

# PERIODIC TABLE OF THE ELEMENTS

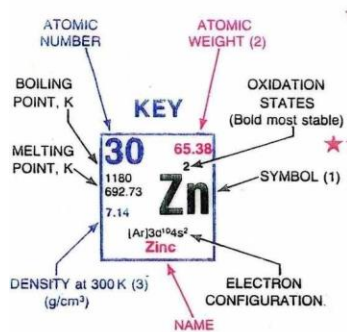


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GROUP IA																				VIII									
1 1.0079 20.268 14.025 0.0899 1s <b>H</b> Hydrogen																			2 4.00260 4.215 0.95 0.1787 1s <b>He</b> Helium										
3 6.941 1815 453.7 0.53 1s <sup>2</sup> 2s <b>Li</b> Lithium	4 9.01218 2745 1560 1.85 1s <sup>2</sup> 2s <b>Be</b> Beryllium																			5 10.81 4275 2300 2.34 1s <sup>2</sup> 2s <sup>2</sup> p <b>B</b> Boron	6 12.011 4470* 4100* 2.62 1s <sup>2</sup> 2s <sup>2</sup> p <b>C</b> Carbon	7 14.0067 77.35 63.14 1.251* 1s <sup>2</sup> 2s <sup>2</sup> p <b>N</b> Nitrogen	8 15.9994 90.18 50.35 1.429* 1s <sup>2</sup> 2s <sup>2</sup> p <b>O</b> Oxygen	9 18.998403 84.95 53.48 1.696* 1s <sup>2</sup> 2s <sup>2</sup> p <b>F</b> Fluorine	10 20.179 27.096 24.553 0.901* 1s <sup>2</sup> 2s <sup>2</sup> p <b>Ne</b> Neon				
11 22.98977 1156 371.0 0.97 [Ne]3s <b>Na</b> Sodium	12 24.305 1363 922 1.74 [Ne]3s <b>Mg</b> Magnesium																			13 26.98154 2793 933.25 2.70 [Ne]3s <sup>2</sup> p <b>Al</b> Aluminum	14 28.0855 3540 1685 2.33 [Ne]3s <sup>2</sup> p <b>Si</b> Silicon	15 30.97376 550 317.30 1.82 [Ne]3s <sup>2</sup> p <b>P</b> Phosphorus	16 32.06 717.75 388.36 2.07 [Ne]3s <sup>2</sup> p <b>S</b> Sulfur	17 35.453 238.1 172.16 3.17* [Ne]3s <sup>2</sup> p <b>Cl</b> Chlorine	18 39.948 87.30 83.81 1.784* [Ne]3s <sup>2</sup> p <b>Ar</b> Argon				
19 39.0983 1032 336.35 0.86 [Ar] 4s <b>K</b> Potassium	20 40.08 1757 1812 1.55 [Ar]4s <b>Ca</b> Calcium	21 44.9559 3104 1943 3.0 [Ar]3d <sup>1</sup> 4s <b>Sc</b> Scandium	22 47.90 3562 1943 4.50 [Ar]3d <sup>2</sup> 4s <b>Ti</b> Titanium	23 50.9415 3682 2175 5.8 [Ar]3d <sup>3</sup> 4s <b>V</b> Vanadium	24 51.996 2945 2130 7.19 [Ar]3d <sup>3</sup> 4s <b>Cr</b> Chromium	25 54.9380 2335 1517 7.43 [Ar]3d <sup>5</sup> 4s <b>Mn</b> Manganese	26 55.847 3135 1809 7.86 [Ar]3d <sup>6</sup> 