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^+	32Ge	68	[275 d] EC		127 m	[109 d] IT	76Os	194	[6.0 y] β^-		236	[2.34 × 10^7 y] α
	14	[5730 y] β^-	33As	73	[80.3 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^+		74	[17.9 d] β^-, β^+, EC		131	[8.040 d] β^-	78Pt	196	[6.18 d] β^+, EC, β^-	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^-		198	[2.696 d] 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^-		199	[3.15 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^-	79Au	195	[186 d] EC	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	[46.6 d] β^-		239	[2.41 × 10^4 y] α
15P	32	[14.26 d] β^-		85	[10.72 y] β^-		137	[30.17 y] β^-	81Tl	204	[3.77 y] β^-		240	[6.54 × 10^3 y] α
16S	35	[87.2 d] β^-	37Rb	86	[18.7 d] β^-	56Ba	140	[12.8 d] β^-	82Pb	202	[3 × 10^5 y] EC		242	[3.8 × 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 × 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 × 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 × 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 × 10^6 y] α		247	[1.55 × 10^7 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 × 10^5 y] α, SF
21Sc	46	[83.80 d] β^-	42Mo	99	[66.02 h] β^-	62Sm	146	[? × 10^8 y] α		209	[102 y] α	97Bk	247	[1.4 × 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		251	[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
26Fe	59	[44.6 d] 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
27Co	56	[78.8d] β^+, EC	45Rh	101	[3.3 y] EC	65Tb	158	[1.2 × 10^2 y] EC, β^-	86Rn	222	[3.824 d] α		254	[276 d] α
	57	[270 d] 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
	58	[71.3 d] β^+, EC		107	[? × 10^6 y] β^-	66Ho	166 m	[1.2 × 10^3 y] β^-		223	[21.8 min] β^-		257	[100.5 d] α
	60	[5.272 y] β^-	47Ag	108	[127 y] EC	67Tm	170	[128.6 d] β^-	88Ra	226	[1.60 × 10^3 y] α	101Md	258	[55 d] α
28Ni	57	[36.0 h] β^+, EC		110	[252 d] β^-		171	[1.92y] β^-	89Ac	227	[21.77 y] β^-	102No	259	[58 min] α
	59	[8 × 10^4 y] EC		111	[7.45 d] β^-	68Er	169	[9.40 d] EC	90Th	230	[7.7 × 10^4 y] α	103Lr	260	[3.0 min] α
	63	[92 y] β^-	48Cd	109	[453 d] EC		171	[7.52 h] β^-		232	[1.40 × 10^{10} y] α	104Rf	261	[65 s] α
29Cu	64	[12.700 h] β^-, β^+, EC	49In	114	[49.51 d] IT	69Tm	170	[3.7 × 10^{10} y] β^-	91Pa	231	[3.28 × 10^4 y] α	105Db	262	[40 s] α
			50Sn	121	[76 y] β^-	70Yb	169	[32.0 d] EC	92U	233	[1.59 × 10^5 y] α	106Sg	263	[0.9 d] α
						71Lu	176	[3.7 × 10^{10} y] β^-		234	[2.44 × 10^5 y] α			
						72Hf	182	[115.0 d] β^-		235	[7.04 × 10^8 y] α			
										236	[2.34 × 10^7 y] α			
										238	[4.47 × 10^9 y] α			

Selected Radioactive Isotopes

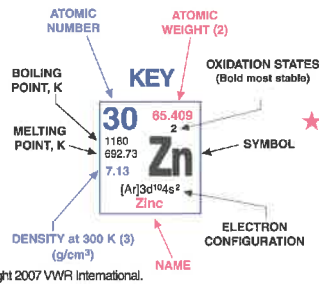
Naturally occurring radioactive isotopes are designated by a mass number in blue (although some are also manufactured). Letter m indicates an isomer of another isotope of the same mass number. Half-lives follow in parentheses, where s, min, h, d, and y stand respectively for seconds, minutes, hours,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

