PERIODIC TABLE OF THE ELEMENTS

Table of Selected Radioactive Isotopes

0n	1	(15.3 min) β^-	30Zn	67	(61.88 h) β^-	51Sb	124	(60.20 d) β^-	74W	181	(140 d) EC	91Pa	231	(3.28×10^4 y) α
1H	3	(12.26 y) β^-		65	(244.1 d) β^+, EC		125	(2.7 y) β^-		185	(75.1 d) β^-	92U	233	(1.59×10^5 y) α
4Be	7	(53.3 d) EC	31Ga	67	(78.2 h) EC	52Te	121 m	(154 d) IT		188	(69 d) β^-		234	(2.44×10^5 y) α
	10	(1.6×10^6 y) β^-		72	(14.10 h) β^-		123 m	(119.7 d) IT	75Re	187	(5×10^{10} y) β^-		235	(7.04×10^8 y) α
6C	11	(20.40 min) β^+		74	(7.75 d) EC		127 m	(109 d) IT	76Os	194	(6.0 y) β^-		236	(2.34×10^7 y) α
	14	(5730 y) β^-	32Ge	68	(275 d) EC	53I	129	(1.6×10^7 y) β^-	77Ir	192	(74.2 d) β^-, β^+, EC		238	(4.47×10^9 y) α
9F	18	(109.8 min) β^+		71	(17.9 d) β^-, β^+, EC		131	(8.040 d) β^-	78Au	195	(183 d) EC	93Np	236	(1.1×10^5 y) EC, β^-
11Na	22	(2.602 y) β^+, EC	34Se	75	(118.5 d) β^-	54Xe	133	(5.25 d) β^-		196	(6.18 d) β^+, EC, β^-		237	(2.14×10^6 y) α
	24	(15.02 h) β^-		79	(6.5×10^4 y) β^-		135	(9.10 h) β^-		198	(2.696 d) β^-		239	(2.346 d) β^-
12Mg	28	(20.9 h) β^-	35Br	82	(35.34 h) β^-	55Cs	134	(2.06 y) β^-		199	(3.15 d) β^-	94Pu	238	(87.75 y) α
13Al	26	(7.2×10^5 y) β^+, EC	36Kr	81	(2.1×10^5 y) EC		135	(2.9×10^6 y) β-	80Hg	203	(46.8 d) β^-		239	(2.41 $\times 10^4$ y) α
15P	32	(14.26 d) β^-		85	(10.72 y) β^-	81Tl	137	(30.17 y) β^-	82Pb	204	(3.77 y) β^-		240	(6.54 $\times 10^3$ y) α
16S	35	(87.2 d) β^-	37Rb	86	(18.7 d) β^-	56Ba	140	(12.8 d) β^-	83Pb	202	(3×10^5 y) EC		242	(3.8 $\times 10^5$ y) α
17Cl	36	(3.01×10^5 y) β^-		87	(4.8×10^{10} y) β^-	57La	137	(6×10^4 y) EC		205	(3×10^7 y) EC		244	(8.3 $\times 10^7$ y) α
	38	(37.2 min) β^-	38Sr	90	(28.8 y) β^-		140	(40.3 h) β^-		210	(22.3 y) β^-, α	95Am	241	(432 y) α
18Ar	37	(35.02 d) EC	39Y	88	(106.6 d) β^+, EC	58Ce	144	(284 d) β^-	83Bi	207	(38 y) EC		243	(7.37 $\times 10^3$ y) α
	39	(265 y) β^-	40Zr	93	(1.5×10^6 y) β^-	59Pr	142	(19.1 h) β^-		208	(3.7 $\times 10^5$ y) EC	96Cm	242	(163.2 d) α
19K	40	(1.28×10^9 y) EC		95	(64.0 d) β^-	60Nd	147	(11.1 d) β^-		210	(5.01 d) β^-, α		244	(18.12 y) α,
	42	(12.36 h) β^-	41Nb	94	(2.0×10^4 y) β^-	61Pm	145	(18 y) EC		210 m	(3 $\times 10^6$ y) α		245	(1.55 $\times 10^3$ y) α
20Ca	45	(165 d) β^-		95	(35.15 d) β^-		147	(2.62 y) β^-	84Po	208	(2.90 y) α		248	(3.5 $\times 10^5$ y) α, SF
21Sc	46	(83.80 d) β^-	42Mo	99	(66.02 h) β^-	62Sm	146	(7×10^7 y) α		209	(102 y) α	97Bk	247	(1.4 $\times 10^3$ y) α
24Cr	51	(27.70 d) EC	43Tc	97	(2.6×10^6 y) EC		151	(93 y) β^-		210	(138.38 d) α	98Cf	249	(351 y) α
25Mn	53	(2×10^6 y) EC		98	(4.2×10^6 y) β^-	63Eu	152	(13 y) β^+, EC, β^-	85At	209	(5.4 h) EC, α		250	(900 y) α
	54	(313.0 d) EC		99	(2.13×10^5 y) β^-		154	(8.5 y) β^-		210	(8.1 h) EC	99Es	252	(472 d) α
	56	(2.578 h) β^-	44Ru	106	(367 d) β^-	64Gd	150	(2.1×10^6 y) α		211	(7.21 h) EC, α		253	(20.47 d) α
26Fe	59	(44.6 d) β^-	45Rh	101	(3.3 y) EC	65Tb	158	(1.2×10^5 y) EC, β^-	86Rn	222	(3.824 d) α		254	(276 d) α
27Co	56	(78.8d) β^+, EC	46Pd	103	(17.0 d) EC		160	(72.3 d) β^-	87Fr	212	(19.3 min) EC, α	100Fm	255	(20.1 h) α
	57	(270 d) EC		107	(7×10^6 y) β^-	66Ho	166 m	(1.2×10^3 y) β^-		222	(15 min) β^-		257	(100.5 d) α
28Ni	58	(71.3 d) β^+, EC	47Ag	108	(127 y) EC	67Ho	166	(1.26 d) β^-		223	(21.8 min) β^-	101Md	258	(55 d) α
	60	(5.272 y) β^-		110	(252 d) β^-	68Er	169	(9.4 d) β^-	88Ra	226	(1.60 $\times 10^3$ y) α	102No	259	(58 min) α
	59	(36.0 h) β^+, EC		111	(7.45 d) β^-	69Tm	170	(128.6 d) β^-	89Ac	227	(21.77 y) β^-	103Lr	260	(3.0 min) α
	59	(8 $\times 10^4$ y) EC	48Cd	109	(453 d) EC		171	(1.92 y) β^-	90Th	228	(1.913 y) α	104Rf	261	(65 s) α
	63	(92 y) β^-	49In	114	(49.51 d) IT	70Yb	169	(32.0 d) EC		230	(7.7 $\times 10^4$ y) α	105Db	262	(40 s) α
29Cu	64	(12.70 h) β^-, β^+, EC	50Sn	121	(76 y) β^-		175	(4.19 d) β^-		232	(1.40 $\times 10^{10}$ y) α	106Sg	263	(0.9 d) α
						71Lu	176	(3.7×10^{10} y) β^-						
						73Ta	182	(115.0 d) β^-						

