup> 2p <sup>6</sup>						
<b>13</b> 26,981538 <b>Al</b> Aluminio 3 2.70 933.5 2793 1.18 [Ne]3s <sup>2</sup> 3p <sup>1</sup>	<b>14</b> 28,0855 <b>Si</b> Silicio 4 2.33 1683 3540 1.11 0.712 1.9 787 12.1 [Ne]3s <sup>2</sup> 3p <sup>2</sup>	<b>15</b> 30,973761 <b>P</b> Fósforo -3.3.4.5 1.82 317.3 550 1.06 0.770 2.19 1012 17.0 [Ne]3s <sup>2</sup> 3p <sup>3</sup>	<b>16</b> 32,066 <b>S</b> Azufre -2.2.4.6 2.07 388.4 717.8 1.02 0.705 2.58 1000 15.5 [Ne]3s <sup>2</sup> 3p <sup>4</sup>	<b>17</b> 35,4527 <b>Cl</b> Cloro -1.1.3.5.7 3.214 172.2 239.1 0.99 0.478 3.16 1251 18.7 [Ne]3s <sup>2</sup> 3p <sup>5</sup>	<b>18</b> 39,948 <b>Ar</b> Argón - 1.784 83.8 87.3 0.98 0.52 - 1521 24.2 [Ne]3s <sup>2</sup> 3p <sup>6</sup>						
<b>31</b> 69,723 <b>Ga</b> Galio 3 5.91 302.9 2478 1.26 [Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>1</sup>	<b>32</b> 72,61 <b>Ge</b> Germanio 4 5.32 1211.5 3107 1.22 0.322 2.01 762 13.6 [Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>2</sup>	<b>33</b> 74,92160 <b>As</b> Arsénico -3.3.5 5.72 1090 (35Atm) 886 (Sublim) 1.20 0.328 2.18 947 13.1 [Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>3</sup>	<b>34</b> 78,96 <b>Se</b> Selenio -2.4.6 4.79 494 958 1.16 0.321 2.55 941 16.5 [Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>4</sup>	<b>35</b> 79,904 <b>Br</b> Bromo -1.1.5 3.12 265.9 332.2 1.14 0.473 2.96 1140 23.5 [Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>5</sup>	<b>36</b> 83,8 <b>Kr</b> Kriptón - 3.7 115.8 119.8 1.12 0.248 - 1351 32.2 [Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>6</sup>						
<b>48</b> 114,818 <b>In</b> Indio 3 7.31 429.8 2346 1.44 [Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>1</sup>	<b>50</b> 118,71 <b>Sn</b> Estaño 2.4 7.31 505.1 2876 1.41 0.228 1.96 709 16.3 [Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>2</sup>	<b>51</b> 121,760 <b>Sb</b> Antimonio -3.3.5 6.69 904 1860 1.40 0.207 2.05 834 18.4 [Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>3</sup>	<b>52</b> 127,60 <b>Te</b> Teluro -2.4.6 6.24 722.7 1261 1.36 0.201 2.1 869 20.5 [Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>4</sup>	<b>53</b> 126,90447 <b>I</b> Yodo -1.1.5.7 4.93 386.7 458.4 1.33 0.214 2.66 1008 25.7 [Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>5</sup>	<b>54</b> 131,29 <b>Xe</b> Xenón - 5.9 161.4 165.1 1.31 0.158 2.6 1170 42.9 [Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>6</sup>						

