PERIODIC TABLE

Atomic Properties of the Elements

NIST National Institute of Standards and Technology
U.S. Department of Commerce

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 ^{133}Cs

speed of light in vacuum	c	299 792 458 m s^{-1}	(exact)
Planck constant	h	6.626 070 x 10^{-34} J s	($\hbar = h/2\pi$)
elementary charge	e	1.602 177 x 10^{-19} C	
electron mass	m_e	9.109 384 x 10^{-31} kg	
	$m_e c^2$	0.510 999 MeV	
proton mass	m_p	1.672 622 x 10^{-27} kg	
fine-structure constant	α	1/137.035 999	
Rydberg constant	R_∞	10 973 731.569 m^{-1}	
	$R_\infty c$	3.289 841 960 x 10^{15} Hz	
	$R_\infty hc$	13.605 693 eV	
electron volt	eV	1.602 176 6 x 10^{-19} J	
Boltzmann constant	k	1.380 65 x 10^{-23} J K^{-1}	
molar gas constant	R	8.314 5 J mol^{-1} K^{-1}	

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

Solids
Liquids
Gases
Artificially Prepared

Group 1 IA; 2 IIA; 3 IIIB; 4 IVB; 5 VB; 6 VIB; 7 VIIB; 8, 9, 10 VIII; 11 IB; 12 IIB; 13 IIIA; 14 IVA; 15 VA; 16 VIA; 17 VIIA; 18 VIIIA

Period 1

Atomic Number	Symbol	Name	Standard Atomic Weight† (Da)	Ground-state Level	Ground-state Configuration	Ionization Energy (eV)
1	H	Hydrogen	1.008*	$^2S_{1/2}$	1s	13.5984
2	He	Helium	4.002602	$^1S_0$	$1s^2$	24.5874

Period 2

Atomic Number	Symbol	Name	Standard Atomic Weight† (Da)	Ground-state Level	Ground-state Configuration	Ionization Energy (eV)
3	Li	Lithium	6.94*	$^2S_{1/2}$	$1s^2 2s$	5.3917
4	Be	Beryllium	9.0121831	$^1S_0$	$1s^2 2s^2$	9.3227
5	B	Boron	10.81*	$^2P^\circ_{1/2}$	$1s^2 2s^2 2p$	8.2980
6	C	Carbon	12.011*	$^3P_0$	$1s^2 2s^2 2p^2$	11.2603
7	N	Nitrogen	14.007*	$^4S^\circ_{3/2}$	$1s^2 2s^2 2p^3$	14.5341
8	O	Oxygen	15.999*	$^3P_2$	$1s^2 2s^2 2p^4$	13.6181
9	F	Fluorine	18.99840316*	$^2P^\circ_{3/2}$	$1s^2 2s^2 2p^5$	17.4228
10	Ne	Neon	20.1797	$^1S_0$	$1s^2 2s^2 2p^6$	21.5645

Period 3

Atomic Number	Symbol	Name	Standard Atomic Weight† (Da)	Ground-state Level	Ground-state Configuration	Ionization Energy (eV)
11	Na	Sodium	22.98976928	$^2S_{1/2}$	[Ne]3s	5.1391
12	Mg	Magnesium	24.305*	$^1S_0$	[Ne]$3s^2$	7.6462
13	Al	Aluminum	26.9815385	$^2P^\circ_{1/2}$	[Ne]$3s^2 3p$	5.9858
14	Si	Silicon	28.085*	$^3P_0$	[Ne]$3s^2 3p^2$	8.1517
15	P	Phosphorus	30.97376199*	$^4S^\circ_{3/2}$	[Ne]$3s^2 3p^3$	10.4867
16	S	Sulfur	32.06*	$^3P_2$	[Ne]$3s^2 3p^4$	10.3600
17	Cl	Chlorine	35.45*	$^2P^\circ_{3/2}$	[Ne]$3s^2 3p^5$	12.9676
18	Ar	Argon	39.948	$^1S_0$	[Ne]$3s^2 3p^6$	15.7596