Selected Radioactive Isotopes

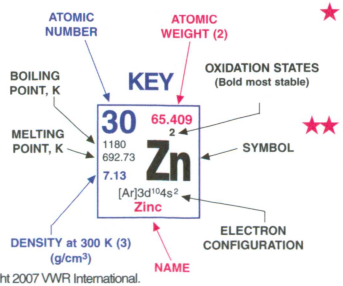
Naturally occurring radioactive isotopes are designated by a mass number in blue (although some are also manufactured). Letter m indicates an isomer of another isotope of the same mass number. Half-lives follow in parentheses, where s, min, h, d, and y stand respectively for seconds, minutes, hours, 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

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
1 1.00794 1,-1 20.28 13.81 0.0899 † $1s^1$ **H** Hydrogen																	**2** 4.00260 4.216 0.95 at 26 atm 0.1785† $1s^2$ **He** Helium
3 (6.941) 1 1615 453.7 0.534 $[He]2s^1$ **Li** Lithium	**4** 9.012182 2 2744 1560 1.85 $[He]2s^2$ **Be** Beryllium											**5** 10.811 3 4275 2348 2.37 $[He]2s^22p^1$ **B** Boron	**6** 12.0107 ±4,2 4675* 3915* 2.26 $[He]2s^22p^2$ **C** Carbon	**7** 14.0067 ±3,5,4,2 77.344 63.15 1.251† $[He]2s^22p^3$ **N** Nitrogen	**8** 15.9994 -2,-1 90.2 54.4 1.429† $[He]2s^22p^4$ **O** Oxygen	**9** 18.99840 -1 85.0 53.55 1.696† $[He]2s^22p^5$ **F** Fluorine	**10** 20.1797 27.07 24.56 0.900† $[He]2s^22p^6$ **Ne** Neon
11 22.989770 1 1156.1 371.0 0.971 $[Ne]3s^1$ **Na** Sodium	**12** 24.3050 2 1363 923 1.74 $[Ne]3s^2$ **Mg** Magnesium											**13** 26.981538 3 2792 933.5 2.6989 $[Ne]3s^23p^1$ **Al** Aluminum	**14** 28.0855 4,2 3538 1687 2.33 $[Ne]3s^23p^2$ **Si** Silicon	**15** 30.97376 ±3,5,4 553 317.3 1.82 $[Ne]3s^23p^3$ **P** Phosphorus	**16** 32.065 6,±2,4, 717.75 388.36 2.07 $[Ne]3s^23p^4$ **S** Sulfur	**17** 35.453 ±1,7,5,3 239.11 171.65 3.214† $[Ne]3s^23p^5$ **Cl** Chlorine	**18** 39.948 87.8 83.8 1.784† $[Ne]3s^23p^6$ **Ar** Argon
19 39.0983 1 1033 336.8 0.862 $[Ar]4s^1$ **K** Potassium	**20** 40.078 2 1757 1115 1.55 $[Ar]4s^2$ **Ca** Calcium	**21** 44.95591 3 3109 1814 2.99 $[Ar]3d^14s^2$ **Sc** Scandium	**22** 47.867 4,3,2 3560 1941 4.54 $[Ar]3d^24s^2$ **Ti** Titanium	**23** 50.9415 5,4,3,2 3680 2183 6.11 $[Ar]3d^34s^2$ **V** Vanadium	**24** 51.996 3,6,2 2945 2180 7.19 $[Ar]3d^54s^1$ **Cr** Chromium	**25** 54.9380 2,3,4,6,7 2234 1519 7.44 $[Ar]3d^54s^2$ **Mn** Manganese	**26** 55.845 3,2,6 3134 1811 7.874 $[Ar]3d^64s^2$ **Fe** Iron	**27** 58.9332 2,3 3200 1768 8.90 $[Ar]3d^74s^2$ **Co** Cobalt	**28** 58.6934 2,3 3186 1728 8.90 $[Ar]3d^84s^2$ **Ni** Nickel	**29** 63.546 2,1 2835 1357.8 8.96 $[Ar]3d^{10}4s^1$ **Cu** Copper	**30** 65.409 2 1180 692.68 7.13 $[Ar]3d^{10}4s^2$ **Zn** Zinc	**31** 69.723 1,3 2477 302.91 6.095 $[Ar]3d^{10}4s^24p^1$ **Ga** Gallium	**32** 72.64 4 3106 1211.4 5.32 $[Ar]3d^{10}4s^24p^2$ **Ge** Germanium	**33** 74.9216 ±3,5 876 (subl.) 1090 (28 atm.) 5.73 $[Ar]3d^{10}4s^24p^3$ **As** Arsenic	**34** 78.96 4,6,-2 958 494 4.79 $[Ar]3d^{10}4s^24p^4$ **Se** Selenium	**35** 79.904 ±1,7,5,3 331.95 265.95 3.12 $[Ar]3d^{10}4s^24p^5$ **Br** Bromine	**36** 83.80 0,2 119.93 115.8 3.73† $[Ar]3d^{10}4s^24p^6$ **Kr** Krypton
37 85.4678 1 961 312.46 1.532 $[Kr]5s^1$ **Rb** Rubidium	**38** 87.62 2 1655 1050 2.54 $[Kr]5s^2$ **Sr** Strontium	**39** 88.9059 3 3618 1795 4.47 $[Kr]4d^15s^2$ **Y** Yttrium	**40** 91.224 4 4682 2128 6.51 $[Kr]4d^25s^2$ **Zr** Zirconium	**41** 92.90638 5,3,4 5017 2730 8.57 $[Kr]4d^45s^1$ **Nb** Niobium	**42** 95.94 6,5,4,3,2 4912 2896 10.22 $[Kr]4d^55s^1$ **Mo** Molybdenum	**43** (98) 7,5,4 4538 2430 11.5* $[Kr]4d^55s^2$ **Tc** Technetium	**44** 101.07 2,3,4,6,8 4423 2607 12.37 $[Kr]4d^75s^1$ **Ru** Ruthenium	**45** 102.90550 2,3,4 3968 2237 12.41 $[Kr]4d^85s^1$ **Rh** Rhodium	**46** 106.42 2,4 3236 1828 12.0 $[Kr]4d^{10}$ **Pd** Palladium	**47** 107.8682 1 2435 1234.93 10.50 $[Kr]4d^{10}5s^1$ **Ag** Silver	**48** 112.41 2 1040 594.22 8.65 $[Kr]4d^{10}5s^2$ **Cd** Cadmium	**49** 114.82 3 2345 429.75 7.31 $[Kr]4d^{10}5s^25p^1$ **In** Indium	**50** 118.710 4,2 2875 505.08 7.31 $[Kr]4d^{10}5s^25p^2$ **Sn** Tin	**51** 121.760 ±3,5 1860 903.78 6.69 $[Kr]4d^{10}5s^25p^3$ **Sb** Antimony	**52** 127.60 4,6,-2 1261 722.66 6.24 $[Kr]4d^{10}5s^25p^4$ **Te** Tellurium	**53** 126.90447 ±1,5,7 457.51 386.85 4.93 $[Kr]4d^{10}5s^25p^5$ **I** Iodine	**54** 131.29 0,2,4,6,8 165.11 161.4 5.90† $[Kr]4d^{10}5s^25p^6$ **Xe** Xenon