# **DOPADO**

# **O**

# **METALIZACION**

## **de un *SEMICONDUCTOR***



# DOPADO



IIIa	IVa	Va	VIa	VIIa	4.22 0.93	31.8 1s
<b>5</b> 10,811 <b>B</b> <b>Boro</b> 3 2.34 1.026 2365 2.04 4275 801 0.82 4.6 [He]2s <sup>2</sup> 2p <sup>1</sup>	<b>6</b> 12,0107 <b>C</b> <b>Carbono</b> -4.24 0.710 2.26 2.55 4100 1087 5100 4.6 0.77 [He]2s <sup>2</sup> 2p <sup>2</sup>	<b>7</b> 14,00674 <b>N</b> <b>Nitrógeno</b> -3.2.3.4.5 1.04 1.251 3.04 63.15 1402 77.35 17.3 0.75 [He]2s <sup>2</sup> 2p <sup>3</sup>	<b>8</b> 15,9994 <b>O</b> <b>Oxígeno</b> -2 0.92 1.429 3.44 54.8 1314 90.18 14.0 0.73 [He]2s <sup>2</sup> 2p <sup>4</sup>	<b>9</b> 18,998403 <b>F</b> <b>Flúor</b> -1 0.824 1.696 3.98 53.48 1681 84.95 17.1 0.72 [He]2s <sup>2</sup> 2p <sup>5</sup>	<b>10</b> 20,1797 <b>Ne</b> <b>Neón</b> - 1.03 0.900 - 24.55 2081 27.1 16.7 0.71 [He]2s <sup>2</sup> 2p <sup>6</sup>	
<b>13</b> 26,981538 <b>Al</b> <b>Aluminio</b> 3 2.70 0.904 933.5 1.61 2793 578 1.18 10.0 [Ne]3s <sup>2</sup> 3p <sup>1</sup>	<b>14</b> 28,0855 <b>Si</b> <b>Silicio</b> 4 2.33 0.712 1683 1.9 3540 787 1.11 12.1 [Ne]3s <sup>2</sup> 3p <sup>2</sup>	<b>15</b> 30,973761 <b>P</b> <b>Fósforo</b> -3.3.4.5 0.770 1.82 2.19 317.3 1012 550 17.0 1.06 [Ne]3s <sup>2</sup> 3p <sup>3</sup>	<b>16</b> 32,066 <b>S</b> <b>Azufre</b> -2.2.4.6 0.705 2.07 2.58 388.4 1000 717.8 15.5 1.02 [Ne]3s <sup>2</sup> 3p <sup>4</sup>	<b>17</b> 35,4527 <b>Cl</b> <b>Cloro</b> -1.1.3.5.7 0.478 3.214 3.16 172.2 1251 239.1 18.7 0.99 [Ne]3s <sup>2</sup> 3p <sup>5</sup>	<b>18</b> 39,948 <b>Ar</b> <b>Argón</b> - 0.52 1.784 - 83.8 1521 87.3 24.2 0.98 [Ne]3s <sup>2</sup> 3p <sup>6</sup>	
<b>31</b> 69,723 <b>Ga</b> <b>Galio</b> 3 5.91 0.371 302.9 1.81 2478 579 1.26 11.8 [Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>1</sup>	<b>32</b> 72,61 <b>Ge</b> <b>Germanio</b> 4 5.32 0.322 1211.5 2.01 3107 762 1.22 13.6 [Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>2</sup>	<b>33</b> 74,92160 <b>As</b> <b>Arsénico</b> -3.3.5 0.328 5.72 2.18 1090 (3sAtm) 947 886 (Sublim) 13.1 1.20 [Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>3</sup>	<b>34</b> 78,96 <b>Se</b> <b>Selenio</b> -2.4.6 0.321 4.79 2.55 494 941 958 16.5 1.16 [Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>4</sup>	<b>35</b> 79,904 <b>Br</b> <b>Bromo</b> -1.1.5 0.473 3.12 2.96 265.9 1140 332.2 23.5 1.14 [Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>5</sup>	<b>36</b> 83,8 <b>Kr</b> <b>Kriptón</b> - 0.248 3.7 - 115.8 1351 119.8 32.2 1.12 [Ar]3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>6</sup>	
<b>49</b> 114,818 <b>In</b> <b>Indio</b> 3 7.31 0.233 429.8 1.78 2346 558 1.44 15.7 [Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>1</sup>	<b>50</b> 118,71 <b>Sn</b> <b>Estaño</b> 2.4 0.228 7.31 1.96 505.1 709 2876 16.3 1.41 [Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>2</sup>	<b>51</b> 121,760 <b>Sb</b> <b>Antimonio</b> -3.3.5 0.207 6.69 2.05 904 834 1860 18.4 1.40 [Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>3</sup>	<b>52</b> 127,60 <b>Te</b> <b>Teluro</b> -2.4.6 0.201 6.24 2.1 722.7 869 1261 20.5 1.36 [Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>4</sup>	<b>53</b> 126,90447 <b>I</b> <b>Yodo</b> -1.1.5.7 0.214 4.93 2.66 386.7 1008 458.4 25.7 1.33 [Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>5</sup>	<b>54</b> 131,29 <b>Xe</b> <b>Xenón</b> - 0.158 5.9 2.6 161.4 1170 165.1 42.9 1.31 [Kr]4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>6</sup>	

