

# Periodic Table of Elements and X-ray Energies

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<b>1</b> H Hydrogen 1.01 0.0007																	<b>2</b> He Helium 4.00 0.0002						
<b>3</b> Li Lithium 6.94 0.53	<b>4</b> Be Beryllium 9.01 1.85 K $\alpha$ 0.108																	<b>5</b> B Boron 10.81 2.34 K $\alpha$ 0.183	<b>6</b> C Carbon 12.01 2.27 K $\alpha$ 0.277	<b>7</b> N Nitrogen 14.01 0.001 K $\alpha$ 0.392	<b>8</b> O Oxygen 16.00 0.001 K $\alpha$ 0.525	<b>9</b> F Fluorine 19.00 0.001 K $\alpha$ 0.677	<b>10</b> Ne Neon 20.18 0.0009 K $\alpha$ 0.849
<b>11</b> Na Sodium 22.99 0.97 K $\alpha$ 1.040	<b>12</b> Mg Magnesium 24.31 1.74 K $\alpha$ 1.254																	<b>13</b> Al Aluminium 26.98 2.70 K $\alpha$ 1.486	<b>14</b> Si Silicon 28.09 2.33 K $\alpha$ 1.740	<b>15</b> P Phosphorus 30.97 1.82 K $\alpha$ 2.010	<b>16</b> S Sulfur 32.07 2.07 K $\alpha$ 2.309	<b>17</b> Cl Chlorine 35.45 0.003 K $\alpha$ 2.622	<b>18</b> Ar Argon 39.95 0.002 K $\alpha$ 2.958
<b>19</b> K Potassium 39.10 0.86 K $\alpha$ 3.314	<b>20</b> Ca Calcium 40.08 1.54 K $\alpha$ 3.692 L $\alpha$ 0.341	<b>21</b> Sc Scandium 44.96 2.99 K $\alpha$ 4.093 L $\alpha$ 0.395	<b>22</b> Ti Titanium 47.87 4.54 K $\alpha$ 4.512 L $\alpha$ 0.452	<b>23</b> V Vanadium 50.94 6.11 K $\alpha$ 4.953 L $\alpha$ 0.510	<b>24</b> Cr Chromium 52.00 7.15 K $\alpha$ 5.415 L $\alpha$ 0.572	<b>25</b> Mn Manganese 54.94 7.44 K $\alpha$ 5.900 L $\alpha$ 0.637	<b>26</b> Fe Iron 55.85 7.87 K $\alpha$ 6.405 L $\alpha$ 0.705	<b>27</b> Co Cobalt 58.93 8.86 K $\alpha$ 6.931 L $\alpha$ 0.775	<b>28</b> Ni Nickel 58.69 8.91 K $\alpha$ 7.480 L $\alpha$ 0.849	<b>29</b> Cu Copper 63.55 8.93 K $\alpha$ 8.046 L $\alpha$ 0.928	<b>30</b> Zn Zinc 65.38 7.13 K $\alpha$ 8.637 L $\alpha$ 1.012	<b>31</b> Ga Gallium 69.72 5.91 K $\alpha$ 9.251 L $\alpha$ 1.098	<b>32</b> Ge Germanium 72.64 5.32 K $\alpha$ 9.886 L $\alpha$ 1.188	<b>33</b> As Arsenic 74.92 5.78 K $\alpha$ 10.543 L $\alpha$ 1.282	<b>34</b> Se Selenium 78.96 4.81 K $\alpha$ 11.224 L $\alpha$ 1.379	<b>35</b> Br Bromine 79.90 3.12 K $\alpha$ 11.924 L $\alpha$ 1.481	<b>36</b> Kr Krypton 83.80 0.004 K $\alpha$ 12.648 L $\alpha$ 1.585						
<b>37</b> Rb Rubidium 85.47 1.53 K $\alpha$ 13.396 L $\alpha$ 1.692	<b>38</b> Sr Strontium 87.62 2.64 K $\alpha$ 14.165 L $\alpha$ 1.806	<b>39</b> Y Yttrium 88.91 4.47 K $\alpha$ 14.958 L $\alpha$ 1.924	<b>40</b> Zr Zirconium 91.22 6.51 K $\alpha$ 15.775 L $\alpha$ 2.044	<b>41</b> Nb Niobium 92.91 8.57 K $\alpha$ 16.615 L $\alpha$ 2.169	<b>42</b> Mo Molybdenum 95.94 10.22 K $\alpha$ 17.480 L $\alpha$ 2.292	<b>43</b> Tc (98) Technetium 115.0 K $\alpha$ 18.367 L $\alpha$ 2.423	<b>44</b> Ru Ruthenium 101.07 12.37 K $\alpha$ 19.279 