GROUP 1/IA	2/IIA	3/IIIA	4/IVA	5/VA	6/VIA	7/VIIA	8	VIIIA 9	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 † H 1s¹ Hydrogen																	2 4.00260 4.216 0.95 at 26 atm 0.1785† He 1s² Helium
3 (6.941) 1 1615 453.7 0.534 Li [He]2s¹ Lithium	4 9.012182 2 2744 1560 1.85 Be [He]2s² Beryllium											5 10.811 3 4275 2348 2.37 B [He]2s²2p¹ Boron	6 12.0107 ±4,2 4675* 3915* 2.26 C [He]2s²2p² Carbon	7 14.0067 ±3,5,4,2 77.344 63.15 1.251† N [He]2s²2p³ Nitrogen	8 15.9994 -2,-1 90.2 54.4 1.429† O [He]2s²2p⁴ Oxygen	9 18.99840 -1 85.0 53.55 1.696† F [He]2s²2p⁵ Fluorine	10 20.1797 27.07 24.56 0.900† Ne [He]2s²2p⁶ Neon
11 22.989770 1 1156.1 371.0 0.971 Na [Ne]3s¹ Sodium	12 24.3050 2 1363 923 1.74 Mg [Ne]3s² Magnesium											13 26.981538 3 2792 933.5 2.6989 Al [Ne]3s²3p¹ Aluminum	14 28.0855 4,2 3538 1687 2.33 Si [Ne]3s²3p² Silicon	15 30.97376 ±3,5,4 553 317.3 1.82 P [Ne]3s²3p³ Phosphorus	16 32.065 ±6,±2,4, 717.75 388.36 2.07 S [Ne]3s²3p⁴ Sulfur	17 35.453 ±1,7,5,3 239.11 171.65 3.214† Cl [Ne]3s²3p⁵ Chlorine	18 39.948 87.8 83.8 1.784† Ar [Ne]3s²3p⁶ Argon
19 39.0983 1 1033 336.8 0.862 K [Ar]4s¹ Potassium	20 40.078 2 1757 1115 1.55 Ca [Ar]4s² Calcium	21 44.95591 3 3109 1814 2.99 Sc [Ar]3d¹4s² Scandium	22 47.867 4,3,2 3560 1941 4.54 Ti [Ar]3d²4s² Titanium	23 50.9415 5,4,3,2 3680 2183 6.11 V [Ar]3d³4s² Vanadium	24 51.996 3,6,2 2945 2160 7.19 Cr [Ar]3d⁵4s¹ Chromium	25 54.9380 2,3,4,6,7 2234 1519 7.44 Mn [Ar]3d⁵4s² Manganese	26 55.845 3,2,6 3134 1811 7.874 Fe [Ar]3d⁶4s² Iron	27 58.9332 2,3 3200 1768 8.90 Co [Ar]3d⁷4s² Cobalt	28 58.6934 2,3 3186 1728 8.90 Ni [Ar]3d⁸4s² Nickel	29 63.546 2,1 2835 1357.8 8.96 Cu [Ar]3d¹⁰4s¹ Copper	30 65.409 2 1180 692.68 7.13 Zn [Ar]3d¹⁰4s² Zinc	31 69.723 1,3 2477 302.91 6.095 Ga [Ar]3d¹⁰4s²4p¹ Gallium	32 72.64 4 3106 1211.4 5.32 Ge [Ar]3d¹⁰4s²4p² Germanium	33 74.9216 ±3,5 876 (sub.) 1090 (28 atm.) 5.73 As [Ar]3d¹⁰4s²4p³ Arsenic	34 78.96 4,6,-2 958 494 4.79 Se [Ar]3d¹⁰4s²4p⁴ Selenium	35 79.904 ±1,7,5,3 331.95 265.95 3.12 Br [Ar]3d¹⁰4s²4p⁵ Bromine	36 83.80 0,2 119.93 115.8 3.73† Kr [Ar]3d¹⁰4s²4p⁶ Krypton
37 85.4678 1 961 312.46 1.532 Rb [Kr]5s¹ Rubidium	38 87.62 2 1655 1050 2.54 Sr [Kr]5s² Strontium	39 88.9059 3 3618 1795 4.47 Y [Kr]4d¹5s² Yttrium	40 91.224 4 4682 2128 6.51 Zr [Kr]4d²5s² Zirconium	41 92.90638 5,3,4 5017 2750 8.57 Nb [Kr]4d⁴5s¹ Niobium	42 95.94 6,5,4,3,2 4912 2896 10.22 Mo [Kr]4d⁵5s¹ Molybdenum	43 (98) 7,5,4 4538 2430 11.5* Tc [Kr]4d⁵5s² Technetium	44 101.07 2,3,4,6,8 