PERIODIC TABLE OF THE ELEMENTS

Table of Selected Radioactive Isotopes

Element	Mass no.	Half-life, decay
0 n	1	(15.3 min) β^-
1 H	3	(12.26 y) β^-
4 Be	7	(53.3 d) EC
	10	(1.6×10^6 y) β^-
6 C	11	(20.40 min) β^+
	14	(5730 y) β^-
9 F	18	(109.8 min) β^+
11 Na	22	(2.602 y) β^+, EC
	24	(15.02 h) β^-
12 Mg	28	(20.9 h) β^-
13 Al	26	(7.2×10^5 y) β^+, EC
15 P	32	(14.26 d) β^-
16 S	35	(87.2 d) β^-
17 Cl	36	(3.01×10^5 y) β^-
	38	(37.2 min) β^-
18 Ar	37	(35.02 d) EC
	39	(265 y) β^-
19 K	40	(1.28×10^9 y) EC
	42	(12.36 h) β^-
20 Ca	45	(165 d) β^-
21 Sc	46	(83.80 d) β^-
24 Cr	51	(27.70 d) EC
25 Mn	53	(2×10^6 y) EC
	54	(313.0 d) EC
	56	(2.578 h) β^-
26 Fe	59	(44.6 d) β^-
27 Co	56	(78.8d) β^+, EC
	57	(270 d) EC
	58	(71.3 d) β^+, EC
	60	(5.272 y) β^-
28 Ni	57	(36.0 h) β^+, EC
	59	(8×10^4 y) EC
	63	(92 y) β^-
29 Cu	64	(12.70 h) β^-, β^+, EC
	67	(61.88 h) β^-
30 Zn	65	(244.1 d) β^+, EC
31 Ga	67	(78.2 h) EC
	72	(14.10 h) β^-
32 Ge	68	(275 d) EC
33 As	73	(80.3 d) EC
	74	(17.9 d) β^-, β^+, EC
34 Se	75	(118.5 d) β^-
	79	(6.5×10^4 y) β^-
35 Br	82	(35.34 h) β^-
36 Kr	81	(2.1×10^5 y) EC
	85	(10.72 y) β^-
37 Rb	86	(18.7 d) β^-
	87	(4.8×10^{10} y) β^-
38 Sr	90	(28.8 y) β^-
39 Y	88	(106.6 d) β^+, EC
40 Zr	93	(1.5×10^6 y) β^-
	95	(64.0 d) β^-
41 Nb	94	(2.0×10^4 y) β^-
	95	(35.15 d) β^-
42 Mo	99	(66.02 h) β^-
43 Tc	97	(2.6×10^6 y) EC
	98	(4.2×10^6 y) β^-
	99	(2.13×10^5 y) β^-
44 Ru	106	(367 d) β^-
45 Rh	101	(3.3 y) EC
46 Pd	103	(17.0 d) EC
	107	(7×10^6 y) β^-
47 Ag	108	(127 y) EC
	110	(252 d) β^-
	111	(7.45 d) β^-
48 Cd	109	(453 d) EC
49 In	114	(49.51 d) IT
50 Sn	121	(76 y) β^-
51 Sb	124	(60.20 d) β^-
	125	(2.7 y) β^-
52 Te	121 m	(154 d) IT
	123 m	(119.7 d) IT
	127 m	(109 d) IT
53 I	129	(1.6×10^7 y) β^-
	131	(8.040 d) β^-
54 Xe	133	(5.25 d) β^-
	135	(9.10 h) β^-
55 Cs	134	(2.06 y) β^-
	135	(2.9×10^6 y) β^-
	137	(30.17 y) β^-
56 Ba	140	(12.8 d) β^-
57 La	137	(6×10^4 y) EC
	140	(40.3 h) β^-