L $\alpha$ 2.558	<b>45</b> Rh Rhodium 102.91 12.41 K $\alpha$ 20.216 L $\alpha$ 2.697	<b>46</b> Pd Palladium 106.42 12.02 K $\alpha$ 21.177 L $\alpha$ 2.838	<b>47</b> Ag Silver 107.87 10.50 K $\alpha$ 22.163 L $\alpha$ 2.983	<b>48</b> Cd Cadmium 112.41 8.69 K $\alpha$ 23.173 L $\alpha$ 3.133	<b>49</b> In Indium 114.82 7.31 K $\alpha$ 24.210 L $\alpha$ 3.286	<b>50</b> Sn Tin 118.71 7.29 K $\alpha$ 25.271 L $\alpha$ 3.444	<b>51</b> Sb Antimony 121.76 6.69 K $\alpha$ 26.359 L $\alpha$ 3.604	<b>52</b> Te Tellurium 127.60 6.23 K $\alpha$ 27.473 L $\alpha$ 3.768	<b>53</b> I Iodine 126.90 4.93 K $\alpha$ 28.612 L $\alpha$ 3.938	<b>54</b> Xe Xenon 131.29 0.006 K $\alpha$ 29.775 L $\alpha$ 4.110						
<b>55</b> Cs Cesium 132.91 1.87 K $\alpha$ 30.973 L $\alpha$ 4.285	<b>56</b> Ba Barium 137.33 3.59 K $\alpha$ 32.194 L $\alpha$ 4.466	<b>57</b> La Lanthanum 138.91 6.15 K $\alpha$ 33.442 L $\alpha$ 4.647	<b>72</b> Hf Hafnium 178.49 13.31 K $\alpha$ 7.899 M $\alpha$ 1.646	<b>73</b> Ta Tantalum 180.95 16.65 K $\alpha$ 8.146 M $\alpha$ 1.712	<b>74</b> W Tungsten 183.84 19.25 K $\alpha$ 8.398 M $\alpha$ 1.775	<b>75</b> Re Rhenium 186.21 21.02 K $\alpha$ 8.652 M $\alpha$ 1.843	<b>76</b> Os Osmium 190.23 22.61 K $\alpha$ 8.911 M $\alpha$ 1.907	<b>77</b> Ir Iridium 192.22 22.65 K $\alpha$ 9.175 M $\alpha$ 1.980	<b>78</b> Pt Platinum 195.08 21.46 K $\alpha$ 9.442 M $\alpha$ 2.050	<b>79</b> Au Gold 196.97 19.28 K $\alpha$ 9.713 M $\alpha$ 2.123	<b>80</b> Hg Mercury 200.59 13.53 K $\alpha$ 9.989 M $\alpha$ 2.195	<b>81</b> Tl Thallium 204.37 11.85 K $\alpha$ 10.269 M $\alpha$ 2.271	<b>82</b> Pb Lead 207.20 11.34 K $\alpha$ 10.551 M $\alpha$ 2.342	<b>83</b> Bi Bismuth 208.98 9.81 K $\alpha$ 10.839 M $\alpha$ 2.423	<b>84</b> (209) Po Polonium 9.32 K $\alpha$ 11.131 M $\alpha$ 2.499	<b>85</b> (210) At Astatine 7.00 K $\alpha$ 11.427 M $\alpha$ 2.577	<b>86</b> (222) Rn Radon 0.01 K $\alpha$ 11.727 M $\alpha$ 2.654						
<b>87</b> Fr Francium (223) 1.87 L $\alpha$ 12.031 M $\alpha$ 2.732	<b>88</b> Ra Radium (226) 5.50 L $\alpha$ 12.339 M $\alpha$ 2.806	<b>89</b> Ac Actinium (227) 10.07 L $\alpha$ 12.652 M $\alpha$ 2.900																					

<b>58</b> Ce Cerium 140.12 6.77 L $\alpha$ 4.839 M $\alpha$ 0.884	<b>59</b> Pr Praseodymium 140.91 6.77 L $\alpha$ 5.035 M $\alpha$ 0.927	<b>60</b> Nd Neodymium 144.24 7.01 L $\alpha$ 5.228 M $\alpha$ 0.979	<b>61</b> Pm (145) Promethium 7.26 L $\alpha$ 5.432 M $\alpha$ 1.023	<b>62</b> Sm Samarium 150.36 7.52 L $\alpha$ 5.633 M $\alpha$ 1.078	<b>63</b> Eu Europium 151.96 5.24 L $\alpha$ 5.849 M $\alpha$ 1.131	<b>64</b> Gd Gadolinium 157.25 7.90 L $\alpha$ 6.053 M $\alpha$ 1.181	<b>65</b> Tb Terbium 158.93 8.23 L $\alpha$ 6.273 M $\alpha$ 