55 132.90545 1 944 301.54 1.87 $[Xe]6s^1$ **Cs** Cesium	**56** 137.327 2 2170 1000 3.5 $[Xe]6s^2$ **Ba** Barium	**57** 138.9055 3 ★ 3737 1191 6.15 $[Xe]5d^16s^2$ **La** Lanthanum	**72** 178.49 4 4876 2506 13.31 $[Xe]4f^{14}5d^26s^2$ **Hf** Hafnium	**73** 180.9479 5,4 5730 3290 16.65 $[Xe]4f^{14}5d^36s^2$ **Ta** Tantalum	**74** 183.84 6,5,4,3,2 5828 3695 19.3 $[Xe]4f^{14}5d^46s^2$ **W** Tungsten	**75** 186.207 7,6,5,4,3,2 5870 3459 21.0 $[Xe]4f^{14}5d^56s^2$ **Re** Rhenium	**76** 190.23 4,8,6,3,2 5285 3306 22.57 $[Xe]4f^{14}5d^66s^2$ **Os** Osmium	**77** 192.217 4,2,6,3 4700 2720 22.42 $[Xe]4f^{14}5d^76s^2$ **Ir** Iridium	**78** 195.08 4,2 4098 2041.55 21.45 $[Xe]4f^{14}5d^96s^1$ **Pt** Platinum	**79** 196.96655 3,1 3130 1337.33 19.3 $[Xe]4f^{14}5d^{10}6s^1$ **Au** Gold	**80** 200.59 2,1 629.88 234.32 13.55 $[Xe]4f^{14}5d^{10}6s^2$ **Hg** Mercury	**81** 204.3833 3,1 1746 577 11.85 $[Xe]4f^{14}5d^{10}6s^26p^1$ **Tl** Thallium	**82** 207.2 2,4 2022 600.61 11.35 $[Xe]4f^{14}5d^{10}6s^26p^2$ **Pb** Lead	**83** 208.9804 3,5 1837 544.55 9.75 $[Xe]4f^{14}5d^{10}6s^26p^3$ **Bi** Bismuth	**84** (209) 4,2,6 — 527 9.3 $[Xe]4f^{14}5d^{10}6s^26p^4$ **Po** Polonium	**85** (210) ±1,7,5,3 610* 575 — $[Xe]4f^{14}5d^{10}6s^26p^5$ **At** Astatine	**86** (222) 0,2 211.4 202 9.73† $[Xe]4f^{14}5d^{10}6s^26p^6$ **Rn** Radon
87 (223) 1 950* 300 — $[Rn]7s^1$ **Fr** Francium	**88** (226) 2 1413 973 5.0 $[Rn]7s^2$ **Ra** Radium	**89** (227) 3 ★★ 3470* 1324 10.07 $[Rn]6d^17s^2$ **Ac** Actinium	**104** (261) — — — $[Rn]5f^{14}6d^27s^2$ **Rf** Rutherfordium	**105** (262) — — — $[Rn]5f^{14}6d^37s^2$ **Db** Dubnium	**106** (266) — — — $[Rn]5f^{14}6d^47s^2$ **Sg** Seaborgium	**107** (264) — — — $[Rn]5f^{14}6d^57s^2$ **Bh** Bohrium	**108** (277) — — — $[Rn]5f^{14}6d^67s^2$ **Hs** Hassium	**109** (268) — — — $[Rn]5f^{14}6d^77s^2$ **Mt** Meitnerium	**110** (269) — — — $[Rn]5f^{14}6d^87s^2$ **Ds** (Darmstadtium)	**111** (272) — — — $[Rn]5f^{14}6d^97s^2$ **Rg** (Roentgenium)	**112** (285) — — — $[Rn]5f^{14}6d^{10}7s^2$ **Uub** (Ununbium)	**113** (284) — — — $[Rn]5f^{14}6d^{10}7s^27p^1$ **Uut** (Ununtrium)	**114** (289) — — — $[Rn]5f^{14}6d^{10}7s^27p^2$ **Uuq** (Ununquadium)	**115** (288) — — — $[Rn]5f^{14}6d^{10}7s^27p^3$ **Uup** (Ununpentium)	**116** — — — $[Rn]5f^{14}6d^{10}7s^27p^4$ **Uuh** (Ununhexium)	**117** — — — **Uus** (Ununseptium)	**118** — — — **Uuo** (Ununoctium)

