

PERIODIC TABLE

Atomic Properties of the Elements

Physical Measurement Laboratory www.nist.gov/pml
Standard Reference Data www.nist.gov/srd

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 ¹³³Cs

speed of light in vacuum	<i>c</i>	299 792 458 m s ⁻¹	(exact)
Planck constant	<i>h</i>	6.626 070 15 × 10 ⁻³⁴ J Hz ⁻¹	(exact)
elementary charge	<i>e</i>	1.602 176 634 × 10 ⁻¹⁹ C	(exact)
Avogadro constant	<i>N_A</i>	6.022 140 76 × 10 ²³ mol ⁻¹	(exact)
Boltzmann constant	<i>k</i>	1.380 649 × 10 ⁻²³ J K ⁻¹	(exact)
electron volt	eV	1.602 176 634 × 10 ⁻¹⁹ J	(exact)
electron mass	<i>m_e</i>	9.109 383 70 × 10 ⁻³¹ kg	
energy equivalent	<i>m_ec²</i>	0.510 998 950 MeV	
proton mass	<i>m_p</i>	1.672 621 924 × 10 ⁻²⁷ kg	
energy equivalent	<i>m_pc²</i>	938.272 088 MeV	
fine-structure constant	<i>α</i>	1/137.035 999	
Rydberg energy	<i>R_∞hc</i>	13.605 693 1230 eV	
Newtonian constant of gravitation	<i>G</i>	6.674 × 10 ⁻¹¹ m ³ kg ⁻¹ s ⁻²	

[§]For the most accurate values of these and other constants, visit pml.nist.gov/constants.