58 Ce	144	(284 d) β^-
59 Pr	142	(19.1 h) β^-
60 Nd	147	(11.1 d) β^-
61 Pm	145	(18 y) EC
	147	(2.62 y) β^-
62 Sm	146	(7×10^7 y) α
	151	(93 y) β^-
63 Eu	152	(13 y) β^+, EC, β^-
	154	(8.5 y) β^-
64 Gd	150	(2.1×10^6 y) α
65 Tb	158	(1.2×10^3 y) EC, β^-
	160	(72.3 d) β^-
67 Ho	166 m	(1.2×10^3 y) β^-
69 Tm	170	(128.6 d) β^-
	171	(1.92 y) β^-
70 Yb	169	(32.0 d) EC
	175	(4.19 d) β^-
71 Lu	176	(3.7×10^{10} y) β^-
73 Ta	182	(115.0 d) β^-
74 W	181	(140 d) EC
	185	(75.1 d) β^-
	188	(69 d) β^-
75 Re	187	(5×10^{10} y) β^-
76 Os	194	(6.0 y) β^-
77 Ir	192	(74.2 d) β^-, β^+, EC
79 Au	195	(183 d) EC
	196	(6.18 d) β^+, EC, β^-
	198	(2.696 d) β^-
	199	(3.15 d) β^-
80 Hg	203	(46.8 d) β^-
81 Tl	204	(3.77 y) β^-
82 Pb	202	(3×10^5 y) EC
	205	(3×10^7 y) EC
	210	(22.3 y) β^-, α
83 Bi	207	(38 y) EC
	208	(3.7×10^5 y) EC
	210	(5.01 d) β^-, α
	210 m	(3×10^6 y) α
84 Po	208	(2.90 y) α
	209	(102 y) α
	210	(138.38 d) α
85 At	209	(5.4 h) EC, α
	210	(8.1 h) EC
	211	(7.21 h) EC, α
86 Rn	222	(3.824 d) α
87 Fr	212	(19.3 min) EC, α
	222	(15 min) β^-
	223	(21.8 min) β^-
88 Ra	226	(1.60×10^3 y) α
89 Ac	227	(21.77 y) β^-
90 Th	228	(1.913 y) α
	230	(7.7×10^4 y) α
	232	(1.40×10^{10} y) α
91 Pa	231	(3.28×10^4 y) α
92 U	233	(1.59×10^5 y) α
	234	(2.44×10^5 y) α
	235	(7.04×10^8 y) α
	236	(2.34×10^7 y) α
	238	(4.47×10^9 y) α
93 Np	236	(1.1×10^5 y) EC, β^-
	237	(2.14×10^6 y) α
	239	(2.346 d) β^-
94 Pu	238	(87.75 y) α
	239	(2.41×10^4 y) α
	240	(6.54×10^3 y) α
	242	(3.8×10^5 y) α
	244	(8.3×10^7 y) α
95 Am	241	(432 y) α
	243	(7.37×10^3 y) α
96 Cm	242	(163.2 d) α
	244	(18.12 y) α
	247	(1.55×10^7 y) α
	248	(3.5×10^5 y) α, SF
97 Bk	247	(1.4×10^3 y) α
98 Cf	249	(351 y) α
	251	(900 y) α
99 Es	252	(472 d) α
	253	(20.47 d) α
	254	(276 d) α
100 Fm	255	(20.1 h) α
	257	(100.5 d) α
101 Md	258	(55 d) α
102 No	259	(58 min) α
103 Lr	260	(3.0 min) α
104 Rf	261	(65 s) α
105 Db	262	(40 s) α
106 Sg	263	(0.9 d) α