* Estimated Values

★ **58** 140.116 3,4 3716 1071 6.77 $[Xe]4f^15d^16s^2$ **Ce** Cerium	**59** 140.90765 3,4 3785 1204 6.77 $[Xe]4f^36s^2$ **Pr** Praseodymium	**60** 144.24 3 3347 1294 7.01 $[Xe]4f^46s^2$ **Nd** Neodymium	**61** (145) 3 3273 1315 7.26 $[Xe]4f^56s^2$ **Pm** Promethium	**62** 150.36 3,2 2067 1347 7.52 $[Xe]4f^66s^2$ **Sm** Samarium	**63** 151.964 3,2 1869 1095 5.24 $[Xe]4f^76s^2$ **Eu** Europium	**64** 157.25 3 3546 1586 7.90 $[Xe]4f^75d^16s^2$ **Gd** Gadolinium	**65** 158.92534 3,4 3503 1629 8.23 $[Xe]4f^96s^2$ **Tb** Terbium	**66** 162.50 3 2840 1685 8.55 $[Xe]4f^{10}6s^2$ **Dy** Dysprosium	**67** 164.9303 3 2973 1747 8.795 $[Xe]4f^{11}6s^2$ **Ho** Holmium	**68** 167.26 3 3140 1802 9.07 $[Xe]4f^{12}6s^2$ **Er** Erbium	**69** 168.9342 3,2 2223 1818 9.32 $[Xe]4f^{13}6s^2$ **Tm** Thulium	**70** 173.04 3,2 1469 1092 6.903 $[Xe]4f^{14}6s^2$ **Yb** Ytterbium	**71** 174.967 3 3675 1936 9.841 $[Xe]4f^{14}5d^16s^2$ **Lu** Lutetium
★★ **90** 232.0381 4 5061 2023 11.72 $[Rn]6d^27s^2$ **Th** Thorium	**91** 231.0359 5,4 4300* 1845 15.4* $[Rn]5f^26d^17s^2$ **Pa** Protactinium	**92** 238.0289 6,5,4,3,2 4404 1408 18.95 $[Rn]5f^36d^17s^2$ **U** Uranium	**93** (237) 6,5,4,3 4175* 917 20.2 $[Rn]5f^46d^17s^2$ **Np** Neptunium	**94** (244) 4,6,5,3 3505 913 19.84 $[Rn]5f^67s^2$ **Pu** Plutonium	**95** (243) 3,6,5,4,2 2284 1449 13.7 $[Rn]5f^77s^2$ **Am** Americium	**96** (247) 3 — 1620 13.5* $[Rn]5f^76d^17s^2$ **Cm** Curium	**97** (247) 3,4 — — 14* $[Rn]5f^97s^2$ **Bk** Berkelium	**98** (251) 3,4 — 1170* — $[Rn]5f^{10}7s^2$ **Cf** Californium	**99** (252) 3 — 1130* — $[Rn]5f^{11}7s^2$ **Es** Einsteinium	**100** (257) 3 — 1800* — $[Rn]5f^{12}7s^2$ **Fm** Fermium	**101** (258) 3 — 1100* — $[Rn]5f^{13}7s^2$ **Md** Mendelevium	**102** (259) 2,3 — 1100* — $[Rn]5f^{14}7s^2$ **No** Nobelium	**103** (262) 3 — 1900* — $[Rn]5f^{14}6d^17s^2$ **Lr** Lawrencium



