# Periodic Table of the Elements


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**Frequently used fundamental physical constants**

1 second = 9 192 631 770 periods of radiation corresponding to the transition between the two hyperfine levels of the ground state of $^{133}Cs$

| | | |
|---|---|---|
| speed of light in vacuum | $c$ | 299 792 458 m $s^{-1}$ *(exact)* |
| Planck constant | $h$ | 6.6261 x $10^{-34}$ J s $(\hbar=h/2\pi)$ |
| elementary charge | $e$ | 1.6022 x $10^{-19}$ C |
| electron mass | $m_e$ | 9.1094 x $10^{-31}$ kg |
| proton mass | $m_p$ | 1.6726 x $10^{-27}$ kg |
| fine-structure constant | $\alpha$ | 1/137.036 |
| Rydberg constant | $R_\infty$ | 10 973 732 $m^{-1}$ |
| Boltzmann constant | $k$ | 1.3807 x $10^{-23}$ J $K^{-1}$ |

† Based upon $^{12}C$. () Indicates the mass number of the most stable isotope.

| | |
|---|---|
| Alkali Metals | Post-Transition Metals |
| Alkaline Earth Metals | Metalloids |
| Lanthanoids | Other-Non Metals |
| Actinoids | Halogens |
| Transition Metals | Noble Gases |