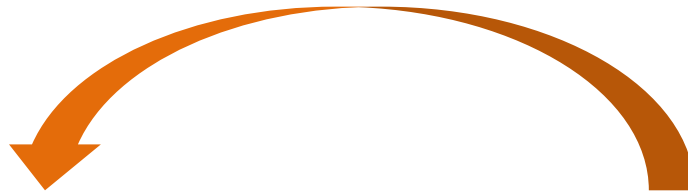
Grupo 13

14

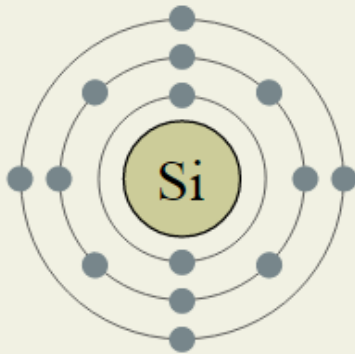
15



# Dopado o Metalización



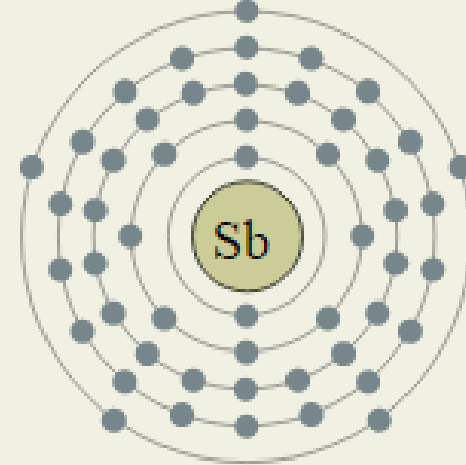
14 SILICO



**4 Electrones en la ultima capa**

+

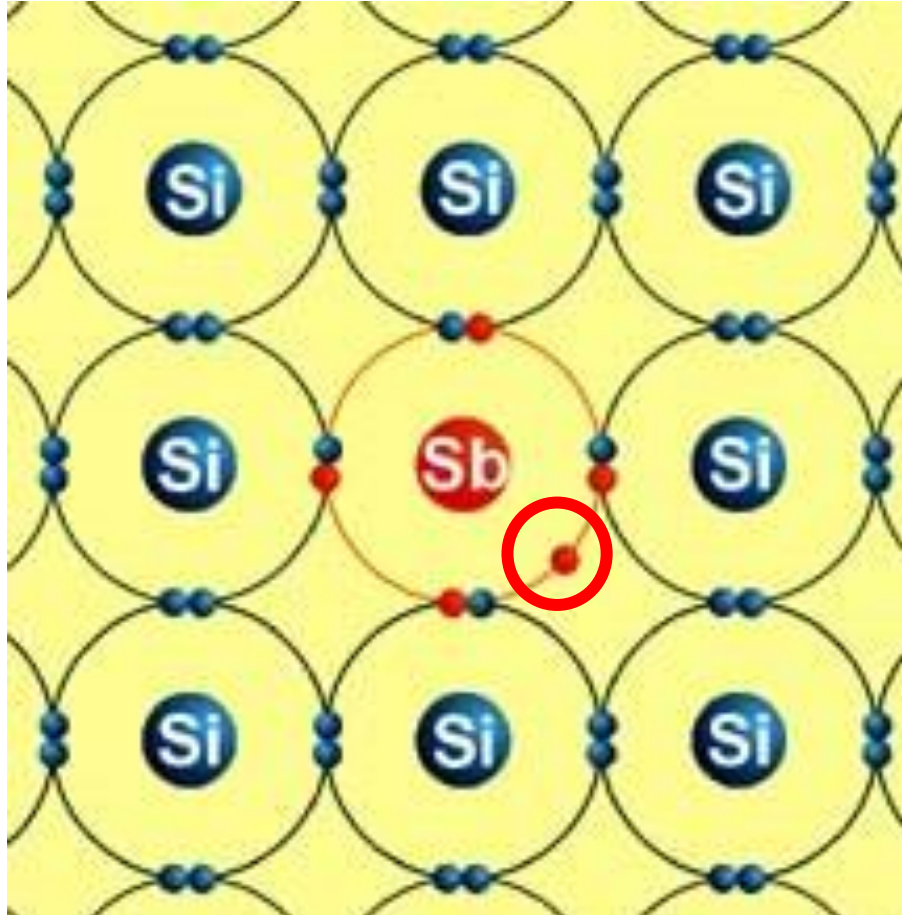
51 ANTIMONIO



**5 Electrones en la ultima capa**



# SEMICONDUCTOR Tipo N

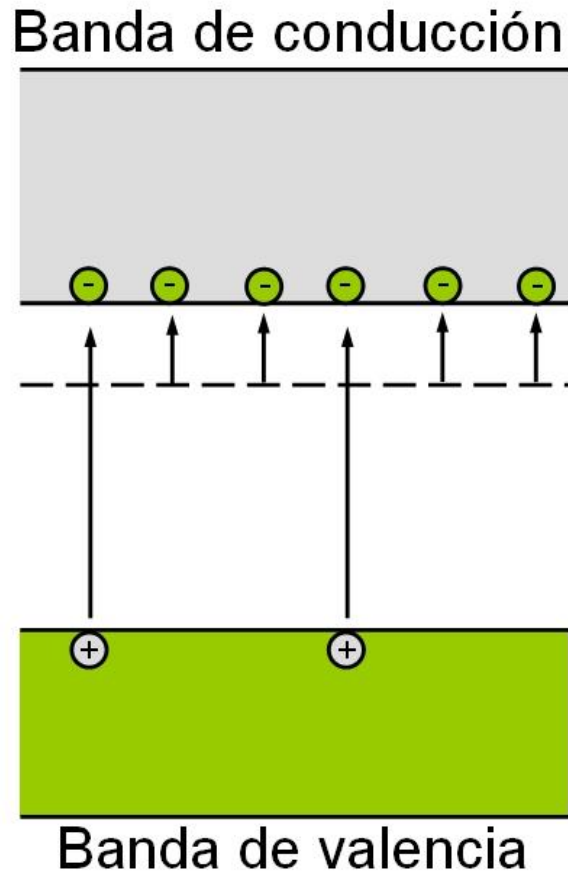
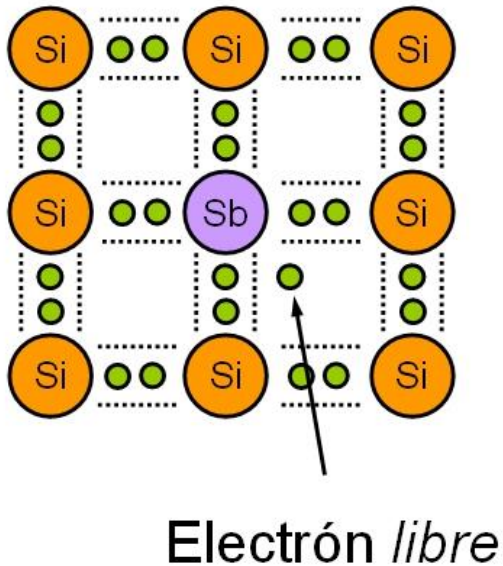