Selected Radioactive Isotopes

Naturally occurring radioactive isotopes are designated by a mass number in blue (although some are also manufactured). Letter m indicates an isomer of another isotope of the same mass number. Half-lives follow in parentheses, where s, min, h, d, and y stand respectively for seconds, minutes, hours, days, and years. The table includes mainly the longer-lived radioactive isotopes; many others have been prepared. Isotopes known to be radioactive but with half-lives exceeding 10^{12} y have not been included. Symbols describing the principal mode (or modes) of decay are as follows (these processes are generally accompanied by gamma radiation):

- α alpha particle emission
- β^- beta particle (electron) emission
- β^+ positron emission
- EC orbital electron capture
- IT isomeric transition from upper to lower isomeric state
- SF spontaneous fission

Periodic Table

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

Atomic number	Symbol	Name	Atomic weight	Oxidation states	Boiling point, K	Melting point, K	Density at 300 K	Electron configuration
1	H	Hydrogen	1.00794	1,-1	20.28	13.81	0.0899 †	$1s^1$
2	He	Helium	4.00260		4.216	0.95 at 26 atm	0.1785 †	$1s^2$
3	Li	Lithium	6.941	1	1615	453.7	0.534	[He]$2s^1$
4	Be	Beryllium	9.012182	2	2744	1560	1.85	[He]$2s^2$
5	B	Boron	10.811	3	4275	2348	2.37	[He]$2s^2 2p^1$
6	C	Carbon	12.0107	±4,2	4675*	3915*	2.26	[He]$2s^2 2p^2$
7	N	Nitrogen	14.0067	±3,5,4,2	77.344	63.15	1.251 †	[He]$2s^2 2p^3$
8	O	Oxygen	15.9994	-2,-1	90.2	54.4	1.429 †	[He]$2s^2 2p^4$
9	F	Fluorine	18.99840	-1	85.0	53.55	1.696 †	[He]$2s^2 2p^5$
10	Ne	Neon	20.1797		27.07	24.56	0.900 †	[He]$2s^2 2p^6$
11	Na	Sodium	22.989770	1	1156.1	371.0	0.971	[Ne]$3s^1$
12	Mg	Magnesium	24.3050	2	1363	923	1.74	[Ne]$3s^2$
13	Al	Aluminum	26.981538	3	2792	933.5	2.6989	[Ne]$3s^2 3p^1$
14	Si	Silicon	28.0855	4,2	3538	1687	2.33	[Ne]$3s^2 3p^2$
15	P	Phosphorus	30.97376	±3,5,4	553	317.3	1.82	[Ne]$3s^2 3p^3$
16	S	Sulfur	32.065	6,±2,4	717.75	388.36	2.07	[Ne]$3s^2 3p^4$
17	Cl	Chlorine	35.453	±1,7,5,3	239.11	171.65	3.214 †	[Ne]$3s^2 3p^5$
18	Ar	Argon	39.948		87.8	83.8	1.784 †	[Ne]$3s^2 3p^6$
19	K	Potassium	39.0983	1	1033	336.8	0.862	[Ar]$4s^1$