4s <b>Fe</b> Iron	27 58.9332 3201 1768 8.90 [Ar]3d <sup>6</sup> 4s <b>Co</b> Cobalt	28 58.70 3187 1726 8.90 [Ar]3d <sup>7</sup> 4s <b>Ni</b> Nickel	29 63.546 2836 1357.6 8.96 [Ar]3d <sup>9</sup> 4s <b>Cu</b> Copper	30 65.38 1180 692.73 7.14 [Ar]3d <sup>10</sup> 4s <b>Zn</b> Zinc	31 69.72 2478 302.90 5.51 [Ar]3d <sup>10</sup> 4s <b>Ga</b> Gallium	32 72.59 3107 1210.4 5.32 [Ar]3d <sup>10</sup> 4s <b>Ge</b> Germanium	33 74.9216 876 1081 5.72 [Ar]3d <sup>10</sup> 4s <b>As</b> Arsenic	34 78.96 958 494 4.80 [Ar]3d <sup>10</sup> 4s <b>Se</b> Selenium	35 79.904 332.25 265.90 3.12 [Ar]3d <sup>10</sup> 4s <b>Br</b> Bromine	36 83.80 119.80 115.78 3.74* [Ar]3d <sup>10</sup> 4s <b>Kr</b> Krypton												
37 85.4678 961 312.64 1.53 [Kr]5s <b>Rb</b> Rubidium	38 87.62 1650 1799 2.6 [Kr]5s <b>Sr</b> Strontium	39 88.9059 3611 1812 4.5 [Kr]4d <sup>1</sup> 5s <b>Y</b> Yttrium	40 91.22 4682 2125 6.49 [Kr]4d <sup>2</sup> 5s <b>Zr</b> Zirconium	41 92.9064 53 4912 2890 8.55 [Kr]4d <sup>3</sup> 5s <b>Nb</b> Niobium	42 95.94 6.5 4538 2473 11.5 [Kr]4d <sup>4</sup> 5s <b>Mo</b> Molybdenum	43 (98) 101.07 4423 2523 12.2 [Kr]4d <sup>5</sup> 5s <b>Tc</b> Technetium	44 101.07 2.3, 4.6, 8 3970 2236 12.4 [Kr]4d <sup>5</sup> 5s <b>Ru</b> Ruthenium	45 102.9055 2.3, 4 3237 1825 12.0 [Kr]4d <sup>6</sup> 5s <b>Rh</b> Rhodium	46 106.4 2.4 2436 1825 10.5 [Kr]4d <sup>8</sup> 5s <b>Pd</b> Palladium	47 107.868 1040 594.18 6.65 [Kr]4d <sup>9</sup> 5s <b>Ag</b> Silver	48 112.41 2 1040 594.18 6.65 [Kr]4d <sup>10</sup> 5s <b>Cd</b> Cadmium	49 114.82 2346 429.76 7.31 [Kr]4d <sup>10</sup> 5s <b>In</b> Indium	50 118.69 4.2 2876 505.06 7.30 [Kr]4d <sup>10</sup> 5s <b>Sn</b> Tin	51 121.75 -3.5 1860 904 6.68 [Kr]4d <sup>10</sup> 5s <b>Sb</b> Antimony	52 127.60 -2.4, 6 1261 722.65 6.24 [Kr]4d <sup>10</sup> 5s <b>Te</b> Tellurium	53 126.9045 -1.5, 7 458.4 386.7 -9.2 [Kr]4d <sup>10</sup> 5s <b>I</b> Iodine	54 131.30 165.03 161.36 5.69* [Kr]4d <sup>10</sup> 5s <b>Xe</b> Xenon												
