

7f. X-Ray Wavelengths and Atomic Energy Levels

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Tables 7f-1 and 2 list the wavelengths of virtually all experimentally observed X-ray emission lines (excluding satellites) and absorption edges. These are taken from a review by J. A. Bearden [1] and are expressed in terms of the \AA^* unit, which is defined [2] in terms of the W $K\alpha_1$ line by setting $\lambda_{W K\alpha_1} = 0.209\ 0100\ \text{\AA}^*$. This figure was chosen to make the \AA^* unit as close to unity as possible; the difference was then estimated to be zero with a probable error of 5 ppm (parts per million). However, the conversion factor must remain an *experimentally determined quantity*.

A number of prominent X-ray reference lines (Cr $K\alpha_2$, Cu $K\alpha_1$, Mo $K\alpha_1$, and Ag $K\alpha_1$) were carefully remeasured in terms of the W $K\alpha_1$ standard [3]. An extensive survey of all experimental X-ray wavelength measurements was made, and the necessary corrections have been applied, as far as possible, to put each one on a basis consistent with the above set of reference values. When two or more values of comparable accuracy were available for the same wavelength, appropriate weighted averages were taken. The same procedure was followed with absorption edges. In all cases estimated probable errors were included.

A thorough recheck of the five reference lines is currently in progress. It now appears that at least one of the crystals used in the original work [3] contained significant imperfections. As a result of this redetermination some of the reference wavelength ratios may be shifted by as much as 10 ppm. Furthermore, a recent reevaluation of the atomic constants by Taylor et al. [4], which includes the highly

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precise a-c Josephson effect work, indicates that the conversion factor between \AA^* units and angstroms may differ from unity by about 20 ppm. As a result of these two developments most of the wavelengths listed below must be considered to have probable errors of no less than 10 ppm in terms of \AA^* units and perhaps somewhat larger errors in terms of angstroms.

Bearden and Burr [5] combined the emission line data of this table with the photoelectron measurements of Hagström, Nordling, and Siegbahn [6] to obtain a revised set of X-ray atomic energy levels. A separate least-squares adjustment was carried out for each element to obtain the values most consistent with all available data. The results are given below in Table 7f-3.

While the reviews [1,5] cited above outline the general principles of the wavelength and energy-level evaluations, full details are found only in the original separately published reports [7,8]. These must be consulted for references to all of the original papers used and for details of the procedures employed in the evaluations.

References

1. Bearden, J. A.: *Rev. Mod. Phys.* **39**, 78 (1967).
2. Bearden, J. A.: *Phys. Rev.* **137**, B155 (1965).
3. Bearden, J. A., A. Henins, J. G. Marzolf, W. C. Sauder, and J. S. Thomsen: *Phys. Rev.* **135**, A899 (1964).
4. Taylor, B. N., W. H. Parker, and D. N. Langenberg: *Rev. Mod. Phys.* **41**, 375 (1969).
5. Bearden, J. A., and A. F. Burr: *Rev. Mod. Phys.* **39**, 125 (1967).
6. Hagström, S., C. Nordling, and K. Siegbahn: "Alpha-, Beta-, and Gamma-ray Spectroscopy," vol. 1, p. 845, K. Siegbahn, ed., North-Holland Publishing Company, Amsterdam, 1965.
7. Bearden, J. A., and collaborators: X-ray Wavelengths, *AEC Rept.* NYO-10580, 1964. Price \$8.45. (Available from Clearinghouse for Federal Scientific and Technical Information, National Bureau of Standards, U.S. Department of Commerce, Springfield, Va. 22151.)
8. Bearden, J. A., and A. F. Burr: Atomic Energy Levels, *AEC Rept.* NYO-2543-1, 1965. Price \$6.00. (Available from Clearinghouse for Federal Scientific and Technical Information, National Bureau of Standards, U.S. Department of Commerce, Springfield, Va. 22151.)