Un electrón libre >

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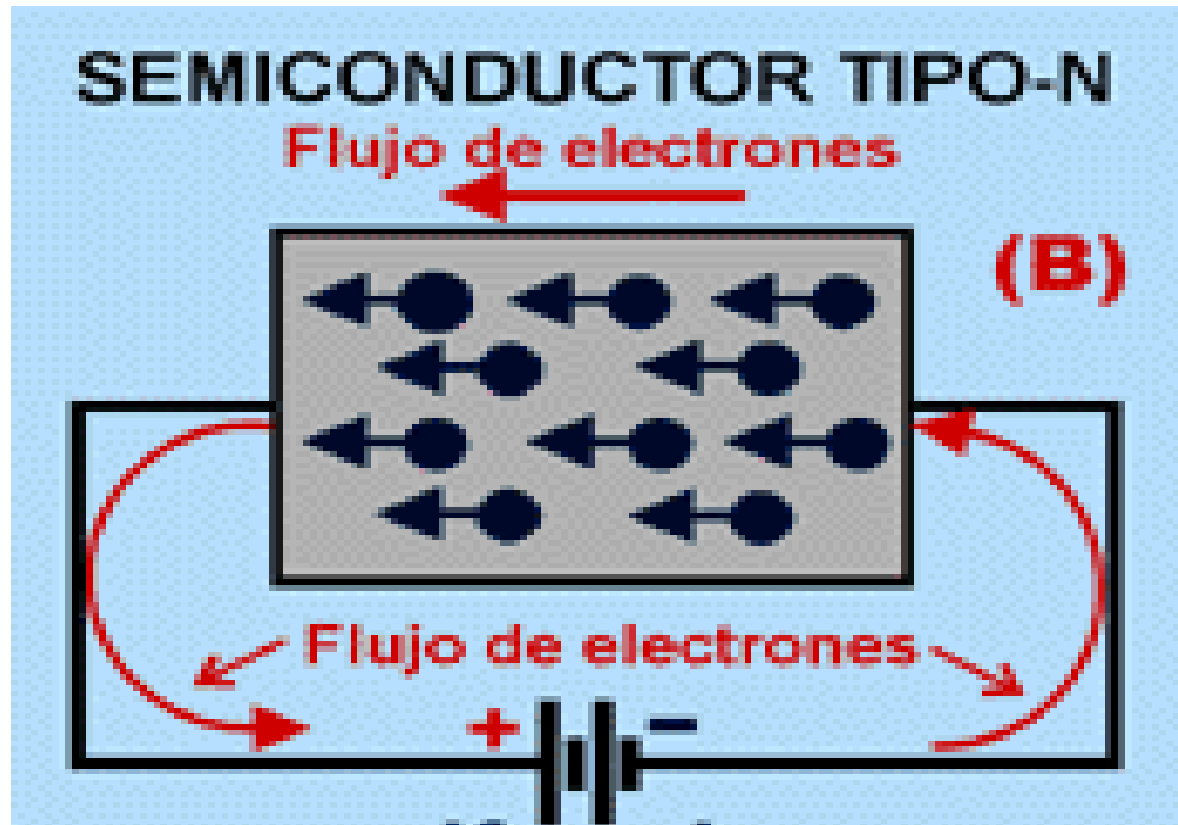
Fuente: [www.asifunciona.com](http://www.asifunciona.com)

# SEMICONDUCTOR Tipo N



Fuente: <https://thetuzaro.wordpress.com/>

# Semiconductor tipo N



Fuente: [www.asifunciona.com](http://www.asifunciona.com)

