PERIODIC TABLE OF THE ELEMENTS

Table of Selected Radioactive Isotopes

Element	Mass number	Half-life and decay mode
$_0$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^{11} 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

Elements

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

Atomic number	Symbol	Name	Atomic weight	Oxidation states	Boiling point, K	Melting point, K	Density	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	5,4	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	Rg	(Roentgenium)	(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)						
★ 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	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]$4f^{14} 5d^1 6s^2$
★★ 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	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]$5f^{14} 6d^1 7s^2$

* Estimated Values

KEY

ATOMIC NUMBER	30
ATOMIC WEIGHT (2)	65.409
OXIDATION STATES (Bold most stable)	2
BOILING POINT, K	1180
MELTING POINT, K	692.73
SYMBOL	Zn
DENSITY at 300 K (3) (g/cm³)	7.13
ELECTRON CONFIGURATION	[Ar]$3d^{10} 4s^2$
NAME	Zinc

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.

Sargent-Welch

VWR INTERNATIONAL

Catalog Number WLS-18806

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TABLE OF PERIODIC PROPERTIES OF THE ELEMENTS

Percent Ionic Character of a Single Chemical Bond

Difference in electronegativity	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2
Percent ionic character %	0.5	1	2	4	6	9	12	15	19	22	26	30	34	39	43	47	51	55	59	63	67	70	74	76	79	82	84	86	88	89	91	92

DATA CONCERNING THE MORE STABLE ELEMENTARY (SUBATOMIC) PARTICLES

	Neutron	Proton	Electron*	Neutrino*	Photon
Symbol	n	P	e (e-)	ν	γ
Rest mass (kg)	1.67495×10^{-27}	1.67265×10^{-27}	9.1095×10^{-31}	~0	0
Relative atomic mass (^{12}C=12)	1.008665	1.007276	5.48580×10^{-4}	~0	0
Charge (C)	0	1.60219×10^{-19}	-1.60219×10^{-19}	0	0
Radius (m)	8×10^{-16}	8×10^{-16}	$<1 \times 10^{-16}$	~0	0
Spin quantum number	1/2	1/2	1/2	1/2	1
Magnetic Moment†	-1.913 μ_N	2.793 μ_N	1.001 μ_B	0	0

* The positron (e^+) has properties similar to those of the (negative) electron or beta particle except that its charge has opposite sign (+). The antineutrino ($\bar{\nu}$) has properties similar to those of the neutrino except that its spin (or rotation) is opposite in relation to its direction of propagation.

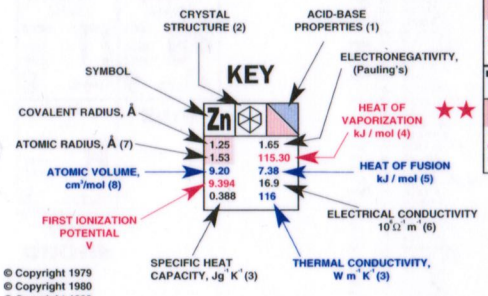
An antineutrino accompanies release of an electron in radioactive β (particle) decay, whereas a neutrino accompanies the release of a positron in β^+ decay.

†μ_B=Bohr magneton and μ_N=Nuclear magneton.

