

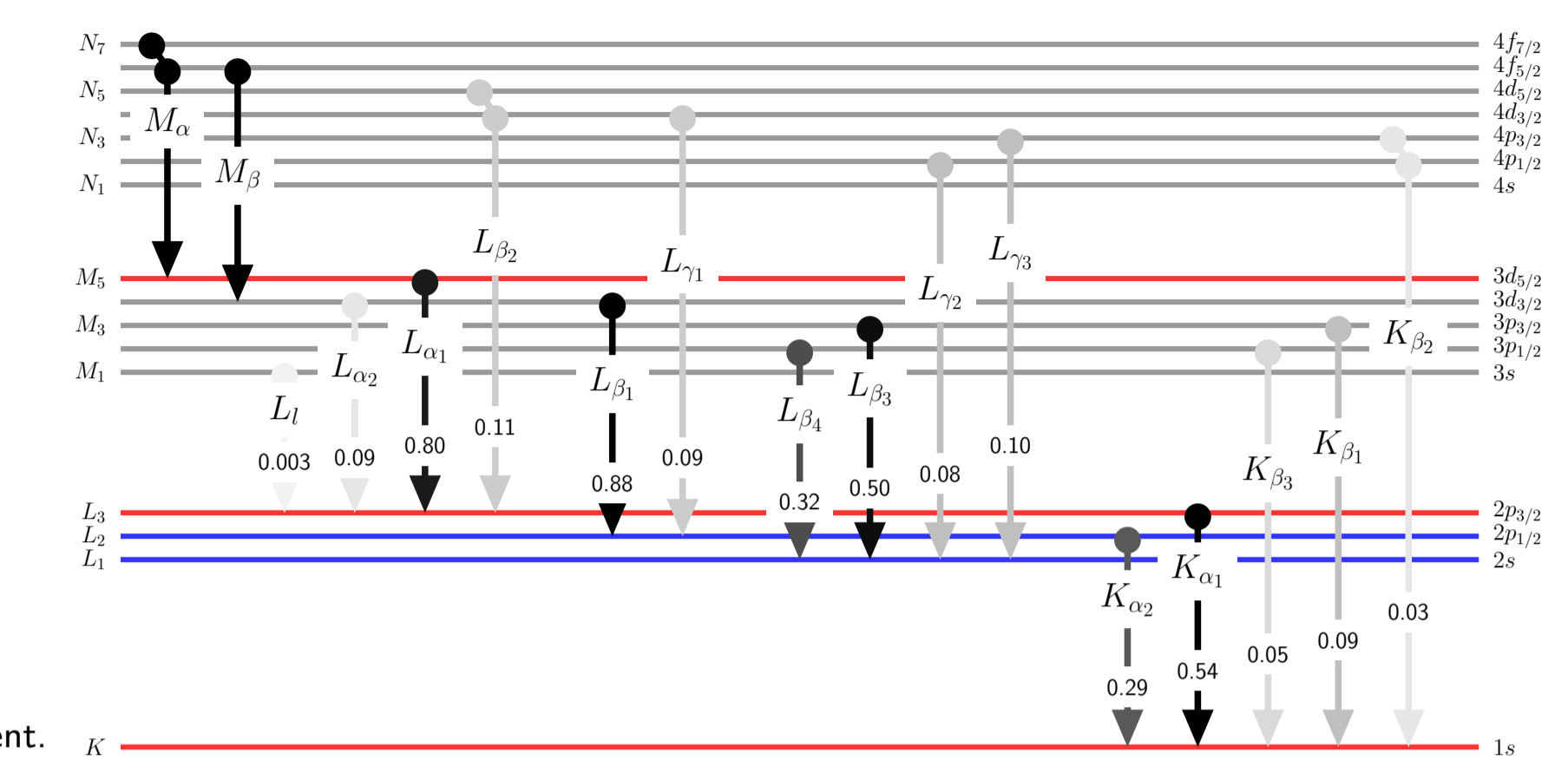
# X-ray Absorption and Emission Energies of the Elements