# DOPADO



IIIa

IVa

Va

VIa

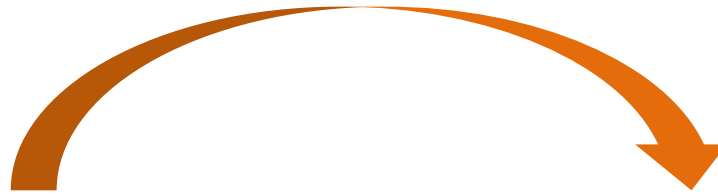
VIIa

4.22	31.8
0.93	1s

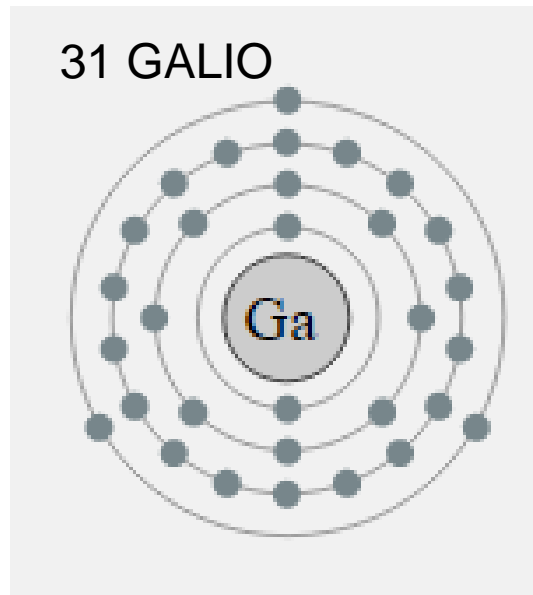
<p><b>5</b></p> <p>10,811</p> <p><b>B</b></p> <p><b>Boro</b></p> <p>3 2.34 1.026 2365 2.04 4275 801 0.82 4.6</p> <p>[He]2s<sup>2</sup>2p<sup>1</sup></p>	<p><b>6</b></p> <p>12,0107</p> <p><b>C</b></p> <p><b>Carbono</b></p> <p>-4.24 0.710 2.26 2.55 4100 1087 5100 4.6 0.77</p> <p>[He]2s<sup>2</sup>2p<sup>2</sup></p>	<p><b>7</b></p> <p>14,00674</p> <p><b>N</b></p> <p><b>Nitrógeno</b></p> <p>-3.2.3.4.5 1.04 1.251 3.04 63.15 1402 77.35 17.3 0.75</p> <p>[He]2s<sup>2</sup>2p<sup>3</sup></p>	<p><b>8</b></p> <p>15,9994</p> <p><b>O</b></p> <p><b>Oxígeno</b></p> <p>-2 0.92 1.429 3.44 54.8 1314 90.18 14.0 0.73</p> <p>[He]2s<sup>2</sup>2p<sup>4</sup></p>	<p><b>9</b></p> <p>18,998403</p> <p><b>F</b></p> <p><b>Flúor</b></p> <p>-1 0.824 1.696 3.98 53.48 1681 84.95 17.1 0.72</p> <p>[He]2s<sup>2</sup>2p<sup>5</sup></p>	<p><b>10</b></p> <p>20,1797</p> <p><b>Ne</b></p> <p><b>Neón</b></p> <p>- 1.03 0.900 - 24.55 2081 27.1 16.7 0.71</p> <p>[He]2s<sup>2</sup>2p<sup>6</sup></p>
<p><b>13</b></p> <p>26,981538</p> <p><b>Al</b></p> <p><b>Aluminio</b></p> <p>3 2.70 0.904 933.5 1.61 2793 578 1.18 10.0</p> <p>[Ne]3s<sup>2</sup>3p<sup>1</sup></p>	<p><b>14</b></p> <p>28,0855</p> <p><b>Si</b></p> <p><b>Silicio</b></p> <p>4 2.33 0.712 1683 1.9 3540 787 1.11 12.1</p> <p>[Ne]3s<sup>2</sup>3p<sup>2</sup></p>	<p><b>15</b></p> <p>30,973761</p> <p><b>P</b></p> <p><b>Fósforo</b></p> <p>-3.3.4.5 0.770 1.82 2.19 317.3 1012 260 17.0 1.06</p> <p>[Ne]3s<sup>2</sup>3p<sup>3</sup></p>	<p><b>16</b></p> <p>32,066</p> <p><b>S</b></p> <p><b>Azufre</b></p> <p>-2.2.4.6 0.705 2.07 2.58 388.4 1000 717.8 15.5 1.02</p> <p>[Ne]3s<sup>2</sup>3p<sup>4</sup></p>	<p><b>17</b></p> <p>35,4527</p> <p><b>Cl</b></p> <p><b>Cloro</b></p> <p>-1.1.3.5.7 0.478 3.214 3.16 172.2 1251 239.1 18.7 0.99</p> <p>[Ne]3s<sup>2</sup>3p<sup>5</sup></p>	<p><b>18</b></p> <p>39,948</p> <p><b>Ar</b></p> <p><b>Argón</b></p> <p>- 0.52 1.784 - 83.8 1521 87.3 24.2 0.98</p> <p>[Ne]3s<sup>2</sup>3p<sup>6</sup></p>