Solids — Liquids — Gases — Artificial

| Group | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | IA | IIA | IIIB | IVB | VB | VIB | VIIB | VIIIB | | | IB | IIB | IIIA | IVA | VA | VIA | VIIA | VIIIA |
| 1 | 1 $^2S_{1/2}$ Hydrogen **H** 1.00794 $1s^1$ 13.5984 | | | | | | | | | | | | | | | | | 2 $^1S_0$ Helium **He** 4.00260 $1s^2$ 24.5874 |
| 2 | 3 $^2S_{1/2}$ Lithium **Li** 6.941 $[He]2s^1$ 5.3917 | 4 $^1S_0$ Beryllium **Be** 9.012182 $[He]2s^2$ 9.3227 | | | | | | | | | | | 5 $^2P°_{1/2}$ Boron **B** 10.811 $[He]2s^2p^1$ 8.2980 | 6 $^3P_0$ Carbon **C** 12.0107 $[He]2s^2p^2$ 11.2603 | 7 $^4S°_{3/2}$ Nitrogen **N** 14.0067 $[He]2s^2p^3$ 14.5341 | 8 $^3P_2$ Oxygen **O** 15.9994 $[He]2s^2p^4$ 13.6181 | 9 $^2P°_{3/2}$ Fluorine **F** 18.99840 $[He]2s^2p^5$ 17.4228 | 10 $^1S_0$ Neon **Ne** 20.1797 $[He]2s^2p^6$ 21.5645 |
| 3 | 11 $^2S_{1/2}$ Sodium **Na** 22.989770 $[Ne]3s^1$ 5.1391 | 12 $^1S_0$ Magnesium **Mg** 24.3050 $[Ne]3s^2$ 7.6462 | | | | | | | | | | | 13 $^2P°_{1/2}$ Aluminum **Al** 26.98154 $[Ne]3s^2p^1$ 5.9858 | 14 $^3P_0$ Silicon **Si** 28.0855 $[Ne]3s^2p^2$ 8.1517 | 15 $^4S°_{3/2}$ Phosphorus **P** 30.97376 $[Ne]3s^2p^3$ 10.4867 | 16 $^3P_2$ Sulphur **S** 32.065 $[Ne]3s^2p^4$ 10.3600 | 17 $^2P°_{3/2}$ Chlorine **Cl** 35.453 $[Ne]3s^2p^5$ 12.9676 | 18 $^1S_0$ Argon **Ar** 39.948 $[Ne]3s^2p^6$ 15.7596 |
| 4 | 19 $^2S_{1/2}$ Potassium **K** 39.0983 $[Ar]4s^1$ 4.3407 | 20 $^1S_0$ Calcium **Ca** 40.078 $[Ar]4s^2$ 6.1132 | 21 $^2D_{3/2}$ Scandium **Sc** 44.95591 $[Ar]3d^14s^2$ 6.5615 | 22 $^3F_2$ Titanium **Ti** 47.867 $[Ar]3d^24s^2$ 6.8281 | 23 $^4F_{3/2}$ Vanadium **V** 50.9415 $[Ar]3d^34s^2$ 6.7462 | 24 $^7S_3$ Chromium **Cr** 51.9961 $[Ar]3d^54s^1$ 6.7665 | 25 $^6S_{5/2}$ Manganese **Mn** 54.93805 $[Ar]3d^54s^2$ 7.4340 | 26 $^5D_4$ Iron **Fe** 55.845 $[Ar]3d^64s^2$ 7.9024 | 27 $^4F_{9/2}$ Cobalt **Co** 58.93320 $[Ar]3d^74s^2$ 7.8810 | 28 $^3F_4$ Nickel **Ni** 58.6934 $[Ar]3d^84s^2$ 7.6398 | 29 $^2S_{1/2}$ Copper **Cu** 63.546 $[Ar]3d^{10}4s^1$ 7.7264 | 30 $^1S_0$ Zinc **Zn** 65.409 $[Ar]3d^{10}4s^2$ 9.3942 | 31 $^2P°_{1/2}$ Gallium **Ga** 69.723 $[Ar]3d^{10}4s^2p^1$ 5.9993 | 32 $^3P_0$ Germanium **Ge** 72.64 $[Ar]3d^{10}4s^2p^2$ 7.8994 | 33 $^4S°_{3/2}$ Arsenic **As** 74.92160 $[Ar]3d^{10}4s^2p^3$ 9.7886 | 34 $^3P_2$ Selenium **Se** 78.96 $[Ar]3d^{10}4s^2p^4$ 9.7524 | 35 $^2P°_{3/2}$ Bromine **Br** 79.904 $[Ar]3d^{10}4s^2p^5$ 11.8138 | 36 $^1S_0$ Krypton **Kr** 83.798 $[Ar]3d^{10}4s^2p^6$ 13.9996 |
