

PERIODIC TABLE Atomic Properties of the Elements

18
VIII A

Group	Frequently used fundamental physical constants										Physical Measurement Laboratory		Standard Reference Data					Group 2 VIII A
	1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIII	9	10	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	
1	1 H Hydrogen 1.008* 1s 13.5984																	2 He Helium 4.002602 1s ² 24.5874
2	3 Li Lithium 6.94* 1s ² 2s 5.3917	4 Be Beryllium 9.0121831 1s ² 2s ² 9.3227											5 B Boron 10.81* 1s ² 2s ² 2p 11.2603	6 C Carbon 12.011* 1s ² 2s ² 2p ² 14.5341	7 N Nitrogen 14.007* 1s ² 2s ² 2p ³ 14.5341	8 O Oxygen 15.999* 1s ² 2s ² 2p ⁴ 17.4228	9 F Fluorine 18.99840316 1s ² 2s ² 2p ⁵ 17.4228	10 Ne Neon 20.1797 1s ² 2s ² 2p ⁶ 21.5645
3	11 Na Sodium 22.98976928 [Ne]3s 5.1391	12 Mg Magnesium 24.305* [Ne]3s ² 7.6462										13 Al Aluminum 26.9815385 [Ne]3s ² 3p 5.9858	14 Si Silicon 28.085* [Ne]3s ² 3p ² 8.1517	15 P Phosphorus 30.97376200 [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	
4	19 K Potassium 39.0983 [Ar]4s 4.3407	20 Ca Calcium 40.078 [Ar]4s ² 6.1132	21 Sc Scandium 44.955908 [Ar]3d ⁴ 4s ² 6.5615	22 Ti Titanium 47.867 [Ar]3d ² 4s ² 6.8281	23 V Vanadium 50.9415 [Ar]3d ³ 4s ² 6.7462	24 Cr Chromium 51.9961 [Ar]3d ⁵ 4s 7.1194	25 Mn Manganese 54.938044 [Ar]3d ⁵ 4s ² 7.4340	26 Fe Iron 55.845 [Ar]3d ⁶ 4s ² 7.9025	27 Co Cobalt 58.933194 [Ar]3d ⁷ 4s ² 7.8810	28 Ni Nickel 58.6934 [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 74.921595 [Ar]3d ¹⁰ 4s ² 4p ³ 7.9886	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 85.4678 [Kr]5s 4.7171	38 Sr Strontium 87.62 [Kr]5s ² 5.6949	39 Y Yttrium 88.90584 [Kr]4d ⁵ 5s ² 6.2173	40 Zr Zirconium 91.224 [Kr]4d ⁵ 5s ² 6.6339	41 Nb Niobium 92.90637 [Kr]4d ⁴ 5s 6.7589	42 Mo Molybdenum 95.95 [Kr]4d ⁵ 5s 7.0924	43 Tc Technetium (98) [Kr]4d ⁵ 5s ² 7.1194	44 Ru Ruthenium 101.07 [Kr]4d ⁷ 5s 7.3605	45 Rh Rhodium 102.90550 [Kr]4d ⁸ 5s 7.4589	46 Pd Palladium 106.42 [Kr]4d ¹⁰ 8.3369	47 Ag Silver 107.8682 [Kr]4d ¹⁰ 5s 7.5762	48 Cd Cadmium 112.414 [Kr]4d ¹⁰ 5s ² 8.9938	49 In Indium 114.818 [Kr]4d ¹⁰ 5s ² 5p 7.5864	50 Sn Tin 118.710 [Kr]4d ¹⁰ 5s ² 5p ² 7.3439	51 Sb Antimony 121.760 [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 126.90447 [Kr]4d ¹⁰ 5s ² 5p ⁵ 10.4513	54 Xe Xenon 131.293 [Kr]4d ¹⁰ 5s ² 5p ⁶ 12.1298
6	55 Cs Cesium 132.9054520 [Xe]6s 3.8939	56 Ba Barium 137.327 [Xe]6s ² 5.2117		72 Hf Hafnium 178.49 [Xe]4f ¹⁴ 5d ⁴ 6s ² 6.8251	73 Ta Tantalum 180.94788 [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 186.207 [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 192.227 [Xe]4f ¹⁴ 5d ⁷ 6s ² 8.9670	78 Pt Platinum 195.084 [Xe]4f ¹⁴ 5d ⁹ 6s ¹ 8.9588	79 Au Gold 196.966569 [Xe]4f ¹⁴ 5d ¹⁰ 6s 9.2256	80 Hg Mercury 200.592 [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 208.98040 [Hg]6p ³ 7.2855	84 Po Polonium (209) [Hg]6p ⁴ 8.414	85 At Astatine (210) [Hg]6p ⁵ 9.31751	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 6.01	105 Db Dubnium (268) [Rn]5f ¹⁴ 6d ³ 7s ² 6.8	106 Sg Seaborgium (271) [Rn]5f ¹⁴ 6d ⁴ 7s ² 7.8	107 Bh Bohrium (272) [Rn]5f ¹⁴ 6d ⁵ 7s ² 7.7	108 Hs Hassium (277) [Rn]5f ¹⁴ 6d ⁶ 7s ² 7.6	109 Mt Meitnerium (276) [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 (280) [Rn]5f ¹⁴ 6d ⁹ 7s ² 7.6	112 Cn Copernicium (285) [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7.6	113 Uut Ununtrium (284) [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7p 7.6	114 Fl Flerovium (289) [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7p ² 7.6	115 Uup Ununpentium (288) [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7p ³ 7.6	116 Lv Livermorium (293) [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7p ⁴ 7.6	117 Uus Ununseptium (294) [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7p ⁵ 7.6	118 Uuo Ununoctium (294) [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7p ⁶ 7.6
			Lanthanides	57 La Lanthanum 138.90547 [Xe]5d ¹ 6s ² 5.5769	58 Ce Cerium 140.116 [Xe]4f ¹ 6s ² 5.5386	59 Pr Praseodymium 140.907 [Xe]4f ² 6s ² 5.473	60 Nd Neodymium 144.242 [Xe]4f ³ 6s ² 5.5250	61 Pm Promethium (145) [Xe]4f ⁴ 6s ² 5.582	62 Sm Samarium 150.36 [Xe]4f ⁵ 6s ² 5.6437	63 Eu Europium 151.964 [Xe]4f ⁶ 6s ² 5.6704	64 Gd Gadolinium 157.25 [Xe]4f ⁷ 6s ² 5.6988	65 Tb Terbium 158.92535 [Xe]4f ⁸ 6s ² 5.8638	66 Dy Dysprosium 162.500 [Xe]4f ⁹ 6s ² 5.9391	67 Ho Holmium 164.93033 [Xe]4f ¹⁰ 6s ² 6.0215	68 Er Erbium 167.259 [Xe]4f ¹¹ 6s ² 6.1077	69 Tm Thulium 168.93422 [Xe]4f ¹² 6s ² 6.1843	70 Yb Ytterbium 173.054 [Xe]4f ¹³ 6s ² 6.2542	71 Lu Lutetium 174.9668 [Xe]4f ¹⁴ 5d ¹ 6s ² 5.4259
			Actinides	89 Ac Actinium (227) [Rn]6d ¹ 7s ² 5.3802	90 Th Thorium 232.0377 [Rn]6d ² 7s ² 6.3067	91 Pa Protactinium 231.03688 [Rn]5f ² 6d ¹ 7s ² 5.89	92 U Uranium 238.02891 [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 ⁷ 6d ¹ 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 6.65	103 Lr Lawrencium (262) [Rn]5f ¹⁴ 7s ² 7p 4.90