<p><b>31</b></p> <p>69,723</p> <p><b>Ga</b></p> <p><b>Galio</b></p> <p>3 5.91 0.371 302.9 1.81 2478 579 1.26 11.8</p> <p>[Ar]3d<sup>10</sup>4s<sup>2</sup>4p<sup>1</sup></p>	<p><b>32</b></p> <p>72,61</p> <p><b>Ge</b></p> <p><b>Germanio</b></p> <p>4 5.32 0.322 1211.5 2.01 3107 762 1.22 13.6</p> <p>[Ar]3d<sup>10</sup>4s<sup>2</sup>4p<sup>2</sup></p>	<p><b>33</b></p> <p>74,92160</p> <p><b>As</b></p> <p><b>Arsénico</b></p> <p>-3.3.5 0.328 5.72 2.18 1090 (36Atm) 947 886 (Sublim) 13.1 1.20</p> <p>[Ar]3d<sup>10</sup>4s<sup>2</sup>4p<sup>3</sup></p>	<p><b>34</b></p> <p>78,96</p> <p><b>Se</b></p> <p><b>Selenio</b></p> <p>-2.4.6 0.321 4.79 2.55 494 941 958 16.5 1.16</p> <p>[Ar]3d<sup>10</sup>4s<sup>2</sup>4p<sup>4</sup></p>	<p><b>35</b></p> <p>79,904</p> <p><b>Br</b></p> <p><b>Bromo</b></p> <p>-1.1.5 0.473 3.12 2.96 265.9 1140 332.2 23.5 1.14</p> <p>[Ar]3d<sup>10</sup>4s<sup>2</sup>4p<sup>5</sup></p>	<p><b>36</b></p> <p>83,8</p> <p><b>Kr</b></p> <p><b>Kriptón</b></p> <p>- 0.248 3.7 - 115.8 1351 119.8 32.2 1.12</p> <p>[Ar]3d<sup>10</sup>4s<sup>2</sup>4p<sup>6</sup></p>
<p><b>49</b></p> <p>114,818</p> <p><b>In</b></p> <p><b>Indio</b></p> <p>3 7.31 0.233 429.8 1.78 2346 558 1.44 15.7</p> <p>[Kr]4d<sup>10</sup>5s<sup>2</sup>5p<sup>1</sup></p>	<p><b>50</b></p> <p>118,71</p> <p><b>Sn</b></p> <p><b>Estaño</b></p> <p>2.4 0.228 7.31 1.96 505.1 709 2876 16.3 1.41</p> <p>[Kr]4d<sup>10</sup>5s<sup>2</sup>5p<sup>2</sup></p>	<p><b>51</b></p> <p>121,760</p> <p><b>Sb</b></p> <p><b>Antimonio</b></p> <p>-3.3.5 0.207 6.69 2.05 904 834 1860 18.4 1.40</p> <p>[Kr]4d<sup>10</sup>5s<sup>2</sup>5p<sup>3</sup></p>	<p><b>52</b></p> <p>127,60</p> <p><b>Te</b></p> <p><b>Teluro</b></p> <p>-2.4.6 0.201 6.24 2.1 722.7 869 1261 20.5 1.36</p> <p>[Kr]4d<sup>10</sup>5s<sup>2</sup>5p<sup>4</sup></p>	<p><b>53</b></p> <p>126,90447</p> <p><b>I</b></p> <p><b>Yodo</b></p> <p>-1.1.5.7 0.214 4.93 2.66 386.7 1008 458.4 25.7 1.33</p> <p>[Kr]4d<sup>10</sup>5s<sup>2</sup>5p<sup>5</sup></p>	<p><b>54</b></p> <p>131,29</p> <p><b>Xe</b></p> <p><b>Xenón</b></p> <p>- 0.158 5.9 2.6 161.4 1170 165.1 42.9 1.31</p> <p>[Kr]4d<sup>10</sup>5s<sup>2</sup>5p<sup>6</sup></p>