Period 4

Atomic Number	Symbol	Name	Standard Atomic Weight† (Da)	Ground-state Level	Ground-state Configuration	Ionization Energy (eV)
19	K	Potassium	39.0983	$^2S_{1/2}$	[Ar]4s	4.3407
20	Ca	Calcium	40.078	$^1S_0$	[Ar]$4s^2$	6.1132
21	Sc	Scandium	44.955908	$^2D_{3/2}$	[Ar]$3d4s^2$	6.5615
22	Ti	Titanium	47.867	$^3F_2$	[Ar]$3d^2 4s^2$	6.8281
23	V	Vanadium	50.9415	$^4F_{3/2}$	[Ar]$3d^3 4s^2$	6.7462
24	Cr	Chromium	51.9961	$^7S_3$	[Ar]$3d^5 4s$	6.7665
25	Mn	Manganese	54.938044	$^6S_{5/2}$	[Ar]$3d^5 4s^2$	7.4340
26	Fe	Iron	55.845	$^5D_4$	[Ar]$3d^6 4s^2$	7.9025
27	Co	Cobalt	58.933194	$^4F_{9/2}$	[Ar]$3d^7 4s^2$	7.8810
28	Ni	Nickel	58.6934	$^3F_4$	[Ar]$3d^8 4s^2$	7.6399
29	Cu	Copper	63.546	$^2S_{1/2}$	[Ar]$3d^{10} 4s$	7.7264
30	Zn	Zinc	65.38	$^1S_0$	[Ar]$3d^{10} 4s^2$	9.3942
31	Ga	Gallium	69.723	$^2P^\circ_{1/2}$	[Ar]$3d^{10} 4s^2 4p$	5.9993
32	Ge	Germanium	72.630	$^3P_0$	[Ar]$3d^{10} 4s^2 4p^2$	7.8994
33	As	Arsenic	74.921595	$^4S^\circ_{3/2}$	[Ar]$3d^{10} 4s^2 4p^3$	9.7886
34	Se	Selenium	78.971	$^3P_2$	[Ar]$3d^{10} 4s^2 4p^4$	9.7524
35	Br	Bromine	79.904*	$^2P^\circ_{3/2}$	[Ar]$3d^{10} 4s^2 4p^5$	11.8138
36	Kr	Krypton	83.798	$^1S_0$	[Ar]$3d^{10} 4s^2 4p^6$	13.9996

Period 5

Atomic Number	Symbol	Name	Standard Atomic Weight† (Da)	Ground-state Level	Ground-state Configuration	Ionization Energy (eV)
37	Rb	Rubidium	85.4678	$^2S_{1/2}$	[Kr]5s	4.1771
38	Sr	Strontium	87.62	$^1S_0$	[Kr]$5s^2$	5.6949
39	Y	Yttrium	88.90584	$^2D_{3/2}$	[Kr]$4d5s^2$	6.2173
40	Zr	Zirconium	91.224	$^3F_2$	[Kr]$4d^2 5s^2$	6.6339
41	Nb	Niobium	92.90637	$^6D_{1/2}$	[Kr]$4d^4 5s$	6.7589
42	Mo	Molybdenum	95.95	$^7S_3$	[Kr]$4d^5 5s$	7.0924
43	Tc	Technetium	(98)	$^6S_{5/2}$	[Kr]$4d^5 5s^2$	7.1194
44	Ru	Ruthenium	101.07	$^5F_5$	[Kr]$4d^7 5s$	7.3605
45	Rh	Rhodium	102.90550	$^4F_{9/2}$	[Kr]$4d^8 5s$	7.4589
46	Pd	Palladium	106.42	$^1S_0$	[Kr]$4d^{10}$	8.3369
47	Ag	Silver	107.8682	$^2S_{1/2}$	[Kr]$4d^{10} 5s$	7.5762
48	Cd	Cadmium	112.414	$^1S_0$	[Kr]$4d^{10} 5s^2$	8.9938
49	In	Indium	114.818	$^2P^\circ_{1/2}$	[Kr]$4d^{10} 5s^2 5p$	5.7864
50	Sn	Tin	118.710	$^3P_0$	[Kr]$4d^{10} 5s^2 5p^2$	7.3439
51	Sb	Antimony	121.760	$^4S^\circ_{3/2}$	[Kr]$4d^{10} 5s^2 5p^3$	8.6084
52	Te	Tellurium	127.60	$^3P_2$	[Kr]$4d^{10} 5s^2 5p^4$	9.0097
53	I	Iodine	126.90447	$^2P^\circ_{3/2}$	[Kr]$4d^{10} 5s^2 5p^5$	10.4513
54	Xe	Xenon	131.293	$^1S_0$	[Kr]$4d^{10} 5s^2 5p^6$	12.1298