Solids
 Liquids
 Gases
 Artificially Prepared

Group	1	2											13	14	15	16	17	18
	IA	IIA											IIIA	IVA	VA	VIA	VIIA	VIII A
Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H Hydrogen 1.008 1s 13.5984																	2 He Helium 4.0026 1s ² 24.5874
2	3 Li Lithium 6.94 1s ² 2s 5.3917	4 Be Beryllium 9.0122 1s ² 2s ² 9.3227											5 B Boron 10.81 1s ² 2s ² 2p 8.2980	6 C Carbon 12.011 1s ² 2s ² 2p ² 11.2603	7 N Nitrogen 14.007 1s ² 2s ² 2p ³ 14.5341	8 O Oxygen 15.999 1s ² 2s ² 2p ⁴ 13.6181	9 F Fluorine 18.998 1s ² 2s ² 2p ⁵ 17.4228	10 Ne Neon 20.180 1s ² 2s ² 2p ⁶ 21.5645
3	11 Na Sodium 22.990 [Ne]3s 5.1391	12 Mg Magnesium 24.305 [Ne]3s ² 7.6462											13 Al Aluminum 26.982 [Ne]3s ² 3p 5.9858	14 Si Silicon 28.085 [Ne]3s ² 3p ² 8.1517	15 P Phosphorus 30.974 [Ne]3s ² 3p ³ 10.4867	16 S Sulfur 32.06 [Ne]3s ² 3p ⁴ 10.3600	17 Cl Chlorine 35.45 [Ne]3s ² 3p ⁵ 12.9676	18 Ar Argon 39.948 [Ne]3s ² 3p ⁶ 21.7596
4	19 K Potassium 39.098 [Ar]4s 4.3407	20 Ca Calcium 40.078 [Ar]3d ⁴ 4s ² 6.1132	21 Sc Scandium 44.956 [Ar]3d ⁴ 4s ² 6.5615	22 Ti Titanium 47.867 [Ar]3d ² 4s ² 6.8281	23 V Vanadium 50.942 [Ar]3d ³ 4s ² 6.7462	24 Cr Chromium 51.996 [Ar]3d ⁵ 4s 6.7665	25 Mn Manganese 54.938 [Ar]3d ⁵ 4s ² 7.4340	26 Fe Iron 55.845 [Ar]3d ⁶ 4s ² 7.9025	27 Co Cobalt 58.933 [Ar]3d ⁷ 4s ² 7.8810	28 Ni Nickel 58.693 [Ar]3d ⁸ 4s ² 7.6399	29 Cu Copper 63.546 [Ar]3d ¹⁰ 4s 7.7264	30 Zn Zinc 65.38 [Ar]3d ¹⁰ 4s ² 9.3942	31 Ga Gallium 69.723 [Ar]3d ¹⁰ 4s ² 4p 5.9993	32 Ge Germanium 72.630 [Ar]3d ¹⁰ 4s ² 4p ² 7.8994	33 As Arsenic 74.922 [Ar]3d ¹⁰ 4s ² 4p ³ 9.7886	34 Se Selenium 78.971 [Ar]3d ¹⁰ 4s ² 4p ⁴ 9.7524	35 Br Bromine 79.904 [Ar]3d ¹⁰ 4s ² 4p ⁵ 11.8138	36 Kr Krypton 83.798 [Ar]3d ¹⁰ 4s ² 4p ⁶ 13.9996
5	37 Rb Rubidium 85.468 [Kr]5s 4.1751	38 Sr Strontium 87.62 [Kr]5s ² 5.6949	39 Y Yttrium 88.906 [Kr]4d ⁵ 5s ² 6.2173	40 Zr Zirconium 91.224 [Kr]4d ⁵ 5s ² 6.6341	41 Nb Niobium 92.906 [Kr]4d ⁴ 5s 6.7589	42 Mo Molybdenum 95.95 [Kr]4d ⁵ 5s 7.0924	43 Tc Technetium (97) [Kr]4d ⁵ 5s ² 7.1194	44 Ru Ruthenium 101.07 [Kr]4d ⁷ 5s 7.3605	45 Rh Rhodium 102.91 [Kr]4d ⁸ 5s 7.4589	46 Pd Palladium 106.42 [Kr]4d ¹⁰ 8.3369	47 Ag Silver 107.87 [Kr]4d ¹⁰ 5s 8.9938	48 Cd Cadmium 112.41 [Kr]4d ¹⁰ 5s ² 8.9938	49 In Indium 114.82 [Kr]4d ¹⁰ 5s ² 5p 5.7864	50 Sn Tin 118.71 [Kr]4d ¹⁰ 5s ² 5p ² 7.3439	51 Sb Antimony 121.76 [Kr]4d ¹⁰ 5s ² 5p ³ 8.6084	52 Te Tellurium 127.60 [Kr]4d ¹⁰ 5s ² 5p ⁴ 9.0097	53 I Iodine 126.90 [Kr]4d ¹⁰ 5s ² 5p ⁵ 10.4513	54 Xe Xenon 131.29 [Kr]4d ¹⁰ 5s ² 5p ⁶ 12.1298
6	55 Cs Cesium 132.91 [Xe]6s 3.8939	56 Ba Barium 137.33 [Xe]6s ² 5.2117		72 Hf Hafnium 178.49 [Xe]4f ¹⁴ 5d ² 6s ² 6.8251	73 Ta Tantalum 180.95 [Xe]4f ¹⁴ 5d ³ 6s ² 7.5496	74 W Tungsten 183.84 [Xe]4f ¹⁴ 5d ⁴ 6s ² 7.8640	75 Re Rhenium 186.21 [Xe]4f ¹⁴ 5d ⁵ 6s ² 7.8335	76 Os Osmium 190.23 [Xe]4f ¹⁴ 5d ⁶ 6s ² 8.4382	77 Ir Iridium 192.22 [Xe]4f ¹⁴ 5d ⁷ 6s ² 8.9670	78 Pt Platinum 195.08 [Xe]4f ¹⁴ 5d ⁹ 6s 8.9588	79 Au Gold 196.97 [Xe]4f ¹⁴ 5d ¹⁰ 6s 9.2256	80 Hg Mercury 200.59 [Xe]4f ¹⁴ 5d ¹⁰ 6s ² 10.4375	81 Tl Thallium 204.38 [Hg]6p 6.1083	82 Pb Lead 207.2 [Hg]6p ² 7.4167	83 Bi Bismuth 208.98 [Hg]6p ³ 7.2855	84 Po Polonium (209) [Hg]6p ⁴ 8.414	85 At Astatine (210) [Hg]6p ⁵ 9.3175	86 Rn Radon (222) [Hg]6p ⁶ 10.7485