V

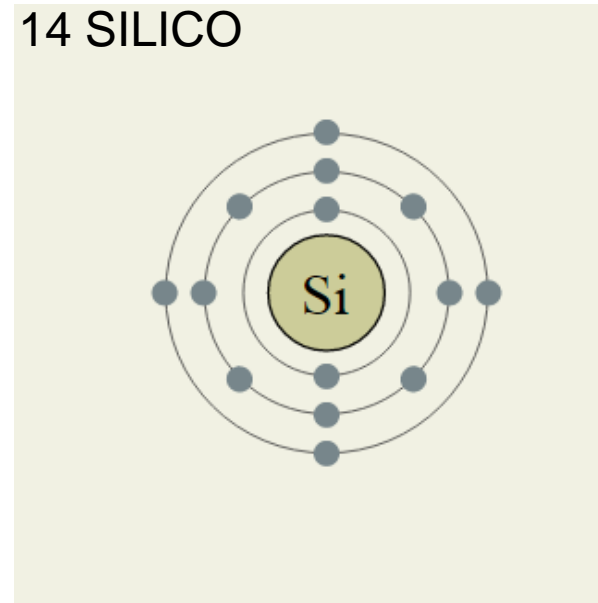
# Dopado o Metalización



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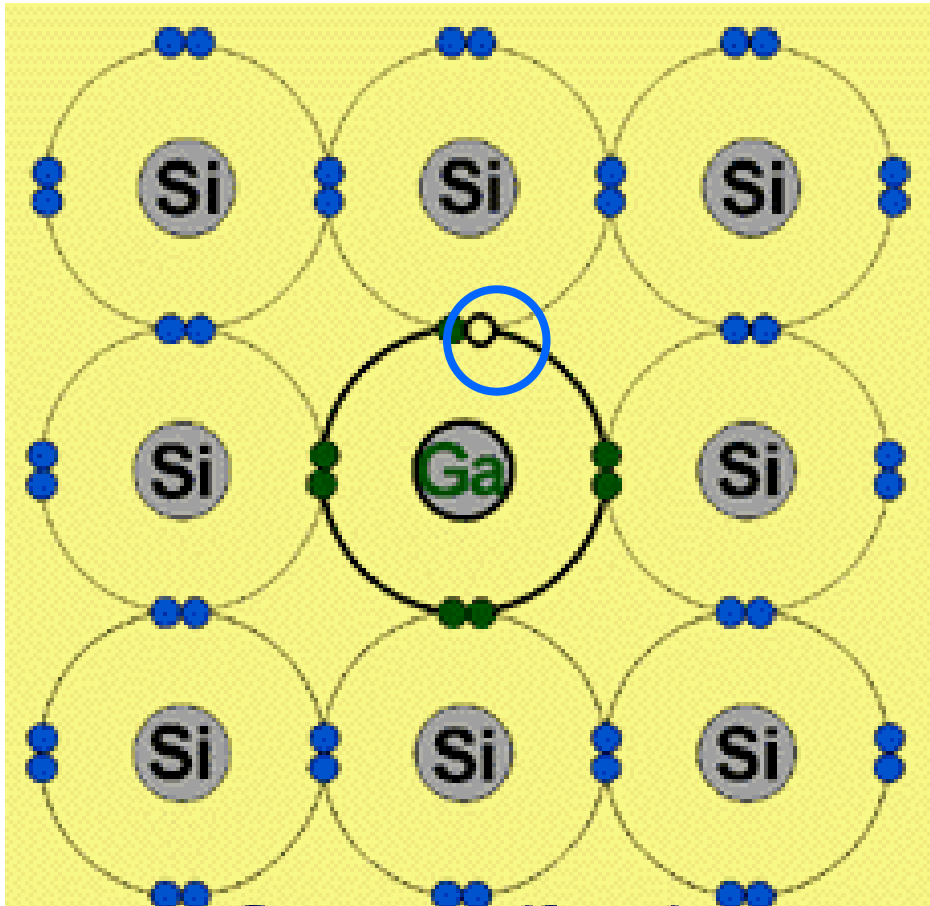