20	Ca	Calcium	40.078	2	1757	1115	1.55	[Ar]$4s^2$
21	Sc	Scandium	44.95591	3	3109	1814	2.99	[Ar]$3d^1 4s^2$
22	Ti	Titanium	47.867	4,3,2	3560	1941	4.54	[Ar]$3d^2 4s^2$
23	V	Vanadium	50.9415	5,4,3,2	3680	2183	6.11	[Ar]$3d^3 4s^2$
24	Cr	Chromium	51.996	3,6,2	2945	2180	7.19	[Ar]$3d^5 4s^1$
25	Mn	Manganese	54.9380	2,3,4,6,7	2234	1519	7.44	[Ar]$3d^5 4s^2$
26	Fe	Iron	55.845	3,2,6	3134	1811	7.874	[Ar]$3d^6 4s^2$
27	Co	Cobalt	58.9332	2,3	3200	1768	8.90	[Ar]$3d^7 4s^2$
28	Ni	Nickel	58.6934	2,3	3186	1728	8.90	[Ar]$3d^8 4s^2$
29	Cu	Copper	63.546	2,1	2835	1357.8	8.96	[Ar]$3d^{10} 4s^1$
30	Zn	Zinc	65.409	2	1180	692.68	7.13	[Ar]$3d^{10} 4s^2$
31	Ga	Gallium	69.723	1,3	2477	302.91	6.095	[Ar]$3d^{10} 4s^2 4p^1$
32	Ge	Germanium	72.64	4	3106	1211.4	5.32	[Ar]$3d^{10} 4s^2 4p^2$
33	As	Arsenic	74.9216	±3,5	876 (subl.)	1090 (28 atm)	5.73	[Ar]$3d^{10} 4s^2 4p^3$
34	Se	Selenium	78.96	4,6,-2	958	494	4.79	[Ar]$3d^{10} 4s^2 4p^4$
35	Br	Bromine	79.904	±1,7,5,3	331.95	265.95	3.12	[Ar]$3d^{10} 4s^2 4p^5$
36	Kr	Krypton	83.80	0,2	119.93	115.8	3.73 †	[Ar]$3d^{10} 4s^2 4p^6$
37	Rb	Rubidium	85.4678	1	961	312.46	1.532	[Kr]$5s^1$
38	Sr	Strontium	87.62	2	1655	1050	2.54	[Kr]$5s^2$
39	Y	Yttrium	88.9059	3	3618	1795	4.47	[Kr]$4d^1 5s^2$
40	Zr	Zirconium	91.224	4	4682	2128	6.51	[Kr]$4d^2 5s^2$
41	Nb	Niobium	92.90638	5,3,4	5017	2730	8.57	[Kr]$4d^4 5s^1$
42	Mo	Molybdenum	95.94	6,5,4,3,2	4912	2896	10.22	[Kr]$4d^5 5s^1$
43	Tc	Technetium	(98)	7,5,4	4538	2430	11.5*	[Kr]$4d^5 5s^2$
44	Ru	Ruthenium	101.07	2,3,4,6,8	4423	2607	12.37	[Kr]$4d^7 5s^1$
45	Rh	Rhodium	102.90550	2,3,4	3968	2237	12.41	[Kr]$4d^8 5s^1$
46	Pd	Palladium	106.42	2,4	3236	1828	12.0	[Kr]$4d^{10}$
47	Ag	Silver	107.8682	1	2435	1234.93	10.50	[Kr]$4d^{10} 5s^1$
48	Cd	Cadmium	112.41	2	1040	594.22	8.65	[Kr]$4d^{10} 5s^2$
49	In	Indium	114.82	3	2345	429.75	7.31	[Kr]$4d^{10} 5s^2 5p^1$
50	Sn	Tin	118.710	4,2	2875	505.08	7.31	[Kr]$4d^{10} 5s^2 5p^2$
51	Sb	Antimony	121.760	±3,5	1860	903.78	6.69	[Kr]$4d^{10} 5s^2 5p^3$
52	Te	Tellurium	127.60	4,6,-2	1261	722.66	6.24	[Kr]$4d^{10} 5s^2 5p^4$
53	I	Iodine	126.90447	±1,5,7	457.51	386.85	4.93	[Kr]$4d^{10} 5s^2 5p^5$
54	Xe	Xenon	131.29	0,2,4,6,8	165.11	161.4	5.90 †	[Kr]$4d^{10} 5s^2 5p^6$