Period 6

Atomic Number	Symbol	Name	Standard Atomic Weight† (Da)	Ground-state Level	Ground-state Configuration	Ionization Energy (eV)
55	Cs	Cesium	132.9054520*	$^2S_{1/2}$	[Xe]6s	3.8939
56	Ba	Barium	137.327	$^1S_0$	[Xe]$6s^2$	5.2117
72	Hf	Hafnium	178.49	$^3F_2$	[Xe]$4f^{14} 5d^2 6s^2$	6.8251
73	Ta	Tantalum	180.94788	$^4F_{3/2}$	[Xe]$4f^{14} 5d^3 6s^2$	7.5496
74	W	Tungsten	183.84	$^5D_0$	[Xe]$4f^{14} 5d^4 6s^2$	7.8640
75	Re	Rhenium	186.207	$^6S_{5/2}$	[Xe]$4f^{14} 5d^5 6s^2$	7.8335
76	Os	Osmium	190.23	$^5D_4$	[Xe]$4f^{14} 5d^6 6s^2$	8.4382
77	Ir	Iridium	192.217	$^4F_{9/2}$	[Xe]$4f^{14} 5d^7 6s^2$	8.9670
78	Pt	Platinum	195.084	$^3D_3$	[Xe]$4f^{14} 5d^9 6s$	8.9588
79	Au	Gold	196.966569	$^2S_{1/2}$	[Xe]$4f^{14} 5d^{10} 6s$	9.2256
80	Hg	Mercury	200.592	$^1S_0$	[Xe]$4f^{14} 5d^{10} 6s^2$	10.4375
81	Tl	Thallium	204.38*	$^2P^\circ_{1/2}$	[Hg]6p	6.1083
82	Pb	Lead	207.2	$^3P_0$	[Hg]$6p^2$	7.4167
83	Bi	Bismuth	208.98040	$^4S^\circ_{3/2}$	[Hg]$6p^3$	7.2855
84	Po	Polonium	(209)	$^3P_2$	[Hg]$6p^4$	8.414
85	At	Astatine	(210)	$^2P^\circ_{3/2}$	[Hg]$6p^5$	9.3175
86	Rn	Radon	(222)	$^1S_0$	[Hg]$6p^6$	10.7485

Period 7

Atomic Number	Symbol	Name	Standard Atomic Weight† (Da)	Ground-state Level	Ground-state Configuration	Ionization Energy (eV)
87	Fr	Francium	(223)	$^2S_{1/2}$	[Rn]7s	4.0727
88	Ra	Radium	(226)	$^1S_0$	[Rn]$7s^2$	5.2784
104	Rf	Rutherfordium	(267)	$^3F_2$	[Rn]$5f^{14} 6d^2 7s^2$	6.01
105	Db	Dubnium	(268)	$^4F_{3/2}$	[Rn]$5f^{14} 6d^3 7s^2$	6.8
106	Sg	Seaborgium	(271)	0	[Rn]$5f^{14} 6d^4 7s^2$	7.8
107	Bh	Bohrium	(270)	5/2	[Rn]$5f^{14} 6d^5 7s^2$	7.7
108	Hs	Hassium	(269)	4	[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	Uut	Ununtrium	(286)			
114	Fl	Flerovium	(289)			
115	Uup	Ununpentium	(289)			
116	Lv	Livermorium	(293)			
117	Uus	Ununseptium	(294)			
118	Uuo	Ununoctium	(294)			