Frequently used fundamental physical constants

For the most accurate values of these and other constants, visit physics.nist.gov/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 07 x 10 ⁻³⁴ J s	(<i>h</i> = <i>h</i> /2π)
elementary charge	<i>e</i>	1.602 177 x 10 ⁻¹⁹ C	
electron mass	<i>m_e</i>	9.109 38 x 10 ⁻³¹ kg	
	<i>m_ec²</i>	0.510 999 MeV	
proton mass	<i>m_p</i>	1.672 622 x 10 ⁻²⁷ kg	
fine-structure constant	<i>α</i>	1/137.035 999	
Rydberg constant	<i>R_∞</i>	10 973 731.569 m ⁻¹	
	<i>R_∞c</i>	3.289 841 960 x 10 ¹⁵ Hz	
	<i>R_∞hc</i>	13.605 69 eV	
Boltzmann constant	<i>k</i>	1.380 6 x 10 ⁻²³ J K ⁻¹	

- Solids
- Liquids
- Gases
- Artificially Prepared

Atomic Number: 58
Ground-state Level: 1G₄
Symbol: Ce
Name: Cerium
Standard Atomic Weight: 140.116
Ground-state Configuration: [Xe]4f5d6s²
Ionization Energy (eV): 5.5386

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

*IUPAC conventional atomic weights; standard atomic weights for these elements are expressed in intervals; see iupac.org for an explanation and values.

For a description of the data, visit physics.nist.gov/data
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The Hubbard Chart of the Atoms, ca. 1924

Henry D. Hubbard, the designer of the “Chart of the Atoms,” was the first secretary of the National Institute of Standards and Technology (then-called the National Bureau of Standards) and served continuously in that capacity from 1901 until his retirement in 1938. Secretary Hubbard made a contribution to instruction in physics that is still in use today, his modernization of Mendeleev’s periodic table. First constructed in the 1920s, it has been frequently revised and reprinted.