<b>H</b> hydrogen 14 1.0078 +1	<b>Li</b> lithium 55 5 6.94 +1	<b>Be</b> beryllium 112 108 3 3 9.0122 +2	<b>Na</b> sodium 1071 1040 64 30 30 22.9898 +1	<b>Mg</b> magnesium 1303 1254 1302 89 88 88 49 24.305 +2	<b>K</b> potassium 3608 3314 3590 379 360 360 297 295 39.0983 +1	<b>Rb</b> rubidium 15200 13396 14961 2065 1826 1816 1864 1751 1804 1692 112 85.4678 +1	<b>Cs</b> cesium 35985 30973 34982 5714 4711 4643 5359 4618 5279 5012 4285 4932 727 727 740 132.905 +1	<b>Fr</b> francium 101137 86106 97474 18639 14976 14312 17907 14771 17304 15031 12031 14428 3000 2732 2868 223.0 +1
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<b>Sc</b> scandium 4492 4093 4464 498 470 470 404 399 44.9559 +3	<b>Ti</b> titanium 4966 4512 4933 561 528 528 460 458 454 452 2 47.867 +3, +4	<b>V</b> vanadium 5465 4953 5428 627 590 590 520 518 590 512 510 2 50.9415 +2, +3, +4, +5	<b>Cr</b> chromium 5989 5415 5947 696 654 654 584 582 574 572 2 51.996 +2, +3, +6	<b>Mn</b> manganese 6539 5900 6492 769 722 722 650 648 639 637 2 54.938 +2, +3, +4, +7	<b>Fe</b> iron 7112 6405 7059 845 792 792 720 718 707 705 2 55.845 +2, +3	<b>Co</b> cobalt 7709 6931 7649 925 865 866 793 790 778 775 3 58.9332 +2, +3	<b>Ni</b> nickel 8333 7480 8267 1009 942 941 870 866 853 849 4 58.6934 +2	<b>Cu</b> copper 8979 8046 8904 1097 1022 1019 952 947 933 928 5 63.546 +1, +2	<b>Zn</b> zinc 9659 8637 9570 1196 1108 1105 1045 1035 1022 1012 10 65.38 +2	<b>Ga</b> gallium 10367 9251 10267 1299 1199 1196 1143 1124 1116 1098 19 69.72 +3	<b>Ge</b> germanium 11103 9886 10982 1415 1294 1290 1248 1218 1217 1188 29 72.63 -4, +2, +4	<b>As</b> arsenic 11867 10543 11726 1527 1386 1381 1359 1317 1324 1282 42 74.9216 -3, +3, +5	<b>Se</b> selenium 12658 11224 12497 1652 1491 1486 1474 1419 1434 1379 55 78.971 -2, +2, +4, +6	<b>Br</b> bromine 13474 11924 13292 1782 1600 1593 1596 1526 1550 1481 69 79.904 -1, +1, +3, +5	<b>Kr</b> krypton 14326 12648 14112 1921 1707 1699 1731 1636 1678 1585 94 83.798
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<b>Ce</b> cerium 40443 34720 39256 6548 5361 5274 6164 5262 6055 5723 4839 5614 884 884 902 140.116 +3, +4	<b>Pr</b> praseodymium 41991 36027 40749 6835 5593 5498 6440 5492 6325 5964 5035 5849 929 927 946 140.908 +3, +4	<b>Nd</b> neodymium 43569 37361 42272 7126 5829 5723 6722 5719 6602 6208 5228 6088 980 979 1002 144.242 +3	<b>Pm</b> promethium 45184 38725 43827 7428 6071 5957 7013 5961 6893 6459 5432 6339 1027 1023 1048 145.0 +3	<b>Sm</b> samarium 46834 40118 45414 7737 6317 6196 7312 6201 7183 6716 5633 6587 1083 1078 1106 150.36 +3	<b>Eu</b> europium 48519 41542 47038 8052 6571 6438 7617 6458 7484 6977 5850 6844 1128 1122 1153 151.96 +2, +3	<b>Gd</b> gadolinium 50239 42996 48695 8376 6832 6688 7930 6708 7787 7243 6053 7100 1190 1181 1213 157.25 +3	<b>Tb</b> terbium 51996 44482 50385 8708 7097 6940 8252 6975 8102 7514 6273 7364 1241 1233 1269 158.925 +3, +4	<b>Dy</b> dysprosium 53789 45999 52113 9046 7370 7204 8581 7248 8427 8071 6720 7911 1351 1342 1383 162.5 +3	<b>Ho</b> holmium 55618 47547 53877 9394 7653 7471 8918 7526 8758 8071 6720 7911 1351 1342 1383 164.93 +3	<b>Er</b> erbium 57486 49128 55674 9751 7939 7745 9264 7811 9096 8358 6949 8190 1409 1404 1448 167.259 +3	<b>Tm</b> thulium 59390 50742 57505 10116 8231 8026 9617 8102 9442 8648 7180 8472 1468 1463 1510 168.934 +3	<b>Yb</b> ytterbium 61332 52388 59382 10486 8536 8313 9978 8402 9787 8944 7416 8753 1528 1526 1574 173.045 +3	<b>Lu</b> lutetium 63314 54070 61290 10870 8846 8606 10349 8710 10143 9244 7655 9038 1589 1580 1630 174.967 +3
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<b>Th</b> thorium 109651 93351 105605 20472 16426 15642 19693 16202 18981 16300 12968 15588 3332 2990 3149 232.038 +4	<b>Pa</b> protactinium 112601 95868 108427 21105 16931 16104 20314 16703 19571 16733 13291 15990 3442 3071 3240 231.036 +5	<b>U</b> uranium 115606 98440 111303 21757 17454 16575 20948 17220 20170 17166 13614 16388 3552 3164 3340 238.029 +4, +6	<b>Np</b> neptunium 118669 101059 114234 22427 17992 17061 22600 17751 20784 17610 13946 16794 3664 3250 3435 237.048 +3, +4, +5	<b>Pu</b> plutonium 121791 103734 117228 23104 18541 17557 22266 18296 21420 18057 14282 17211 3775 3339 3534 239.052 +3, +4, +5	<b>Am</b> americium 124982 106472 120284 23808 19110 18069 22952 18856 22072 18510 14620 17630 3890 3429 3635 243.0 +3, +4, +5	<b>Cm</b> curium 128241 109271 123403 24526 19688 18589 23651 19427 22735 18970 14961 18054 4009 3525 3740 247.0 +3	<b>Bk</b> berkelium 131556 112121 126580 25256 20280 19118 24371 20018 23416 19435 15308 18480 4127 3616 3842 247.0 +3, +4	<b>Cf</b> californium 134939 115032 129823 26010 20894 19665 25108 20624 24117 19907 15660 18916 4247 3709 3946 251.0 +3	<b>Es</b> einsteinium 139000 117000 132000 27000 21000 19500 26000 21000 24500 20000 15000 18500 4500 4000 4300 252.0 +3	<b>Fm</b> fermium 143000 120000 135000 28000 22000 20500 27000 22000 25500 21000 16000 19500 4800 4300 4600 257.0 +3	<b>Md</b> mendelevium 147000 124000 139000 29000 23000 21500 28000 23000 26500 22000 17000 20500 5100 4600 4900 258.0 +3	<b>No</b> nobelium 151000 128000 143000 30000 24000 22500 29000 24000 27500 23000 18000 21500 5400 4900 5200 259.0 +3	<b>Lr</b> lawrencium 155000 132000 147000 31000 25000 23500 30000 25000 28500 24000 19000 22500 5700 5200 5500 260.0 +3
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Atomic Data and Energies from  
W. T. Elam, B. D. Ravel and J. R. Sieber,  
*Radiation Physics and Chemistry* 63, pp 121-128 (2002)