4423 2607 12.37 Ru [Kr]4d⁷5s¹ Ruthenium	45 102.90550 2,3,4 3968 2237 12.41 Rh [Kr]4d⁸5s¹ Rhodium	46 106.42 2,4 3236 1828 12.0 Pd [Kr]4d¹⁰ Palladium	47 107.8682 1 2435 1234.93 10.50 Ag [Kr]4d¹⁰5s¹ Silver	48 112.41 2 1040 594.22 8.65 Cd [Kr]4d¹⁰5s² Cadmium	49 114.82 3 2345 429.75 7.31 In [Kr]4d¹⁰5s²5p¹ Indium	50 118.710 4,2 2875 505.08 7.31 Sn [Kr]4d¹⁰5s²5p² Tin	51 121.760 ±3,5 1860 903.78 6.69 Sb [Kr]4d¹⁰5s²5p³ Antimony	52 127.60 4,6,-2 1261 722.66 6.24 Te [Kr]4d¹⁰5s²5p⁴ Tellurium	53 126.90447 ±1,7,5 457.51 386.85 4.93 I [Kr]4d¹⁰5s²5p⁵ Iodine	54 131.29 0,2,4,6,8 165.11 161.4 5.90† Xe [Kr]4d¹⁰5s²5p⁶ Xenon
55 132.90545 1 944 301.54 1.87 Cs [Xe]6s¹ Cesium	56 137.327 2 2170 1000 3.5 Ba [Xe]6s² Barium	57 138.9055 3 ★ 3737 1191 6.15 La [Xe]5d¹6s² Lanthanum	72 178.49 4 4876 2506 13.31 Hf [Xe]4f¹⁴5d²6s² Hafnium	73 180.9479 5,4 5730 3290 16.65 Ta [Xe]4f¹⁴5d³6s² Tantalum	74 183.84 6,5,4,3,2 5828 3695 19.3 W [Xe]4f¹⁴5d⁴6s² Tungsten	75 186.207 7,6,5,4,3,2 5870 3459 21.0 Re [Xe]4f¹⁴5d⁵6s² Rhenium	76 190.23 4,6,6,3,2 5285 3306 22.57 Os [Xe]4f¹⁴5d⁶6s² Osmium	77 192.217 4,2,6,3 4700 2720 22.42 Ir [Xe]4f¹⁴5d⁷6s² Iridium	78 195.08 4,2 4098 2041.55 21.45 Pt [Xe]4f¹⁴5d⁹6s¹ Platinum	79 196.96655 3,1 3130 1337.33 19.3 Au [Xe]4f¹⁴5d¹⁰6s¹ Gold	80 200.59 2,1 629.88 234.32 13.55 Hg [Xe]4f¹⁴5d¹⁰6s² Mercury	81 204.3833 3,1 1746 577 11.85 Tl [Xe]4f¹⁴5d¹⁰6s²6p¹ Thallium	82 207.2 2,4 2022 600.61 11.35 Pb [Xe]4f¹⁴5d¹⁰6s²6p² Lead	83 208.9804 3,5 1637 544.55 9.75 Bi [Xe]4f¹⁴5d¹⁰6s²6p³ Bismuth	84 (209) 4,2,6 — 527 9.3 Po [Xe]4f¹⁴5d¹⁰6s²6p⁴ Polonium	85 (210) ±1,7,5,3 610* 575 — At [Xe]4f¹⁴5d¹⁰6s²6p⁵ Astatine	86 (222) 0,2 211.4 202 9.73† Rn [Xe]4f¹⁴5d¹⁰6s²6p⁶ Radon
87 (223) 1 950* 300 — Fr [Rn]7s¹ Francium	88 (226) 2 1413 973 5.0 Ra [Rn]7s² Radium	89 (227) 3 ★★ 3470* 1324 10.07 Ac [Rn]6d¹7s² Actinium	104 (261) — — — Rf [Rn]5f¹⁴6d²7s² Rutherfordium	105 (262) — — — Db [Rn]5f¹⁴6d³7s² Dubnium	106 (266) — — — Sg [Rn]5f¹⁴6d⁴7s² Seaborgium	107 (264) — — — Bh [Rn]5f¹⁴6d⁵7s² Bohrium	108 (277) — — — Hs [Rn]5f¹⁴6d⁶7s² Hassium	109 (268) — — — Mt [Rn]5f¹⁴6d⁷7s² Meitnerium	110 (269) — — — Ds [Rn]5f¹⁴6d⁸7s² (Darmstadtium)	111 (272) — — — Rg [Rn]5f¹⁴6d⁹7s² (Roentgenium)	112 (285) — — — Uub [Rn]5f¹⁴6d¹⁰7s² (Ununbium)	113 (284) — — — Uut [Rn]5f¹⁴6d¹⁰7s²7p¹ (Ununtrium)	114 (289) — — — Uuq [Rn]5f¹⁴6d¹⁰7s²7p² (Ununquadium)	115 (288) — — — Uup [Rn]5f¹⁴6d¹⁰7s²7p³ (Ununpentium)	116 — — — Uuh [Rn]5f¹⁴6d¹⁰7s²7p⁴ (Ununhexium)	117 (Ununseptium)	118 (Ununoctium)