55	Cs	Cesium	132.90545	1	944	301.54	1.87	[Xe]$6s^1$
56	Ba	Barium	137.327	2	2170	1000	3.5	[Xe]$6s^2$
57	La ★	Lanthanum	138.9055	3	3737	1191	6.15	[Xe]$5d^1 6s^2$
72	Hf	Hafnium	178.49	4	4876	2506	13.31	[Xe]$4f^{14} 5d^2 6s^2$
73	Ta	Tantalum	180.9479	5	5730	3290	16.65	[Xe]$4f^{14} 5d^3 6s^2$
74	W	Tungsten	183.84	6,5,4,3,2	5828	3695	19.3	[Xe]$4f^{14} 5d^4 6s^2$
75	Re	Rhenium	186.207	7,6,5,4,3,2	5870	3459	21.0	[Xe]$4f^{14} 5d^5 6s^2$
76	Os	Osmium	190.23	4,8,6,3,2	5285	3306	22.57	[Xe]$4f^{14} 5d^6 6s^2$
77	Ir	Iridium	192.217	4,2,6,3	4700	2720	22.42	[Xe]$4f^{14} 5d^7 6s^2$
78	Pt	Platinum	195.08	4,2	4098	2041.55	21.45	[Xe]$4f^{14} 5d^9 6s^1$
79	Au	Gold	196.96655	3,1	3130	1337.33	19.3	[Xe]$4f^{14} 5d^{10} 6s^1$
80	Hg	Mercury	200.59	2,1	629.88	234.32	13.55	[Xe]$4f^{14} 5d^{10} 6s^2$
81	Tl	Thallium	204.3833	3,1	1746	577	11.85	[Xe]$4f^{14} 5d^{10} 6s^2 6p^1$
82	Pb	Lead	207.2	2,4	2022	600.61	11.35	[Xe]$4f^{14} 5d^{10} 6s^2 6p^2$
83	Bi	Bismuth	208.9804	3,5	1837	544.55	9.75	[Xe]$4f^{14} 5d^{10} 6s^2 6p^3$
84	Po	Polonium	(209)	4,2,6	—	527	9.3	[Xe]$4f^{14} 5d^{10} 6s^2 6p^4$
85	At	Astatine	(210)	±1,7,5,3	610*	575	—	[Xe]$4f^{14} 5d^{10} 6s^2 6p^5$
86	Rn	Radon	(222)	0,2	211.4	202	9.73 †	[Xe]$4f^{14} 5d^{10} 6s^2 6p^6$
87	Fr	Francium	(223)	1	950*	300	—	[Rn]$7s^1$
88	Ra	Radium	(226)	2	1413	973	5.0	[Rn]$7s^2$
89	Ac ★★	Actinium	(227)	3	3470*	1324	10.07	[Rn]$6d^1 7s^2$
104	Rf	Rutherfordium	(261)		—			[Rn]$5f^{14} 6d^2 7s^2$*
105	Db	Dubnium	(262)		—			[Rn]$5f^{14} 6d^3 7s^2$*
106	Sg	Seaborgium	(266)		—			[Rn]$5f^{14} 6d^4 7s^2$*
107	Bh	Bohrium	(264)		—			[Rn]$5f^{14} 6d^5 7s^2$*
108	Hs	Hassium	(277)		—			[Rn]$5f^{14} 6d^6 7s^2$*
109	Mt	Meitnerium	(268)		—			[Rn]$5f^{14} 6d^7 7s^2$*
110	Ds	(Darmstadtium)	(269)		—			[Rn]$5f^{14} 6d^8 7s^2$*
111	Uuu	(Unununium)	(272)		—			[Rn]$5f^{14} 6d^9 7s^2$*
112	Uub	(Ununbium)	(285)		—			[Rn]$5f^{14} 6d^{10} 7s^2$*
113	Uut	(Ununtrium)	(284)		—			[Rn]$5f^{14} 6d^{10} 7s^2 7p^1$*
114	Uuq	(Ununquadium)	(289)		—			[Rn]$5f^{14} 6d^{10} 7s^2 7p^2$
115	Uup	(Ununpentium)	(288)		—			[Rn]$5f^{14} 6d^{10} 7s^2 7p^3$*
116	Uuh	(Ununhexium)			—			[Rn]$5f^{14} 6d^{10} 7s^2 7p^4$
117	Uus	(Ununseptium)						
118	Uuo	(Ununoctium)						