Common oxidation states from wikipedia.org, after  
N. N. Greenwood and A. Earnshaw,  
*Chemistry of the Elements*, 2nd ed. (1997).

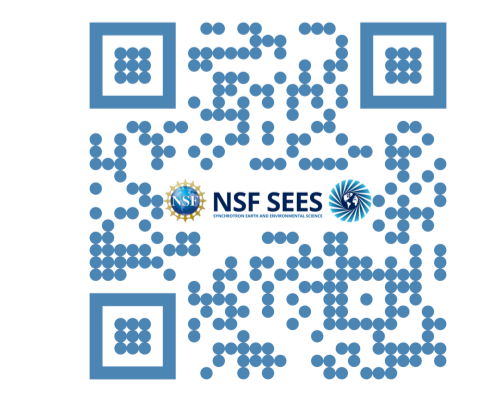
All energies in eV.  
Emission line strengths are approximate, and vary with element.

Symbol	Z
K edge	K <sub>α1</sub> K <sub>β1</sub>
L <sub>1</sub> edge	L <sub>β3</sub> L <sub>β4</sub>
L <sub>2</sub> edge	L <sub>β1</sub> L <sub>β2</sub>
L <sub>3</sub> edge	L <sub>α1</sub> L <sub>α2</sub>
M <sub>5</sub> edge	M <sub>α</sub> M <sub>β</sub>
Mass	oxidation states

<b>B</b> boron 188 183 13 5 5 10.81 +3	<b>C</b> carbon 284 277 18 7 7 12.011 -4, -3, ..., +2, +3, +4	<b>N</b> nitrogen 410 392 37 18 18 14.007 -3, +3, +5	<b>O</b> oxygen 543 525 42 18 18 15.999 -2	<b>F</b> fluorine 697 677 45 20 20 18.9984 -1	<b>Ne</b> neon 870 849 48 22 22 20.1797	<b>Al</b> aluminum 1559 1486 1557 118 116 116 73 72 26.9815 +3	<b>Si</b> silicon 1839 1740 1837 150 148 148 100 99 28.085 -4, +4	<b>P</b> phosphorus 2146 2010 2140 189 183 182 136 135 30.9738 -3, +3, +5	<b>S</b> sulfur 2472 2310 2465 231 224 223 164 162 32.06 -2, +2, +4, +6	<b>Cl</b> chlorine 2822 2622 2812 270 260 260 202 200 35.453 -1, +1, +3, +5, +7	<b>Ar</b> argon 3206 2958 3190 326 311 310 251 248 39.948	<b>Ga</b> gallium 10367 9251 10267 1299 1199 1196 1143 1124 1116 1098 19 69.72 +3	<b>Ge</b> germanium 11103 9886 10982 1415 1294 1290 1248 1218 1217 1188 29 72.63 -4, +2, +4	<b>As</b> arsenic 11867 10543 11726 1527 1386 1381 1359 1317 1324 1282 42 74.9216 -3, +3, +5	<b>Se</b> selenium 12658 11224 12497 1652 1491 1486 1474 1419 1434 1379 55 78.971 -2, +2, +4, +6	<b>Br</b> bromine 13474 11924 13292 1782 1600 1593 1596 1526 1550 1481 69 79.904 -1, +1, +3, +5	<b>Kr</b> krypton 14326 12648 14112 1921 1707 1699 1731 1636 1678 1585 94 83.798
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Marie Skłodowska Curie



Version 6, 2025-September-22  
<https://xraydb.seescience.org>