* Estimated Values

★	58 140.116 3,4 3716 1071 6.77 Ce [Xe]4f¹5d¹6s² Cerium	59 140.90765 3,4 3785 1204 6.77 Pr [Xe]4f³6s² Praseodymium	60 144.24 3 3347 1294 7.01 Nd [Xe]4f⁴6s² Neodymium	61 (145) 3 3273 1315 7.26 Pm [Xe]4f⁵6s² Promethium	62 150.36 3,2 2067 1347 7.52 Sm [Xe]4f⁶6s² Samarium	63 151.964 3,2 1869 1095 5.24 Eu [Xe]4f⁷6s² Europium	64 157.25 3 3546 1586 7.90 Gd [Xe]4f⁷5d¹6s² Gadolinium	65 158.92534 3,4 3503 1629 8.23 Tb [Xe]4f⁹6s² Terbium	66 162.50 3 2840 1685 8.55 Dy [Xe]4f¹⁰6s² Dysprosium	67 164.9303 3 2973 1747 8.795 Ho [Xe]4f¹¹6s² Hoimium	68 167.26 3 3140 1802 9.07 Er [Xe]4f¹²6s² Erbium	69 168.9342 3,2 2223 1818 9.32 Tm [Xe]4f¹³6s² Thulium	70 173.04 3,2 1469 1092 6.903 Yb [Xe]4f¹⁴6s² Ytterbium	71 174.967 3 3675 1936 9.841 Lu [Xe]4f¹⁴5d¹6s² Lutetium
★★	90 232.0381 4 5061 2023 11.72 Th [Rn]6d²7s² Thorium	91 231.0359 5,4 4300* 1845 15.4* Pa [Rn]5f²6d¹7s² Protactinium	92 238.0289 6,5,4,3,2 4404 1408 18.95 U [Rn]5f³6d¹7s² Uranium	93 (237) 5,6,4,3 4175* 917 20.2 Np [Rn]5f⁴6d¹7s² Neptunium	94 (244) 4,6,5,3 3505 913 19.84 Pu [Rn]5f⁶7s² Plutonium	95 (243) 3,6,5,4,2 2284 1449 13.7 Am [Rn]5f⁷7s² Americium	96 (247) 3 — 1620 13.5* Cm [Rn]5f⁷6d¹7s² Curium	97 (247) 3,4 — — 14* Bk [Rn]5f⁹7s² Berkelium	98 (251) 3,4 — 1170* — Cf [Rn]5f¹⁰7s² Californium	99 (252) 3 — 1130* — Es [Rn]5f¹¹7s² Einsteinium	100 (257) 3 — 1800* — Fm [Rn]5f¹²7s² Fermium	101 (258) 3 — 1100* — Md [Rn]5f¹³7s² Mendelevium	102 (259) 2,3 — 1100* — No [Rn]5f¹⁴7s² Nobelium	103 (262) 3 — 1900* — Lr [Rn]5f¹⁴6d¹7s² 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.

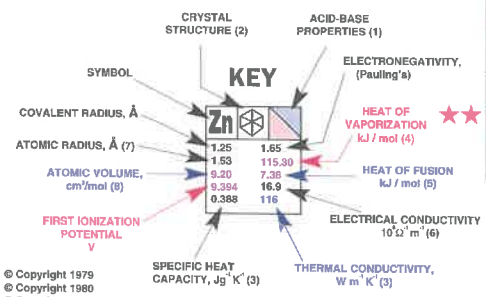
An antineutrino accompanies release of an electron in radioactive β (particle) decay, whereas a neutrino accompanies the release of a positron in β^+ decay.

†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	0.76	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	0.25	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									10.6	10.7	12.1	50.2	17.0	0.63	15.50	1.73	16.70	3.21	24.20 1.188
5.139	20.1	7.646	22.4									8.966	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	0.62	1.74	1.00	1.44	1.36	1.32	1.54	1.22	1.53	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	1.31	32.4	1.21	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	13.5	31.80	23.5	5.285	32.20 1.64
4.341	16.4	6.113	31.3	5.55	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	7.840	14.6	7.726	60.7	9.394	16.9	5.998	1.8	9.79	3.8	9.752	9	11.814	10^{-18}	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	7.62	0.449	80.2	0.421	100	0.444	90.7	0.385	401	0.388	116	0.371	40.6	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	1.81	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	580.5	2.09	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	57.97	1.42	50.63	1.32	20.9	1.24 12.64
55.9	2.34	33.7	6.2	19.8	17.15	14.1	21	10.80	25.9	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	28.5	17.49	25.70	7.76	42.90 2.30
4.177	47.8	5.695	5.0	5.22	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	395.57	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	35	9.53	35.4	8.85	33.05	6.43	29.29	8.54	26.36	9.10	19.65	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		
—	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	16.6	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	1.14	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	2.02	—	2.59	191.63	2.66	175.73	2.54	311.71	2.51	—	2.49	230	2.47	251.04	2.45	282.88	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*
	5.536	1.4	5.473	1.5	5.55	1.6	5.582	2	5.844	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
	0.18	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*	—	1.3*
	—	543.92	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	19.90	15.65	15.8	—	21.10	—	20.8	—	12.32	—	18.3	—	5.991	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	6.31	7.1	5.89	5.6	6.194	3.6	6.266	0.8	6.026	0.7	5.974	0.7	—	10*	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*	—	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