Lanthanides

Atomic Number	Symbol	Name	Standard Atomic Weight† (Da)	Ground-state Level	Ground-state Configuration	Ionization Energy (eV)
57	La	Lanthanum	138.90547	$^2D_{3/2}$	[Xe]$5d6s^2$	5.5769
58	Ce	Cerium	140.116	$^1G^\circ_4$	[Xe]$4f5d6s^2$	5.5386
59	Pr	Praseodymium	140.90766	$^4I^\circ_{9/2}$	[Xe]$4f^3 6s^2$	5.473
60	Nd	Neodymium	144.242	$^5I_4$	[Xe]$4f^4 6s^2$	5.5250
61	Pm	Promethium	(145)	$^6H^\circ_{5/2}$	[Xe]$4f^5 6s^2$	5.582
62	Sm	Samarium	150.36	$^7F_0$	[Xe]$4f^6 6s^2$	5.6437
63	Eu	Europium	151.964	$^8S^\circ_{7/2}$	[Xe]$4f^7 6s^2$	5.6704
64	Gd	Gadolinium	157.25	$^9D^\circ_2$	[Xe]$4f^7 5d6s^2$	6.1498
65	Tb	Terbium	158.92535	$^6H^\circ_{15/2}$	[Xe]$4f^9 6s^2$	5.8638
66	Dy	Dysprosium	162.500	$^5I_8$	[Xe]$4f^{10} 6s^2$	5.9391
67	Ho	Holmium	164.93033	$^4I^\circ_{15/2}$	[Xe]$4f^{11} 6s^2$	6.0215
68	Er	Erbium	167.259	$^3H_6$	[Xe]$4f^{12} 6s^2$	6.1077
69	Tm	Thulium	168.93422	$^2F^\circ_{7/2}$	[Xe]$4f^{13} 6s^2$	6.1843
70	Yb	Ytterbium	173.045	$^1S_0$	[Xe]$4f^{14} 6s^2$	6.2542
71	Lu	Lutetium	174.9668	$^2D_{3/2}$	[Xe]$4f^{14} 5d6s^2$	5.4259

Actinides

Atomic Number	Symbol	Name	Standard Atomic Weight† (Da)	Ground-state Level	Ground-state Configuration	Ionization Energy (eV)
89	Ac	Actinium	(227)	$^2D_{3/2}$	[Rn]$6d7s^2$	5.3802
90	Th	Thorium	232.0377	$^3F_2$	[Rn]$6d^2 7s^2$	6.3067
91	Pa	Protactinium	231.03588	$^4K_{11/2}$	[Rn]$5f^2 6d7s^2$	5.89
92	U	Uranium	238.02891	$^5L^\circ_6$	[Rn]$5f^3 6d7s^2$	6.1941
93	Np	Neptunium	(237)	$^6L_{11/2}$	[Rn]$5f^4 6d7s^2$	6.2655
94	Pu	Plutonium	(244)	$^7F_0$	[Rn]$5f^6 7s^2$	6.0258
95	Am	Americium	(243)	$^8S^\circ_{7/2}$	[Rn]$5f^7 7s^2$	5.9738
96	Cm	Curium	(247)	$^9D^\circ_2$	[Rn]$5f^7 6d7s^2$	5.9914
97	Bk	Berkelium	(247)	$^6H^\circ_{15/2}$	[Rn]$5f^9 7s^2$	6.1978
98	Cf	Californium	(251)	$^5I_8$	[Rn]$5f^{10} 7s^2$	6.2817
99	Es	Einsteinium	(252)	$^4I^\circ_{15/2}$	[Rn]$5f^{11} 7s^2$	6.3676
100	Fm	Fermium	(257)	$^3H_6$	[Rn]$5f^{12} 7s^2$	6.50
101	Md	Mendelevium	(258)	$^2F^\circ_{7/2}$	[Rn]$5f^{13} 7s^2$	6.58
102	No	Nobelium	(259)	$^1S_0$	[Rn]$5f^{14} 7s^2$	6.65
103	Lr	Lawrencium	(266)	$^2P^\circ_{1/2}$	[Rn]$5f^{14} 7s^2 7p$	4.96

†Based upon ^{12}C. () indicates the mass number of the longest-lived isotope.

*For the most precise value visit ciaaw.org.

For a description of the data, visit physics.nist.gov/data

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