55 132.9054 944 310.55 1.87 [Xe]6s <b>Cs</b> Cesium	56 137.33 2171 1002 3.5 [Xe]6s <b>Ba</b> Barium	57 138.9055 3730 1193 6.7 [Xe]5d <sup>1</sup> 6s <b>La</b> Lanthanum	72 178.49 4876 2500 13.1 [Xe]4f <sup>1</sup> 5d <sup>1</sup> 6s <b>Hf</b> Hafnium	73 180.9479 5731 3287 16.6 [Xe]4f <sup>14</sup> 5d <sup>1</sup> 6s <b>Ta</b> Tantalum	74 183.85 5828 3680 19.3 [Xe]4f <sup>14</sup> 5d <sup>2</sup> 6s <b>W</b> Tungsten	75 186.207 5869 3453 21.0 [Xe]4f <sup>14</sup> 5d <sup>4</sup> 6s <b>Re</b> Rhenium	76 190.2 5285 3300 22.4 [Xe]4f <sup>14</sup> 5d <sup>6</sup> 6s <b>Os</b> Osmium	77 192.22 2.3, 4.6, 8 4701 2716 22.5 [Xe]4f <sup>14</sup> 5d <sup>7</sup> 6s <b>Ir</b> Iridium	78 195.09 2.4 4100 2045 21.4 [Xe]4f <sup>14</sup> 5d <sup>8</sup> 6s <b>Pt</b> Platinum	79 196.9665 3.1 3130 1337.58 19.3 [Xe]4f <sup>14</sup> 5d <sup>9</sup> 6s <b>Au</b> Gold	80 200.59 2.1 630 234.28 13.53 [Xe]4f <sup>14</sup> 5d <sup>10</sup> 6s <b>Hg</b> Mercury	81 204.37 3.1 1746 577 11.65 [Xe]4f <sup>14</sup> 5d <sup>10</sup> 6s <b>Tl</b> Thallium	82 207.2 4.2 2023 600.6 11.4 [Xe]4f <sup>14</sup> 5d <sup>10</sup> 6s <b>Pb</b> Lead	83 208.9804 3.5 1837 544.52 9.6 [Xe]4f <sup>14</sup> 5d <sup>10</sup> 6s <b>Bi</b> Bismuth	84 (209) 4.2 1837 544.52 9.4 [Xe]4f <sup>14</sup> 5d <sup>10</sup> 6s <b>Po</b> Polonium	85 (210) -1.3, 5, 7 610 575 9.91* [Xe]4f <sup>14</sup> 5d <sup>10</sup> 6s <b>At</b> Astatine	86 (222) 211 202 9.91* [Xe]4f <sup>14</sup> 5d <sup>10</sup> 6s <b>Rn</b> Radon												
87 (223) 950 300 [Rn]7s <b>Fr</b> Francium	88 226.0254 1809 973 5 [Rn]7s <b>Ra</b> Radium	89 227.0278 3473 1323 10.07 [Rn]6d <sup>1</sup> 7s <b>Ac</b> Actinium	104 (261) [Rn]5f <sup>14</sup> 6d <sup>2</sup> 7s <b>Unq</b> (Unnilquadium)	105 (262) [Rn]5f <sup>14</sup> 6d <sup>3</sup> 7s <b>Unp</b> (Unnilpentium)	106 (263) [Rn]5f <sup>14</sup> 6d <sup>4</sup> 7s <b>Unh</b> (Unnilhexium)																								



