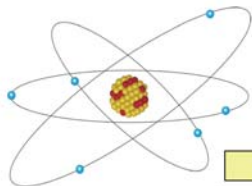


Atomic Structure and Periodic Law



| Atom | Nucleus | Proton | Charge |
|----------|---------|--------|----------|
| | | | + |
| | Neutron | | 0 |
| Electron | | | - |

The number of protons (atomic number) determines the chemical properties.

| Periodic Table of Elements | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|----------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|---------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--|--|--|--------------------|----------------|----------------|----------------|---------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|--|--|--|
| Group | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Period | 1 | 1 H 1.008 | | | | | | | | | | | | | | | | | 2 He 4.003 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2 | 3 Li 6.941 | 4 Be 9.012 | | | | | | | | | 5 B 10.81 | 6 C 12.01 | 7 N 14.01 | 8 O 16.00 | 9 F 19.00 | 10 Ne 20.18 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 3 | 11 Na 22.99 | 12 Mg 24.31 | | | | | | | | | 13 Al 26.98 | 14 Si 28.09 | 15 P 30.97 | 16 S 32.07 | 17 Cl 35.46 | 18 Ar 39.95 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 4 | 19 K 39.10 | 20 Ca 40.08 | 21 Sc 44.96 | 22 Ti 47.87 | 23 V 50.94 | 24 Cr 52.00 | 25 Mn 54.94 | 26 Fe 55.85 | 27 Co 58.93 | 28 Ni 58.69 | 29 Cu 63.55 | 30 Zn 65.38 | 31 Ga 69.72 | 32 Ge 72.63 | 33 As 74.92 | 34 Se 78.97 | 35 Br 79.90 | 36 Kr 83.80 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 5 | 37 Rb 85.47 | 38 Sr 87.62 | 39 Y 88.91 | 40 Zr 91.22 | 41 Nb 92.91 | 42 Mo 95.95 | (99) | 44 Ru 101.1 | 45 Rh 102.9 | 46 Pd 106.4 | 47 Ag 107.9 | 48 Cd 112.4 | 49 In 114.8 | 50 Sn 118.7 | 51 Sb 121.8 | 52 Te 127.6 | 53 I 126.9 | 54 Xe 131.3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | 55 Cs 132.9 | 56 Ba 137.3 | Lanthanoid | | 72 Hf 178.5 | 73 Ta 180.9 | 74 W 183.8 | 75 Re 186.2 | 76 Os 190.2 | 77 Ir 192.2 | 78 Pt 195.1 | 79 Au 197.0 | 80 Hg 200.6 | 81 Tl 204.4 | 82 Pb 207.2 | 83 Bi 209.0 | 84 Po (210) | 85 At (210) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | 87 Fr (223) | 88 Ra (226) | Actinoid | | 104 Rf (267) | 105 Db (268) | 106 Sg (271) | 107 Bh (272) | 108 Hs (277) | 109 Mt (276) | 110 Ds (281) | 111 Rg (280) | 112 Cn (285) | 113 Nh (286) | 114 Fl (289) | 115 Mc (289) | 116 Lv (293) | 117 Ts (293) | 118 Og (294) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table><tr><td>57-71 Lanthanoid</td><td>57 La 138.9</td><td>58 Ce 140.1</td><td>59 Pr 140.9</td><td>60 Nd 144.2</td><td>61 Pm (145)</td><td>62 Sm 150.4</td><td>63 Eu 152.0</td><td>64 Gd 157.3</td><td>65 Tb 158.9</td><td>66 Dy 162.5</td><td>67 Ho 164.9</td><td>68 Er 167.3</td><td>69 Tm 168.9</td><td>70 Yb 173.0</td><td>71 Lu 175.0</td><td colspan="3"></td></tr><tr><td>89-103 Actinoid</td><td>89 Ac (227)</td><td>90 Th 232.0</td><td>91 Pa 231.0</td><td>92 U 238.0</td><td>93 Np (237)</td><td>94 Pu (243)</td><td>95 Am (243)</td><td>96 Cm (247)</td><td>97 Bk (247)</td><td>98 Cf (252)</td><td>99 Es (252)</td><td>100 Fm (257)</td><td>101 Md (269)</td><td>102 No (269)</td><td>103 Lr (262)</td><td colspan="3"></td></tr></table> | | | | | | | | | | | | | | | | | | | 57-71 Lanthanoid | 57 La 138.9 | 58 Ce 140.1 | 59 Pr 140.9 | 60 Nd 144.2 | 61 Pm (145) | 62 Sm 150.4 | 63 Eu 152.0 | 64 Gd 157.3 | 65 Tb 158.9 | 66 Dy 162.5 | 67 Ho 164.9 | 68 Er 167.3 | 69 Tm 168.9 | 70 Yb 173.0 | 71 Lu 175.0 | | | | 89-103 Actinoid | 89 Ac (227) | 90 Th 232.0 | 91 Pa 231.0 | 92 U 238.0 | 93 Np (237) | 94 Pu (243) | 95 Am (243) | 96 Cm (247) | 97 Bk (247) | 98 Cf (252) | 99 Es (252) | 100 Fm (257) | 101 Md (269) | 102 No (269) | 103 Lr (262) | | | |
| 57-71 Lanthanoid | 57 La 138.9 | 58 Ce 140.1 | 59 Pr 140.9 | 60 Nd 144.2 | 61 Pm (145) | 62 Sm 150.4 | 63 Eu 152.0 | 64 Gd 157.3 | 65 Tb 158.9 | 66 Dy 162.5 | 67 Ho 164.9 | 68 Er 167.3 | 69 Tm 168.9 | 70 Yb 173.0 | 71 Lu 175.0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 89-103 Actinoid | 89 Ac (227) | 90 Th 232.0 | 91 Pa 231.0 | 92 U 238.0 | 93 Np (237) | 94 Pu (243) | 95 Am (243) | 96 Cm (247) | 97 Bk (247) | 98 Cf (252) | 99 Es (252) | 100 Fm (257) | 101 Md (269) | 102 No (269) | 103 Lr (262) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

The numbers in parentheses are the nuclear numbers of the typical radioisotopes of the elements (IUPAC).

Prepared based on "One Periodic Table per One Household (11th Edition)": Ministry of Education, Culture, Sports, Science and Technology (MEXT)

An atom is composed of a nucleus and electrons that go around the former. The nucleus is composed of protons with a positive charge and neutrons without charge, and the number of protons (atomic number) determines the chemical properties of the atom (element type).

For example, carbon has six protons, but there are also types of carbon with five, six, seven or eight neutrons. All of them have the same chemical properties.

When calling them distinctively, they are called Carbon 11, Carbon 12, Carbon 13 and Carbon 14, adding the nuclear number (total of protons and neutrons) after the element name, which is a nominal designation that covers the same types of atoms. Carbon 12 is the one that most commonly exists in nature.

Carbon 14 is a radionuclide which exists in nature and is made through a process where a proton of Nitrogen 14 is hit and removed by a neutron created as a result of collisions of cosmic rays and the atmosphere. Carbon 14 has six protons and eight neutrons, and the state is energetically unstable because of the unbalance of both numbers.

If one neutron of Carbon 14 changes to a proton, the element becomes stable because the numbers of protons and neutrons are both seven. At this time, an electron is emitted as extra energy. This is the identity of β (beta)-particles. In other words, Carbon 14 returns to nitrogen having seven protons by emitting β -particles, and becomes energetically stable.

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