TABLE 7I-1. X-RAY WAVELENGTHS IN Å* UNITS AND IN KEV

Designation	Wave-length, Å*	p.e.† keV	Wave-length, Å*	p.e.† keV	Designation	Wave-length, Å*	p.e.† keV	Wave-length, Å*	p.e.† keV
α KL	228	0.9543	3 Lithium		β ₁ L _{III} M _{IV} L _{III} M _I α _{1,2} L _{III} M _{IV,V}	21 Scandium (Cont.)		22 Titanium (Cont.)	
			1	114		1	0.1085	31.02	2	0.3996	27.05	2	0.4584
α KL	67.6	0.1833	5 Boron		α _{1,2} L _{III} M _{IV,V}	23 Vanadium		24 Chromium	
			3	44.7		3	0.277	2.50738	2	4.94464	2.293606	3	5.40551
α KL	31.6	0.3924	7 Nitrogen		α _{1,2} KL _{III} β KM	8 Oxygen		25 Manganese	
			4	23.62		3	0.5249	2.50356	2	4.95220	2.28970	2	5.41472
α _{1,2} KL _{III} β KM	18.32	0.6768	9 Fluorine		β _{1,2} KM _{III,II} β ₃ KM _{IV,V} β _{3,4} L _{II} M _{III,II} γ L _{II} M _I β ₁ L _{II} M _{IV} L _{III} M _I α _{1,2} L _{III} M _{IV,V} M _{III,II} M _{IV,V}	10 Neon		26 Iron	
			2	14.610		3	0.8486	2.28440	2	5.42729	2.08487	2	5.94671
α _{1,2} KL _{III} β KM	11.9101	1.0410	11 Sodium		α _{1,2} KL _{III} α ₁ KL _{III} β _{1,2} KM _{III,II} β ₃ KM _{IV,V} β _{3,4} L _{II} M _{III,II} γ L _{II} M _I β ₁ L _{II} M _{IV} L _{III} M _I α _{1,2} L _{III} M _{IV,V} M _{III,II} M _{IV,V}	12 Magnesium		28 Nickel	
			2	14.452		5	0.8579	2.26951	6	5.4629	2.07087	6	5.9869
α _{1,2} KL _{III} β KM	11.575	1.0711	13 Aluminum		α _{1,2} KL _{III} α ₁ KL _{III} β _{1,2} KM _{III,II} β ₃ KM _{IV,V} β _{3,4} L _{II} M _{III,II} γ L _{II} M _I β ₁ L _{II} M _{IV} L _{III} M _I α _{1,2} L _{III} M _{IV,V} M _{III,II} M _{IV,V}	14 Silicon		29 Copper	
			5	8.34173		9	1.48627	21.19†	9	0.585	18.96	2	0.654
L _{III} M L _{II} III	407.1	0.03045	15 Phosphorus		α _{1,2} KL _{III} α ₁ KL _{III} β _{1,2} KM _{III,II} β ₃ KM _{IV,V} β _{3,4} L _{II} M _{III,II} γ L _{II} M _I β ₁ L _{II} M _{IV} L _{III} M _I α _{1,2} L _{III} M _{IV,V} M _{III,II} M _{IV,V}	16 Sulfur		30 Zinc	
			1	8.33934		9	1.48670	27.34	3	0.4535	24.30	3	0.5102
L _{III} III	171.4	0.0724	16 Sulfur		α _{1,2} KL _{III} α ₁ KL _{III} β _{1,2} KM _{III,II} β ₃ KM _{IV,V} β _{3,4} L _{II} M _{III,II} γ L _{II} M _I β ₁ L _{II} M _{IV} L _{III} M _I α _{1,2} L _{III} M _{IV,V} M _{III,II} M _{IV,V}	17 Chlorine		31 Gallium	
			5	7.960		2	1.5574	23.88	4	0.5192	21.27	1	0.5828
L _{II} III	290	0.0428	17 Chlorine		α _{1,2} KL _{III} α ₁ KL _{III} β _{1,2} KM _{III,II} β ₃ KM _{IV,V} β _{3,4} L _{II} M _{III,II} γ L _{II} M _I β ₁ L _{II} M _{IV} L _{III} M _I α _{1,2} L _{III} M _{IV,V} M _{III,II} M _{IV,V}	18 Argon		32 Germanium	
			1	171.4		5	0.0724	27.77	1	0.4465	24.78	1	0.5003
L _{II} III	290	0.0428	18 Argon		α _{1,2} KL _{III} α ₁ KL _{III} β _{1,2} KM _{III,II} β ₃ KM _{IV,V} β _{3,4} L _{II} M _{III,II} γ L _{II} M _I β ₁ L _{II} M _{IV} L _{III} M _I α _{1,2} L _{III} M _{IV,V} M _{III,II} M _{IV,V}	19 Potassium		33 Arsenic	
			1	171.4		5	0.0724	24.25	3	0.5113	21.64	3	0.5728
L _{II} III	290	0.0428	19 Potassium		α _{1,2} KL _{III} α ₁ KL _{III} β _{1,2} KM _{III,II} β ₃ KM _{IV,V} β _{3,4} L _{II} M _{III,II} γ L _{II} M _I β ₁ L _{II} M _{IV} L _{III} M _I α _{1,2} L _{III} M _{IV,V} M _{III,II} M _{IV,V}	20 Calcium		34 Selenium	
			1	171.4		5	0.0724	337	9	0.037	309	9	0.040