| 5 | 37 $^2S_{1/2}$ Rubidium **Rb** 85.4678 $[Kr]5s^1$ 4.1771 | 38 $^1S_0$ Strontium **Sr** 87.62 $[Kr]5s^2$ 5.6949 | 39 $^2D_{3/2}$ Yttrium **Y** 88.90585 $[Kr]4d^15s^2$ 6.2173 | 40 $^3F_2$ Zirconium **Zr** 91.224 $[Kr]4d^25s^2$ 6.6339 | 41 $^6D_{1/2}$ Niobium **Nb** 92.90638 $[Kr]4d^45s^1$ 6.7589 | 42 $^7S_3$ Molybdenum **Mo** 95.94 $[Kr]4d^55s^1$ 7.0924 | 43 $^6S_{5/2}$ Technetium **Tc** [98] $[Kr]4d^55s^2$ 7.28 | 44 $^5F_5$ Ruthenium **Ru** 101.07 $[Kr]4d^75s^1$ 7.3605 | 45 $^4F_{9/2}$ Rhodium **Rh** 102.90550 $[Kr]4d^85s^1$ 7.4589 | 46 $^1S_0$ Palladium **Pd** 106.42 $[Kr]4d^{10}$ 8.3369 | 47 $^2S_{1/2}$ Silver **Ag** 107.8682 $[Kr]4d^{10}5s^1$ 7.5762 | 48 $^1S_0$ Cadmium **Cd** 112.411 $[Kr]4d^{10}5s^2$ 8.9938 | 49 $^2P°_{1/2}$ Indium **In** 114.818 $[Kr]4d^{10}5s^2p^1$ 5.7864 | 50 $^3P_0$ Tin **Sn** 118.710 $[Kr]4d^{10}5s^2p^2$ 7.3439 | 51 $^4S°_{3/2}$ Antimony **Sb** 121.760 $[Kr]4d^{10}5s^2p^3$ 8.6084 | 52 $^3P_2$ Tellurium **Te** 127.60 $[Kr]4d^{10}5s^2p^4$ 9.0096 | 53 $^2P°_{3/2}$ Iodine **I** 126.90447 $[Kr]4d^{10}5s^2p^5$ 10.4513 | 54 $^1S_0$ Xenon **Xe** 131.293 $[Kr]4d^{10}5s^2p^6$ 12.1298 |
| 6 | 55 $^2S_{1/2}$ Cesium **Cs** 132.90545 $[Xe]6s^1$ 3.8939 | 56 $^1S_0$ Barium **Ba** 137.327 $[Xe]6s^2$ 5.2117 | ***57 – 71*** | 72 $^3F_2$ Hafnium **Hf** 178.49 $[Xe]4f^{14}5d^26s^2$ 6.8251 | 73 $^4F_{3/2}$ Tantalum **Ta** 180.9479 $[Xe]4f^{14}5d^36s^2$ 7.5496 | 74 $^5D_0$ Tungsten **W** 183.84 $[Xe]4f^{14}5d^46s^2$ 7.8640 | 75 $^6S_{5/2}$ Rhenium **Re** 186.207 $[Xe]4f^{14}5d^56s^2$ 7.8335 | 76 $^5D_4$ Osmium **Os** 190.23 $[Xe]4f^{14}5d^66s^2$ 8.4382 | 77 $^4F_{9/2}$ Iridium **Ir** 192.217 $[Xe]4f^{14}5d^76s^2$ 8.9670 | 78 $^3D_3$ Platinum **Pt** 195.078 $[Xe]4f^{14}5d^96s^1$ 8.9588 | 79 $^2S_{1/2}$ Gold **Au** 196.96655 $[Xe]4f^{14}5d^{10}6s^1$ 9.2255 | 80 $^1S_0$ Mercury **Hg** 200.59 $[Xe]4f^{14}5d^{10}6s^2$ 10.4375 | 81 $^2P°_{1/2}$ Thallium **Tl** 204.3833 $[Xe]4f^{14}5d^{10}6s^2p^1$ 6.1082 | 82 $^3P_0$ Lead **Pb** 207.2 $[Xe]4f^{14}5d^{10}6s^2p^2$ 7.4167 | 83 $^4S°_{3/2}$ Bismuth **Bi** 208.98038 $[Xe]4f^{14}5d^{10}6s^2p^3$ 7.2855 | 84 $^3P_2$ Polonium **Po** [209] $[Xe]4f^{14}5d^{10}6s^2p^4$ 8.414 | 85 $^2P°_{3/2}$ Astatine **At** [210] $[Xe]4f^{14}5d^{10}6s^2p^5$ | 86 $^1S_0$ Radon **Rn** [222] $[Xe]4f^{14}5d^{10}6s^2p^6$ 10.7485 |
| 7 | 87 $^2S_{1/2}$ Francium **Fr** [223] $[Rn]7s^1$ 4.0727 | 88 $^1S_0$ Radium **Ra** [226] $[Rn]7s^2$ 5.2784 | ***89 – 103*** | 104 $^3F_2$ ? Rutherfordium **Rf** [261] $[Rn]5f^{14}6d^27s^2$ ? 6.0 ? | 105 Dubnium **Db** [262] | 106 Seaborgium **Sg** [266] | 107 Bohrium **Bh** [264] | 108 Hassium **Hs** [277] | 109 Meitnerium **Mt** [268] | 110 Darmstadtium **Ds** [281] | 111 Roentgenium **Rg** [272] | 112 Copernicium **Cn** [285] | 113 Ununtrium **Uut** [?] | 114 Ununquadium **Uuq** [289] | 115 Ununpentium **Uup** [?] | 116 Ununhexium **Uuh** [292] | 117 Ununseptium **Uus** [?] | 118 Ununoctium **Uuo** [?] |