* Estimated Values

★ Lanthanides

Atomic number	Symbol	Name	Atomic weight	Oxidation states	Boiling point, K	Melting point, K	Density at 300 K	Electron configuration
58	Ce	Cerium	140.116	3,4	3716	1071	6.77	[Xe]$4f^1 5d^1 6s^2$
59	Pr	Praseodymium	140.90765	3,4	3785	1204	6.77	[Xe]$4f^3 6s^2$
60	Nd	Neodymium	144.24	3	3347	1294	7.01	[Xe]$4f^4 6s^2$
61	Pm	Promethium	(145)	3	3273	1315	7.26	[Xe]$4f^5 6s^2$
62	Sm	Samarium	150.36	3,2	2067	1347	7.52	[Xe]$4f^6 6s^2$
63	Eu	Europium	151.964	3,2	1869	1095	5.24	[Xe]$4f^7 6s^2$
64	Gd	Gadolinium	157.25	3	3546	1586	7.90	[Xe]$4f^7 5d^1 6s^2$
65	Tb	Terbium	158.92534	3,4	3503	1629	8.23	[Xe]$4f^9 6s^2$
66	Dy	Dysprosium	162.50	3	2840	1685	8.55	[Xe]$4f^{10} 6s^2$
67	Ho	Holmium	164.9303	3	2973	1747	8.795	[Xe]$4f^{11} 6s^2$
68	Er	Erbium	167.26	3	3140	1802	9.07	[Xe]$4f^{12} 6s^2$
69	Tm	Thulium	168.9342	3,2	2223	1818	9.32	[Xe]$4f^{13} 6s^2$
70	Yb	Ytterbium	173.04	3,2	1469	1092	6.903	[Xe]$4f^{14} 6s^2$
71	Lu	Lutetium	174.967	3	3675	1936	9.841	[Xe]$4f^{14} 5d^1 6s^2$

★★ Actinides

Atomic number	Symbol	Name	Atomic weight	Oxidation states	Boiling point, K	Melting point, K	Density at 300 K	Electron configuration
90	Th	Thorium	232.0381	4	5061	2023	11.72	[Rn]$6d^2 7s^2$
91	Pa	Protactinium	231.0359	5,4	4300*	1845	15.4*	[Rn]$5f^2 6d^1 7s^2$
92	U	Uranium	238.0289	6,5,4,3	4404	1408	18.95	[Rn]$5f^3 6d^1 7s^2$
93	Np	Neptunium	(237)	5,6,4,3	4175*	917	20.2	[Rn]$5f^4 6d^1 7s^2$
94	Pu	Plutonium	(244)	4,6,5,3	3505	913	19.84	[Rn]$5f^6 7s^2$
95	Am	Americium	(243)	3,6,5,4,2	2284	1449	13.7	[Rn]$5f^7 7s^2$
96	Cm	Curium	(247)	3	—	1620	13.5*	[Rn]$5f^7 6d^1 7s^2$
97	Bk	Berkelium	(247)	3,4	—	—	14*	[Rn]$5f^9 7s^2$
98	Cf	Californium	(251)	3	—	1170*	—	[Rn]$5f^{10} 7s^2$
99	Es	Einsteinium	(252)	3	—	1130*	—	[Rn]$5f^{11} 7s^2$
100	Fm	Fermium	(257)	3	—	1800*	—	[Rn]$5f^{12} 7s^2$
101	Md	Mendelevium	(258)	3	—	1100*	—	[Rn]$5f^{13} 7s^2$
102	No	Nobelium	(259)	2,3	—	1100*	—	[Rn]$5f^{14} 7s^2$
103	Lr	Lawrencium	(262)	3	—	1900*	—	[Rn]$5f^{14} 6d^1 7s^2$

KEY

NOTES:
(1) Black — solid.
Red — gas.
Blue — liquid.
Outline — synthetically prepared.
(2) Based upon carbon-12. ( ) indicates most stable or best known isotope.
(3) Entries marked with daggers refer to the gaseous state at 273 K and 1 atm and are given in units of g/l.

The A & B subgroup designations, are those recommended by the International Union of Pure and Applied Chemistry.

Catalog Number WLS-18806

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