58 140.12 3.4 3699 1071 6.76 [Xe]4f <sup>14</sup> 5d <sup>1</sup> 6s <b>Ce</b> Cerium	59 140.9077 3.4 3785 1204 7.00 [Xe]4f <sup>15</sup> 6s <b>Pr</b> Praseodymium	60 144.24 3 3341 1289 7.00 [Xe]4f <sup>6</sup> 6s <b>Nd</b> Neodymium	61 (145) 3 3785 1204 6.475 [Xe]4f <sup>6</sup> 6s <b>Pm</b> Promethium	62 150.4 3.2 2064 1345 7.54 [Xe]4f <sup>6</sup> 6s <b>Sm</b> Samarium	63 151.96 3.2 1870 1090 5.26 [Xe]4f <sup>6</sup> 6s <b>Eu</b> Europium	64 157.25 3 3539 1585 7.85 [Xe]4f <sup>7</sup> 6s <b>Gd</b> Gadolinium	65 158.9254 3.4 3496 1682 8.27 [Xe]4f <sup>7</sup> 6s <b>Tb</b> Terbium	66 162.50 3 2835 1682 6.54 [Xe]4f <sup>9</sup> 6s <b>Dy</b> Dysprosium	67 164.9304 3 2968 1743 8.80 [Xe]4f <sup>10</sup> 6s <b>Ho</b> Holmium	68 167.26 3 3136 1795 9.05 [Xe]4f <sup>11</sup> 6s <b>Er</b> Erbium	69 168.9342 3.2 2220 1818 9.33 [Xe]4f <sup>12</sup> 6s <b>Tm</b> Thulium	70 173.04 3.2 1467 1097 6.98 [Xe]4f <sup>13</sup> 6s <b>Yb</b> Ytterbium	71 174.967 3 3668 1936 9.84 [Xe]4f <sup>14</sup> 5d <sup>1</sup> 6s <b>Lu</b> Lutetium
90 232.0381 4 5061 2028 11.7 [Rn]6d <sup>2</sup> 7s <b>Th</b> Thorium	91 231.0359 5.4 4407 1405 15.4 [Rn]5f <sup>6</sup> 6d <sup>2</sup> 7s <b>Pa</b> Protactinium	92 238.029 5.4 4407 1405 19.50 [Rn]5f <sup>6</sup> 6d <sup>2</sup> 7s <b>U</b> Uranium	93 237.0482 6.5, 4.3 910 20.4 19.8 [Rn]5f <sup>6</sup> 6d <sup>2</sup> 7s <b>Np</b> Neptunium	94 244 6.5, 4.3 3503 913 12.6 [Rn]5f <sup>7</sup> 7s <b>Pu</b> Plutonium	95 (243) 6.5, 4.3 2880 1368 13.511 [Rn]5f <sup>7</sup> 7s <b>Am</b> Americium	96 (247) 3 1340 13.511 [Rn]5f <sup>7</sup> 7s <b>Cm</b> Curium	97 (247) 4.3 [Rn]5f <sup>7</sup> 7s <b>Bk</b> Berkelium	98 (251) 3 900 [Rn]5f <sup>7</sup> 7s <b>Cf</b> Californium	99 (257) [Rn]5f <sup>7</sup> 7s <b>Es</b> Einsteinium	100 (257) [Rn]5f <sup>7</sup> 7s <b>Fm</b> Fermium	101 (258) [Rn]5f <sup>7</sup> 7s <b>Md</b> Mendelevium	102 (259) [Rn]5f <sup>7</sup> 7s <b>No</b> Nobelium	103 (260) [Rn]5f <sup>6</sup> 6d <sup>1</sup> 7s <b>Lr</b> Lawrencium