***s – block*** ***d – block*** ***p – block***

***f – block***

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| 57 $^2D_{3/2}$ Lanthanum **La** 138.9055 $[Xe]5d^16s^2$ 5.5769 | 58 $^1G°_4$ Cerium **Ce** 140.116 $[Xe]4f^15d^16s^2$ 5.5387 | 59 $^4I°_{9/2}$ Praseodymium **Pr** 140.90765 $[Xe]4f^36s^2$ 5.473 | 60 $^5I_4$ Neodymium **Nd** 144.24 $[Xe]4f^46s^2$ 5.5250 | 61 $H°_{5/2}$ Promethium **Pm** [145] $[Xe]4f^56s^2$ 5.582 | 62 $^7F_0$ Samarium **Sm** 150.36 $[Xe]4f^66s^2$ 5.6437 | 63 $^8S°_{7/2}$ Europium **Eu** 151.964 $[Xe]4f^76s^2$ 5.6704 | 64 $^9D°_2$ Gadolinium **Gd** 157.25 $[Xe]4f^75d^16s^2$ 6.1498 | 65 $^6H°_{15/2}$ Terbium **Tb** 158.92534 $[Xe]4f^96s^2$ 5.8638 | 66 $^5I_8$ Dysprosium **Dy** 162.500 $[Xe]4f^{10}6s^2$ 5.9389 | 67 $^4I°_{15/2}$ Holmium **Ho** 164.93032 $[Xe]4f^{11}6s^2$ 6.0215 | 68 $^3H_6$ Erbium **Er** 167.259 $[Xe]4f^{12}6s^2$ 6.1077 | 69 $^2F°_{7/2}$ Thulium **Tm** 168.93421 $[Xe]4f^{13}6s^2$ 6.1843 | 70 $^1S_0$ Ytterbium **Yb** 173.04 $[Xe]4f^{14}6s^2$ 6.2542 | 71 $^2D_{3/2}$ Lutetium **Lu** 174.967 $[Xe]4f^{14}5d^16s^2$ 5.4259 |
| 89 $^2D_{3/2}$ Actinium **Ac** [227] $[Rn]6d^17s^2$ 5.17 | 90 $^3F_2$ Thorium **Th** 232.0381 $[Rn]6d^27s^2$ 6.3067 | 91 $^4K_{11/2}$ Protactinium **Pa** 231.03588 $[Rn]5f^26d^17s^2$ 5.89 | 92 $^5L°_6$ Uranium **U** 238.02891 $[Rn]5f^36d^17s^2$ 6.1941 | 93 $^6L_{11/2}$ Neptunium **Np** [237] $[Rn]5f^46d^17s^2$ 6.2657 | 94 $^7F_0$ Plutonium **Pu** [244] $[Rn]5f^67s^2$ 6.0260 | 95 $^8S°_{7/2}$ Americium **Am** [243] $[Rn]5f^77s^2$ 5.9738 | 96 $^9D°_2$ Curium **Cm** [247] $[Rn]5f^76d^17s^2$ 5.9914 | 97 $^6H°_{15/2}$ Berkelium **Bk** [247] $[Rn]5f^97s^2$ 6.1979 | 98 $^5I_8$ Californium **Cf** [251] $[Rn]5f^{10}7s^2$ 6.2817 | 99 $^4I°_{15/2}$ Einsteinium **Es** [252] $[Rn]5f^{11}7s^2$ 6.42 | 100 $^3H_6$ Fermium **Fm** [257] $[Rn]5f^{12}7s^2$ 6.50 | 101 $^2F°_{7/2}$ Mendelevium **Md** [258] $[Rn]5f^{13}7s^2$ 6.58 | 102 $^1S_0$ Nobelium **No** [259] $[Rn]5f^{14}7s^2$ 6.65 | 103 $^2P°_{1/2}$? Lawrencium **Lr** [262] $[Rn]5f^{14}6d^17s^2$ 4.9 ? |