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-18806-20

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Side 1

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}	$<1\times10^{-16}$	~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.

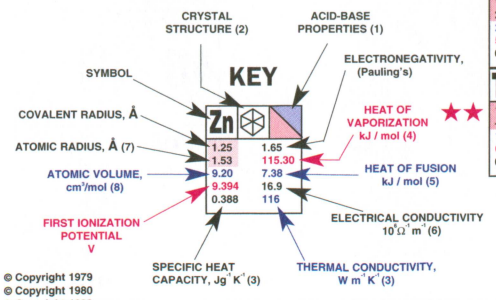
An antineutrino accompanies release of an electron in radioactive β (particle) decay, whereas a neutrino accompanies the release of a positron in β^+ decay.

†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																	He
0.32 2.20																	0.93 —
0.79 0.4581																	0.49 0.084
14.10 0.0585																	31.80 0.021
13.598 —																	24.587 —
14.304 0.1815																	5.193 0.152
Li	Be											B	C	N	O	F	Ne
1.23 0.98	0.90 1.57											0.82 2.04	0.77 2.55	0.75 3.04	0.73 3.44	0.72 3.98	0.71 —
2.05 147.1	1.40 297											1.17 507.8	0.91 715	0.75 2.793	0.65 3.410	0.57 3.27	0.51 1.77
13.10 3.0	5.0 11.71											4.6 22.6	5.30 —	17.30 0.36	14.0 0.222	17.10 0.26	16.90 0.34
5.392 11.7	9.323 25											8.298 5×10^{-12}	11.260 0.07	14.534 —	13.618 —	17.422 —	21.564 —
3.582 84.7	1.825 200											1.026 27.0	0.709 80-230	1.042 0.02598	0.918 0.2674	0.824 0.0279	1.030 0.0493
Na	Mg											Al	Si	P	S	Cl	Ar
1.54 0.93	1.36 1.31											1.18 1.61	1.11 1.90	1.06 2.19	1.02 2.58	0.99 3.16	0.98 —
2.23 98.01	1.72 127.6											1.82 290.8	1.46 359.0	1.23 12.4	1.09 10	0.97 10.20	0.88 6.506
23.70 2.601	14.0 8.95											10.0 10.7	12.1 50.2	17.0 0.63	15.50 1.73	18.70 3.21	24.20 1.188
5.139 20.1	7.646 22.4											5.986 37.7	8.152 4×10^{-4}	10.487 10^{-16}	10.360 5×10^{-16}	12.967 —	15.759 —
1.228 141	1.02 156											0.90 237	0.70 148.	0.769 0.235	0.710 0.269	0.479 0.0089	0.520 0.0177
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^{-5}	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	18.80 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	1.63 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	— —	— 422.58	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —
	19.90 15.65	15.0 —	12.50 15.48	21.10 —	12.32 —	20.8 —	18.3 —	— —	— —	— —	— —	— —	— —	— —
	6.31 7.1	5.89 5.6	6.194 3.6	6.266 0.8	6.026 0.7	5.974 0.7	5.991 —	6.198 —	6.282 —	6.42 —	6.5 —	6.58 —	6.65 —	4.9* —
	0.113 54	— 47	0.12 27.6	— 6.3	0.13* 6.74	— 10*	— 10*	— 10*	— 10*	— 10*	— 10*	— 10*	— 10*	— 10*



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

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

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SIDE 2