GROUP 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
H												B	C	N	O	F	He
0.32 2.20												0.82 2.04	0.77 2.55	0.75 3.04	0.73 3.44	0.72 3.98	0.93 —
0.79 0.4581												1.17 507.8	0.91 715	0.75 2.793	0.65 3.410	0.57 3.27	0.49 0.084
14.10 0.0585												4.6 22.6	5.30 —	17.30 0.36	14.0 0.222	17.10 0.26	31.80 0.021
13.598 —												8.298 5×10^{12}	11.260 0.07	14.534 —	13.618 —	17.422 —	24.587 —
14.304 0.1815												1.026 27.0	0.709 80-230	1.042 0.02598	0.918 0.2674	0.824 0.0279	5.193 0.152
Li	Be											Al	Si	P	S	Cl	Ne
1.23 0.98	0.90 1.57											1.18 1.61	1.11 1.90	1.06 2.19	1.02 2.58	0.99 3.16	0.71 —
2.05 147.1	1.40 297											1.82 290.8	1.46 359.0	1.23 12.4	1.09 10	0.97 10.20	0.51 1.77
13.10 3.0	5.0 11.71											10.0 10.7	12.1 50.2	17.0 0.63	15.90 1.73	18.70 3.21	16.90 0.34
5.392 11.7	9.323 25											5.986 37.7	8.152 4×10^{-3}	10.487 10^{-16}	10.360 5×10^{-16}	12.967 —	21.564 —
3.582 84.7	1.825 200											0.90 237	0.70 148.	0.769 0.235	0.710 0.269	0.479 0.0089	0.520 0.0177
Na	Mg																
1.54 0.93	1.36 1.31																
2.23 98.01	1.72 127.6																
23.70 2.601	14.0 8.95																
5.139 20.1	7.646 22.4																
1.228 141	1.02 156																
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
2.03 0.82	1.74 1.00	1.44 1.36	1.32 1.54	1.22 1.63	1.18 1.66	1.17 1.55	1.17 1.83	1.16 1.88	1.15 1.91	1.17 1.90	1.25 1.65	1.26 1.81	1.22 2.01	1.20 2.18	1.16 2.55	1.14 2.96	1.89 —
2.77 76.9	2.23 154.67	2.09 304.80	2.00 425.2	1.92 446.7	1.85 339.5	1.79 219.74	1.72 349.5	1.67 373.3	1.62 377.5	1.57 300.5	1.53 115.31	1.81 256.06	1.52 334.30	1.33 32.4	1.22 26.32	1.12 14.725	1.03 9.03
45.30 2.33	29.90 8.53	15.0 16.11	10.60 18.6	8.35 22.8	7.23 20	7.39 14.64	7.1 13.8	6.70 16.2	6.60 17.2	7.1 13.14	9.2 7.38	11.8 5.59	13.6 31.80	13.1 27.7	16.50 5.44	23.5 5.285	32.20 1.64
4.341 16.4	6.113 31.3	6.56 1.5	6.83 2.6	6.75 4.0	6.766 7.9	7.434 0.5	7.902 11.2	7.88 17.9	7.640 14.6	7.726 60.7	9.394 16.9	5.999 1.8	7.899 3×10^{-3}	9.79 3.8	9.752 8	11.814 10^{-16}	13.999 —
0.757 102.5	0.647 200	0.568 15.8	0.523 21.9	0.489 30.7	0.449 93.7	0.479 7.82	0.449 80.2	0.421 100	0.444 90.7	0.385 401	0.388 116	0.371 40.6	0.32 59.9	0.29 50	0.321 2.04	0.226 0.122	0.248 0.00949
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
2.16 0.82	1.91 0.95	1.62 1.22	1.45 1.33	1.34 1.6	1.30 2.16	1.27 1.9	1.25 2.2	1.25 2.28	1.28 2.20	1.34 1.93	1.41 1.69	1.44 1.78	1.41 1.96	1.40 2.05	1.36 2.1	1.33 2.66	1.31 2.6
2.98 69.2	2.45 136.9	2.27 393.30	2.16 590.5	2.08 690.1	2.01 590.4	1.95 502	1.89 567.77	1.83 495.39	1.79 393.3	1.75 250.63	1.71 99.87	2.00 226.35	1.72 290.37	1.53 67.97	1.42 50.63	1.32 20.9	1.24 12.64
55.9 2.34	33.7 8.2	19.8 17.15	14.1 21	10.80 26.9	9.4 36	8.5 23	8.3 25.52	8.30 21.76	8.9 16.74	10.3 11.3	13.1 6.07	15.7 3.26	16.3 7.2	18.40 19.83	20.5 17.49	25.70 7.76	42.90 2.30
4.177 47.8	5.695 5.0	6.22 1.8	6.63 2.3	6.76 6.6	7.092 17.3	7.28 0.001	7.36 14.9	7.46 23	8.34 10.0	7.576 62.9	8.993 14.7	5.786 3.4	7.344 8.7	8.608 2.6	9.009 2×10^{-4}	10.451 10^{11}	12.130 —
0.363 58.2	0.301 35.3	0.30 17.2	0.278 22.7	0.265 53.7	0.25 138	0.24 50.6	0.238 117	0.243 150	0.244 71.8	0.235 429	0.232 96.8	0.233 81.6	0.228 66.6	0.207 24.3	0.202 2.35	0.145 0.449	0.158 0.00569
Cs	Ba	La*	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
2.35 0.79	1.98 0.89	1.25 1.10	1.44 1.3	1.34 1.5	1.30 2.36	1.28 1.9	1.26 2.2	1.27 2.20	1.30 2.28	1.34 2.54	1.49 2.00	1.48 2.04	1.47 2.33	1.46 2.02	1.53 2.0	1.47 2.2	— —
3.34 67.740	2.78 140.2	2.74 399.57	2.16 661.07	2.09 737.0	2.02 422.58	1.97 707.10	1.92 627.6	1.87 563.58	1.83 510.45	1.79 324.43	1.76 59.30	2.08 162.09	1.81 177.9	1.63 179	1.53 120	1.43 30	1.34 16.4
70 2.09	39.0 8.01	22.50 11.30	13.60 21.76	10.90 36	9.53 35.4	8.85 33.05	8.43 29.29	8.54 26.36	9.10 19.66	10.20 12.36	14.80 2.292	17.20 4.27	18.30 4.77	21.30 11.0	22.70 13	— 12*	50.5 2.9
3.894 5.3	5.212 2.8	5.58 1.9	6.825 3.4	7.55 8.1	7.864 18.2	7.833 5.8	8.438 12.3	8.967 21.3	8.959 9.4	9.225 48.8	10.437 1.0	6.108 5.6	7.416 4.8	7.289 0.9	8.41 0.7	— —	10.748 —
0.24 35.9	0.204 18.4	0.195 13.5	0.144 23.0	0.140 57.5	0.132 174	0.137 47.9	0.130 87.6	0.131 147	0.13 71.6	0.129 317	0.140 8.34	0.129 46.1	0.129 35.3	0.122 7.87	— 20	— 1.7	0.094 0.00364
Fr	Ra	Ac**	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Uub	Uut	Uuq	Uup	Uuh	Uus	Uuo
— 0.7	— 0.9	— 1.1	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —
2.7 64*	— 136.82	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —
— 2.1*	45.2 8.37	22.5 —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —
4.073 —	5.278 1.0	5.17 —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —
— 15	0.094 18.6	0.120 12	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —

*ESTIMATED VALUES

★	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	DY	Ho	Er	Tm	Yb	Lu
	1.65 1.12	1.65 1.13	1.64 1.14	— 1.13	1.62 1.17	1.85 1.2	1.61 1.20	1.59 1.1	1.59 1.22	1.58 1.23	1.57 1.24	1.56 1.25	1.70 1.1	1.56 1.27
	2.70 313.80	2.67 332.63	2.64 283.68	2.62 —	2.59 191.63	2.56 175.73	2.54 311.71	2.51 —	2.49 230	2.47 251.04	2.45 292.88	2.42 191*	2.40 128*	2.25 355*
	21.0 9.20	20.80 10.04	20.6 10.88	22.4 —	19.90 11.09	28.9 10.46	19.90 15.48	19.20 —	19.0 11.06	18.70 17.15	18.40 17.15	18.10 16.8*	24.80 7.7*	17.80 18.6*
	5.538 1.4	5.473 1.5	5.525 1.6	5.582 2	5.644 1.1	5.67 1.1	6.15 0.8	5.864 0.9	5.939 1.1	6.021 1.1	6.108 1.2	6.184 1.3	6.254 3.7	5.426 1.5
	0.19 11.4	0.193 12.5	0.190 16.5	— 17.9*	0.197 13.3	0.182 13.9	0.236 10.6	0.182 11.1	0.173 10.7	0.165 16.2	0.168 14.3	0.160 16.8	0.155 34.9	0.154 16.4
	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
	1.65 1.3	— 1.5	1.42 1.38	— 1.36	1.08 1.28	— 1.3*	— 1.3*	— 1.3*	— 1.3*	— 1.3*	— 1.3*	— 1.3*	— 1.3*	— 1.3*
	— 543.92	— —	12.50 422.58	— —	12.32 —	20.8 —	18.3 —	— —	— —	— —	— —	— —	— —	— —
	19.90 15.65	15.0 —	12.50 15.48	21.10 —	6.026 0.7	5.974 0.7	5.991 —	6.198 —	6.282 —	6.42 —	6.5 —	6.58 —	6.65 —	4.9* —
	6.31 7.1	5.89 5.6	6.194 3.6	6.266 0.8	0.13* 6.74	— 10*	— 10*	— 10*	— 10*	— 10*	— 10*	— 10*	— 10*	— 10*
	0.113 54	— 47	0.12 27.6	— 6.3										



NOTES: (1) For representative oxides (higher valence) of group. Oxide is acidic if color is red, basic if color is blue and amphoteric if both colors are shown. Intensity of color indicates relative strength.

(2) Cubic, face centered; cubic, body centered; cubic; hexagonal; rhombohedral; tetragonal; orthorhombic; monoclinic.

(3) At 300 K (27°C)
(4) At boiling point
(5) At melting point
(6) Generally at 293 K (20°C) for polycrystalline material
(7) Quantum mechanical value for free atom
(8) From density at 300 K (27°C) for liquid and solid elements; values for gaseous elements refer to liquid state at boiling point

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