**3** Electrones en la ultima capa



**4** Electrones en la ultima capa

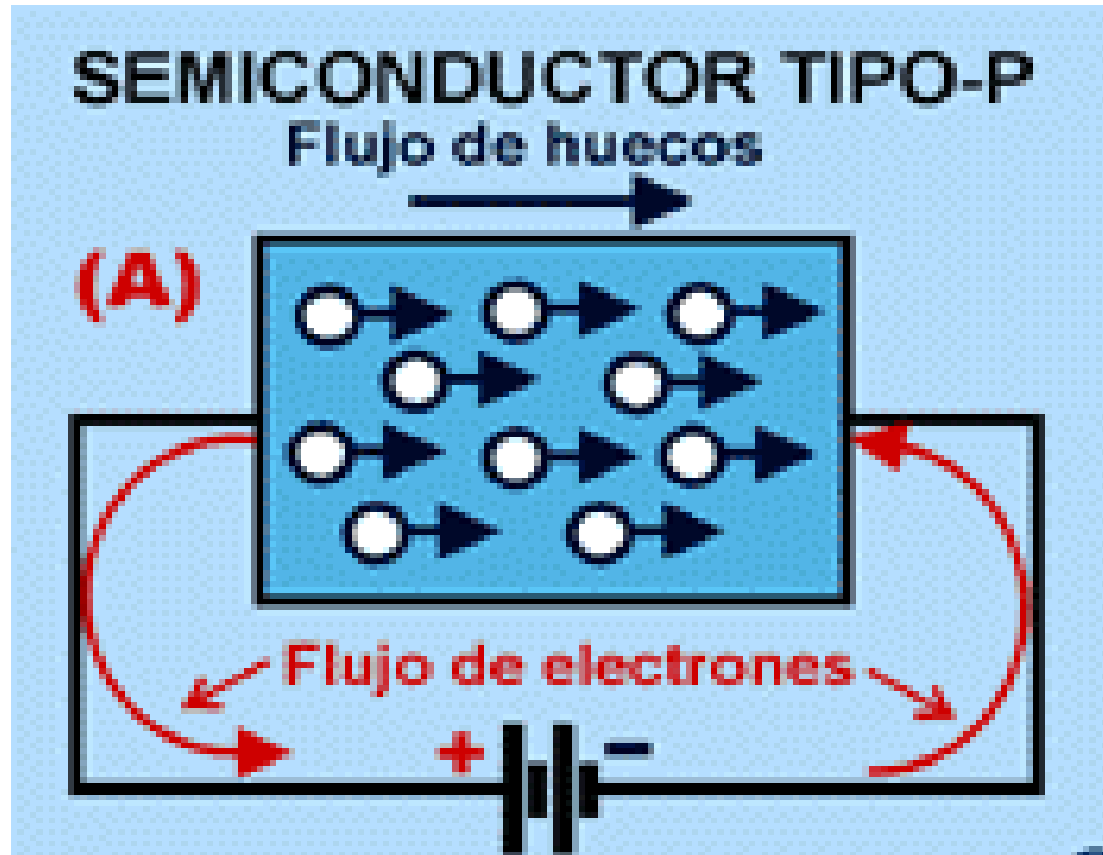
# SEMICONDUCTOR Tipo P



Falta un electrón,  
hueco (laguna) >

Fuente: [www.asifunciona.com](http://www.asifunciona.com)

# Semiconductor tipo P

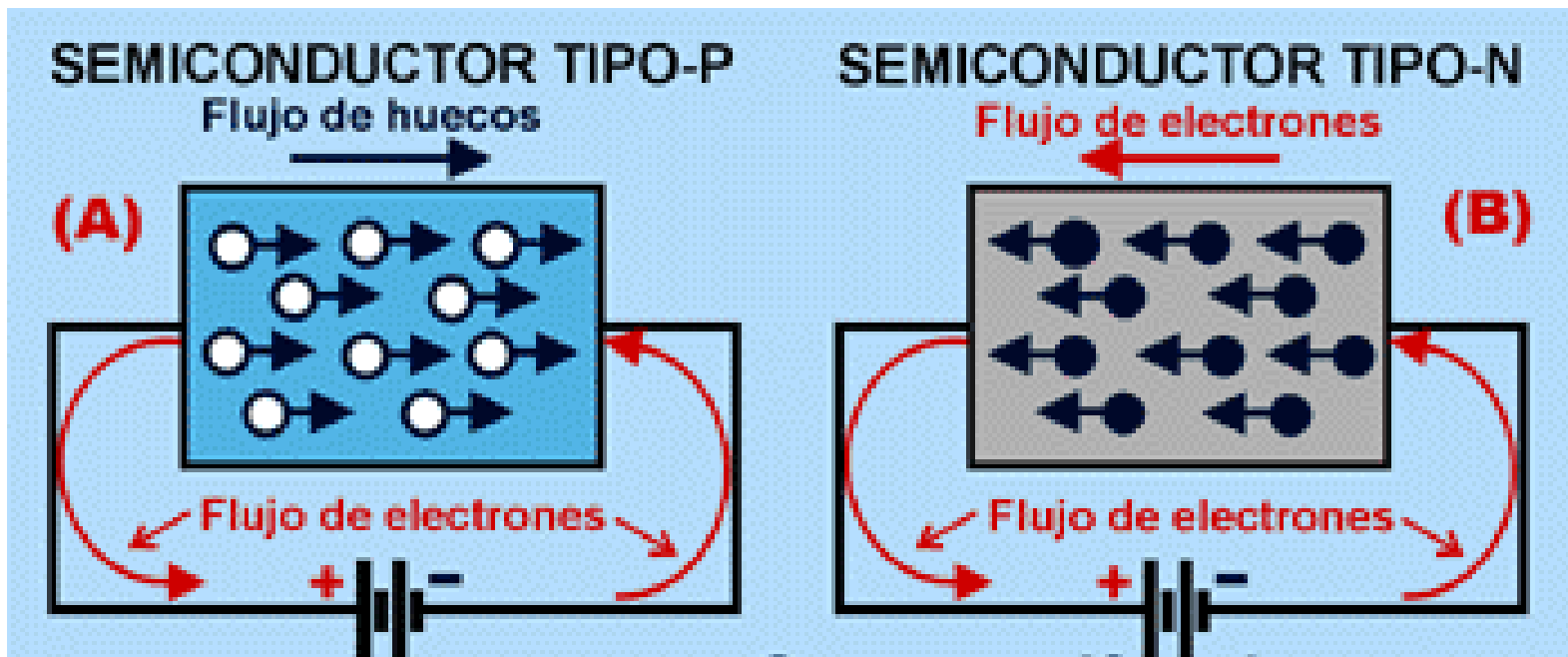


Fuente: [www.asifunciona.com](http://www.asifunciona.com)

# Conducción en Materiales

## SEMICONDUCTORES

### *Extrínsecos*



Fuente: [www.asifunciona.com](http://www.asifunciona.com)



# CONDUCCION DE MATERIAL SEMICONDUCTOR EXTRINSECO (Metalizado)



# FIN