1.240	<b>66</b> Dy Dysprosium 162.50 8.55 L $\alpha$ 6.498 M $\alpha$ 1.293	<b>67</b> Ho Holmium 164.93 8.80 L $\alpha$ 6.720 M $\alpha$ 1.348	<b>68</b> Er Erbium 167.26 9.07 L $\alpha$ 6.949 M $\alpha$ 1.404	<b>69</b> Tm Thulium 168.93 9.32 L $\alpha$ 7.180 M $\alpha$ 1.462	<b>70</b> Yb Ytterbium 173.04 6.97 L $\alpha$ 7.416 M $\alpha$ 1.526	<b>71</b> Lu Lutetium 174.47 9.84 L $\alpha$ 7.655 M $\alpha$ 1.580
<b>90</b> Th Thorium 232.04 11.72 L $\alpha$ 12.968 M $\alpha$ 2.996	<b>91</b> Pa Protactinium 231.04 15.37 L $\alpha$ 13.291 M $\alpha$ 3.082	<b>92</b> U Uranium 238.03 18.95 L $\alpha$ 13.614 M $\alpha$ 3.171	<b>93</b> Np (237) Neptunium 20.45 L $\alpha$ 13.946 M $\alpha$ 3.250	<b>94</b> Pu (244) Plutonium 19.84 L $\alpha$ 14.282 M $\alpha$ 3.339	<b>95</b> Am (243) Americium 13.69 L $\alpha$ 14.620 M $\alpha$ 3.438	<b>96</b> Cm (247) Curium 13.51 L $\alpha$ 14.79	<b>97</b> Bk (247) Berkelium 14.79	<b>98</b> Cf (251) Californium 15.1	<b>99</b> Es (252) Einsteinium 13.5	<b>100</b> Fm (257) Fermium	<b>101</b> Md (258) Mendelevium	<b>102</b> No (259) Nobelium	<b>103</b> Lr (262) Lawrencium

Atomic number	Atomic weight	Density (g/cm <sup>3</sup> )	Symbol	Element name	Energy (keV)	Spectral line
35	79.90	3.12	Br	Bromine	11.924	L $\alpha$ 1.481



Z	Element	$K\alpha_1$	$K\beta_1$	$L\alpha_1$	$L\beta_1$	Z	Element	$K\alpha_1$	$K\beta_1$	$L\alpha_1$	$L\beta_1$	Z	Element	$K\alpha_1$	$K\beta_1$	$L\alpha_1$	$L\beta_1$	$M\alpha_1$	$M\beta_1$
3	Li Lithium					34	Se Selenium	11.224	12.497	1.379	1.419	65	Tb Terbium	44.482	50.385	6.273	6.975	1.240	1.269
4	Be Beryllium	0.108				35	Br Bromine	11.924	13.292	1.481	1.526	66	Dy Dysprosium	45.999	52.113	6.498	7.248	1.293	1.325
5	B Boron	0.183				36	Kr Krypton	12.648	14.112	1.585	1.636	67	Ho Holmium	47.547	53.877	6.720	7.526	1.348	1.383
6	C Carbon	0.277				37	Rb Rubidium	13.396	14.961	1.692	1.751	68	Er Erbium	49.128	55.674	6.949	7.811	1.404	1.448
7	N Nitrogen	0.392				38	Sr Strontium	14.165	15.835	1.806	1.871	69	Tm Thulium	50.742	57.505	7.180	8.102	1.462	1.503
8	O Oxygen	0.525				39	Y Yttrium	14.958	16.739	1.924	1.998	70	Yb Ytterbium	52.388	59.382	7.416	8.402	1.526	1.573
9	F Fluorine	0.677				40	Zr Zirconium	15.775	17.668	2.044	2.126	71	Lu Lutetium	54.070	61.290	7.655	8.710	1.580	1.630
10	Ne Neon	0.849				41	Nb Niobium	16.615	18.625	2.169	2.260	72	Hf Hafnium	55.790	63.244	7.899	9.023	1.646	1.700
11	Na Sodium	1.040				42	Mo Molybdenum	17.480	19.606	2.292	2.394	73	Ta Tantalum	57.535	65.222	8.146	9.343	1.712	1.770
12	Mg Magnesium	1.254	1.302			43	Tc Technetium	18.367	20.626	2.423	2.535	74	W Tungsten	59.318	67.244	8.398	9.672	1.775	1.838
13	Al Aluminium	1.486	1.557			44	Ru Ruthenium	19.279	21.656	2.558	2.683	75	Re Rhenium	61.141	69.309	8.652	10.010	1.843	1.906