# TABLE OF PERIODIC PROPERTIES OF THE ELEMENTS

## Percent Ionic Character of a Single Chemical Bond

Difference in electronegativity	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2
Percent ionic character %	0.5	1	2	4	6	9	12	15	19	22	26	30	34	39	43	47	51	55	59	63	67	70	74	76	79	82	84	86	88	89	91	92

### GROUP IA

H	0.32	2.20
Li	0.79	0.44936
Na	14.4	0.058.68
K	13.598	—
Rb	14.304	0.001815

### IIA

Be	0.90	1.57
Mg	1.23	0.98
Ca	2.05	1.45920
Sc	13.10	3.00
Ti	5.392	0.154
V	3.6	0.847
Cr	1.82	2.00
Mn	1.54	0.93
Fe	2.23	0.96960
Ni	23.7	2.598
Cu	3.139	0.310
Zn	1.23	1.41

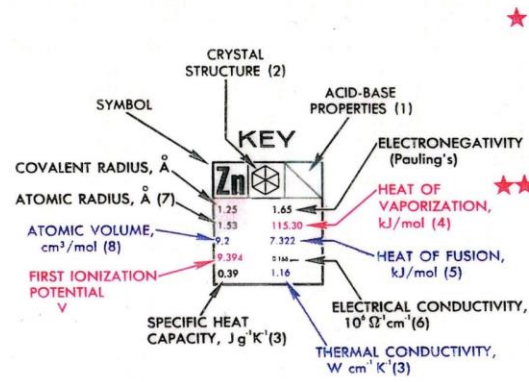
	Neutron	Proton	Electron <sup>+</sup>	Neutrino <sup>+</sup>	Photon
Symbol	n	p	e (e <sup>-</sup> )	ν	γ
Rest mass (kg)	1.67495x10 <sup>-27</sup>	1.67265x10 <sup>-27</sup>	9.1095x10 <sup>-31</sup>	~0	0
Relative atomic mass ( <sup>12</sup> C = 12)	1.008665	1.007276	5.48580x10 <sup>-4</sup>	~0	0
Charge (C)	0	1.60219x10 <sup>-19</sup>	-1.60219x10 <sup>-19</sup>	0	0
Radius (m)	8x10 <sup>-16</sup>	8x10 <sup>-16</sup>	<1x10 <sup>-16</sup>	~0	0
Spin quantum number	1/2	1/2	1/2	1/2	1
Magnetic Moment†	-1.913 μ <sub>N</sub>	2.793 μ <sub>N</sub>	1.001 μ <sub>B</sub>	0	0

\* The positron (e<sup>+</sup>) has properties similar to those of the (negative) electron or beta particle except that its charge has opposite sign (+). The antineutrino (ν̄) has properties similar to those of the neutrino except that its spin (or rotation) is opposite in relation to its direction of propagation.  
 † μ<sub>B</sub> = Bohr magneton and μ<sub>N</sub> = Nuclear magneton.

### VIII

He	0.93	—
Ne	0.49	0.0845
Ar	24.587	—
Kr	5.193	0.00152

IIIA	IVA	VA	VIA	VIIA	VIIIA	IB	IIB	IIIB	IVB	VB	VIB	VIIB	VIII				
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	Unq	Unp	Unh												



Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
1.65	1.12	1.65	1.13	1.64	1.14	1.63	1.13	1.62	1.17	1.85	1.2	1.61	1.20
2.70	4.140	2.67	296.80	2.64	273.0	2.62	—	2.59	166.40	2.56	143.50	2.54	359.40
20.67	5.460	20.8	6.890	20.6	7.140	22.39	—	19.95	8.630	28.9	9.210	19.9	10.030
5.54	0.015	5.46	0.014	5.53	0.015	5.554	—	5.64	0.0094	5.67	0.012	5.65	0.0094
0.19	0.114	0.19	0.125	0.19	0.119	0.165	—	0.20	0.133	0.18	0.139	0.23	0.105
1.65	1.3	—	1.5	1.42	1.38	—	1.36	—	1.28	—	1.3	—	1.3
19.9	16.10	15.0	12.30	12.59	8.520	11.62	5.190	112.32	2.840	17.84	14.40	18.28	15.0
6.08	0.943	5.89	0.029	6.05	0.030	6.19	0.032	6.06	0.0066	5.993	0.029	6.02	—
0.12	0.540	—	0.47*	0.12	0.276	0.12	0.063	0.13*	0.0674	0.11*	0.1*	—	—

- NOTES: (1) For representative oxides (higher valence) of group. Oxide is acidic if color is red, basic if color is blue and amphoteric if both colors are shown. Intensity of color indicates relative strength.
- (2) Cubic, face centered; Cubic, body centered; Cubic; Hexagonal; Rhombohedral; Tetragonal; Orthorhombic; Monoclinic.
- (3) At 300 K (27°C) (6) Generally at 293 K (20°C) (8) From density at 300 K (27°C) for liquid and solid elements; values for gaseous elements refer to liquid state at boiling point
- (4) At boiling point (7) Quantum mechanical value for free atom
- (5) At melting point

