

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

Period	1	1 IA H Hydrogen 1.008 1s 13.5984	2 IIA 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 15.5645	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 15.7596																														
	3	19 K Potassium 39.098 [Ar]4s 4.3407	20 Ca Calcium 40.078 [Ar]4s ² 6.1132	21 Sc Scandium 44.956 [Ar]3d4s 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																												
	4	37 Rb Rubidium 85.468 [Kr]5s 4.1771	38 Sr Strontium 87.62 [Kr]5s ² 5.6949	39 Y Yttrium 88.906 [Kr]4d5s ² 6.2173	40 Zr Zirconium 91.224 [Kr]4d ² 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 8.3368	47 Ag Silver 107.87 [Kr]4d ¹⁰ 5s 7.5762	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 9.0098	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																												
	5	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 8.4181	85 At Astatine (210) [Hg]6p ⁵ 9.3175	86 Rn Radon (222) [Hg]6p ⁶ 10.7485																													
	6	87 Fr Francium (223) [Rn]7s 4.0727	88 Ra Radium (226) [Rn]7s ² 5.2784	104 Rf Rutherfordium (267) [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 (269) [Rn]5f ¹⁴ 6d ⁶ 7s ² 7.6	109 Mt Meitnerium (278)	110 Ds Darmstadtium (281)	111 Rg Roentgenium (282)	112 Cn Copernicium (285)	113 Nh Nihonium (286)	114 Fl Flerovium (289)	115 Mc Moscovium (289)	116 Lv Livermorium (293)	117 Ts Tennessine (294)	118 Og Oganesson (294)																													
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Atomic Number: 58
Ground State: 1G₄
Symbol: Ce
Name: Cerium
Standard Atomic Weight: 140.12
Ionization Energy (eV): 5.5386
Ground-state Configuration: [Xe]4f5d6s²

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