7	87 Fr Francium (223) [Rn]7s 4.0727	88 Ra Radium (226) [Rn]7s ² 5.2784		104 Rf Rutherfordium (261) [Rn]5f ¹⁴ 6d ² 7s ² 6.02	105 Db Dubnium (268) [Rn]5f ¹⁴ 6d ³ 7s ² 6.8	106 Sg Seaborgium (269) [Rn]5f ¹⁴ 6d ⁴ 7s ² 7.8	107 Bh Bohrium (270) [Rn]5f ¹⁴ 6d ⁵ 7s ² 7.7	108 Hs Hassium (281) [Rn]5f ¹⁴ 6d ⁶ 7s ² 7.6	109 Mt Meitnerium (278) [Rn]5f ¹⁴ 6d ⁷ 7s ² 7.6	110 Ds Darmstadtium (281) [Rn]5f ¹⁴ 6d ⁸ 7s ² 7.6	111 Rg Roentgenium (282) [Rn]5f ¹⁴ 6d ⁹ 7s ² 7.6	112 Cn Copernicium (285) [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7.6	113 Nh Nihonium (286) [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7.6	114 Fl Flerovium (289) [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7.6	115 Mc Moscovium (289) [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7.6	116 Lv Livermorium (293) [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7.6	117 Ts Tennessine (294) [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7.6	118 Og Oganesson (294) [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7.6
				57 La Lanthanum 138.91 [Xe]5d ¹ 6s ² 5.5769	58 Ce Cerium 140.12 [Xe]4f ¹ 5d ¹ 6s ² 5.5386	59 Pr Praseodymium 140.91 [Xe]4f ³ 6s ² 5.4702	60 Nd Neodymium 144.24 [Xe]4f ⁴ 6s ² 5.5250	61 Pm Promethium (145) [Xe]4f ⁵ 6s ² 5.577	62 Sm Samarium 150.36 [Xe]4f ⁶ 6s ² 5.6437	63 Eu Europium 151.96 [Xe]4f ⁷ 6s ² 5.6704	64 Gd Gadolinium 157.25 [Xe]4f ⁷ 5d ¹ 6s ² 6.1498	65 Tb Terbium 158.93 [Xe]4f ⁹ 6s ² 5.8638	66 Dy Dysprosium 162.50 [Xe]4f ¹⁰ 6s ² 5.9391	67 Ho Holmium 164.93 [Xe]4f ¹¹ 6s ² 6.0215	68 Er Erbium 167.26 [Xe]4f ¹² 6s ² 6.1077	69 Tm Thulium 168.93 [Xe]4f ¹³ 6s ² 6.1843	70 Yb Ytterbium 173.05 [Xe]4f ¹⁴ 6s ² 6.2542	71 Lu Lutetium 174.97 [Xe]4f ¹⁴ 5d ¹ 6s ² 5.4259
				89 Ac Actinium (227) [Rn]6d ¹ 7s ² 5.3802	90 Th Thorium 232.04 [Rn]6d ² 7s ² 6.3067	91 Pa Protactinium 231.04 [Rn]5f ² 6d ¹ 7s ² 5.89	92 U Uranium 238.03 [Rn]5f ³ 6d ¹ 7s ² 6.1941	93 Np Neptunium (237) [Rn]5f ⁴ 6d ¹ 7s ² 6.2655	94 Pu Plutonium (244) [Rn]5f ⁶ 7s ² 6.0258	95 Am Americium (243) [Rn]5f ⁷ 7s ² 5.9738	96 Cm Curium (247) [Rn]5f ⁸ 7s ² 5.9914	97 Bk Berkelium (247) [Rn]5f ⁹ 7s ² 6.1978	98 Cf Californium (251) [Rn]5f ¹⁰ 7s ² 6.2817	99 Es Einsteinium (252) [Rn]5f ¹¹ 7s ² 6.3676	100 Fm Fermium (257) [Rn]5f ¹² 7s ² 6.50	101 Md Mendelevium (258) [Rn]5f ¹³ 7s ² 6.58	102 No Nobelium (259) [Rn]5f ¹⁴ 7s ² 6.66	103 Lr Lawrencium (262) [Rn]5f ¹⁴ 7s ² 7p 4.96

Atomic Number	Ground State
58	1G ₄
Symbol	Ce
Name	Cerium
Standard Atomic Weight ^(u)	140.12
Ground-state Configuration	[Xe]4f ¹ 5d ¹ 6s ²
Ionization Energy (eV)	5.5386

[†]Based upon ¹²C. () indicates the mass number of the longest-lived isotope.

For the most precise values and uncertainties visit ciaaw.org and pml.nist.gov/data.
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NISTory of the Periodic Table