14	Si Silicon	1.740	1.837			45	Rh Rhodium	20.216	22.724	2.697	2.834	76	Os Osmium	63.000	71.414	8.911	10.354	1.907	1.978
15	P Phosphorus	2.010	2.139			46	Pd Palladium	21.177	23.818	2.838	2.990	77	Ir Iridium	64.896	73.560	9.175	10.708	1.980	2.052
16	S Sulfur	2.309	2.465			47	Ag Silver	22.163	24.941	2.983	3.150	78	Pt Platinum	66.831	75.750	9.442	11.071	2.050	2.127
17	Cl Chlorine	2.622	2.812			48	Cd Cadmium	23.173	26.093	3.133	3.315	79	Au Gold	68.806	77.982	9.713	11.443	2.123	2.203
18	Ar Argon	2.958	3.190			49	In Indium	24.210	27.275	3.286	3.487	80	Hg Mercury	70.818	80.255	9.989	11.824	2.195	2.281
19	K Potassium	3.314	3.590			50	Sn Tin	25.271	28.485	3.444	3.663	81	Tl Thallium	72.872	82.573	10.269	12.213	2.271	2.363
20	Ca Calcium	3.692	4.013	0.341	0.345	51	Sb Antimony	26.359	29.725	3.604	3.842	82	Pb Lead	74.970	84.939	10.551	12.614	2.342	2.444
21	Sc Scandium	4.093	4.464	0.395	0.400	52	Te Tellurium	27.473	30.993	3.768	4.029	83	Bi Bismuth	77.107	87.349	10.839	13.023	2.423	2.526
22	Ti Titanium	4.512	4.933	0.452	0.458	53	I Iodine	28.612	32.294	3.938	4.221	84	Po Polonium	79.291	89.803	11.131	13.446	2.499	2.614
23	V Vanadium	4.953	5.428	0.510	0.518	54	Xe Xenon	29.775	33.620	4.110	4.418	85	At Astatine	81.516	92.304	11.427	13.876	2.577	2.699
24	Cr Chromium	5.415	5.947	0.572	0.582	55	Cs Cesium	30.973	34.982	4.285	4.619	86	Rn Radon	83.785	94.866	11.727	14.315	2.654	2.784
25	Mn Manganese	5.900	6.492	0.637	0.648	56	Ba Barium	32.194	36.378	4.466	4.828	87	Fr Francium	86.106	97.474	12.031	14.771	2.732	2.868
26	Fe Iron	6.405	7.059	0.705	0.718	57	La Lanthanum	33.442	37.797	4.647	5.038	88	Ra Radium	88.478	100.130	12.339	15.236	2.806	2.949
27	Co Cobalt	6.931	7.649	0.775	0.790	58	Ce Cerium	34.720	39.256	4.839	5.262	89	Ac Actinium	90.884	102.846	12.652	15.713	2.900	3.051
28	Ni Nickel	7.480	8.267	0.849	0.866	59	Pr Praseodymium	36.027	40.749	5.035	5.492	90	Th Thorium	93.351	105.605	12.968	16.202	2.996	3.149
29	Cu Copper	8.046	8.904	0.928	0.947	60	Nd Neodymium	37.361	42.272	5.228	5.719	91	Pa Protactinium	95.868	108.427	13.291	16.703	3.082	3.240
30	Zn Zinc	8.637	9.570	1.012	1.035	61	Pm Promethium	38.725	43.827	5.432	5.961	92	U Uranium	98.440	111.303	13.614	17.220	3.171	3.336
31	Ga Gallium	9.251	10.267	1.098	1.125	62	Sm Samarium	40.118	45.414	5.633	6.201	93	Np Neptunium	101.059	114.234	13.946	17.751	3.250	3.435
32	Ge Germanium	9.886	10.982	1.188	1.218	63	Eu Europium	41.542	47.038	5.849	6.458	94	Pu Plutonium	103.734	117.228	14.282	18.296	3.339	3.534
33	As Arsenic	10.543	11.726	1.282	1.317	64	Gd Gadolinium	42.996	48.695	6.053	6.708	95	Am Americium	106.472	120.284	14.620	18.856	3.438	3.646

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