15 Phosphorus		16 Sulfur		17 Chlorine		18 Argon		19 Potassium		20 Calcium		21 Scandium		22 Titanium		23 Vanadium		24 Chromium		25 Manganese		26 Iron		27 Cobalt		28 Nickel		29 Copper		30 Zinc		31 Gallium		32 Germanium		33 Arsenic		34 Selenium																																																
α_2 KLiII	6.160†	1	2.0127	5.37496	8	2.30604	α_2 KLiII	4.7307	1	2.62078	4.19474	5	2.95563	α_2 KLiII	3.36166	3	3.98809	α_2 KLiII	1.792850	9	6.91530	7.46989	8	1.661747	8	7.46989	1.544390	2	8.02783	8.61578	8	1.439000	8	8.61578	1.34399	1	9.22482	9.85532	9	1.258011	9	9.85532	1.19600	2	10.3663	11.1008	2	11.1008	1.20835	6	10.2603	10.9780	9	1.24936	9	10.9780	1.20789	2	10.2642	10.9821	2	10.9821	1.20789	2	10.2642	10.9821	2	10.9821	1.20789	2	10.2642	10.9821	2	10.9821	1.20789	2	10.2642	10.9821	2	10.9821	1.20789	2	10.2642	10.9821	2	10.9821

† The probable error (p.e.) is the error in the last digit of wavelength. Designation indicates both conventional Siegbahn notation (if applicable) and transition, e.g., β_1, LuM_{IV} denotes a transition between L_{III} and M_{IV} levels, which is the $L\beta_1$ line in Siegbahn notation.
 ‡ This is an interpolated value. In some instances, no experimental values were available; in others, experimental measurements appeared clearly inconsistent with other data, as indicated by a Moseley diagram.

TABLE 7f-1. X-RAY WAVELENGTHS IN Å* UNITS AND IN KEV (Continued)

Designation	Wave-length, Å*		p.e.†		keV		Designation	Wave-length, Å*		p.e.†		keV			
	Wave-length, Å*	p.e.†	Wave-length, Å*	p.e.†	Wave-length, Å*	p.e.†		Wave-length, Å*	p.e.†	Wave-length, Å*	p.e.†	Wave-length, Å*	p.e.†		
7 $L_{III}M_I$ β ₁ $L_{III}M_{IV}$ γ $L_{III}M_I$ α _{1,2} $L_{III}M_{IV,V}$	31 Gallium (Cont.)						M _I M _{III} M _{II} M _{IV} M _{III} N _I M _{III} M _{IV,V} M _{III} N _I	37 Rubidium (Cont.)							
	12.597	2	0.9842		11.609	2		1.0680	144.4	3	0.0859		85.7	2	0.1447
	11.023	2	1.1248		10.175	1		1.2185	91.5	2	0.1355		51.3	1	0.2416
	12.953	2	0.9572		11.965	4		1.0362	57.0	2	0.2174		91.4	2	0.1357
α _{1,2} $L_{III}M_{IV,V}$	11.292	1	1.09792		10.4361	8	1.18800	59.5	2	0.2083		53.6	1	0.2313	
	33 Arsenic						γ ₂ $M_{IV}N_{II}$ M _{IV} N _{III} γ ₁ $M_{IV}N_{II,III}$ γ ₁ $M_{IV}N_{III}$	39 Yttrium							
	1.17987	1	10.50799		1.10882	2		11.1814	0.83305	1	14.8829		0.79015	1	15.6909
	1.17588	1	10.54372		1.10477	2		11.2224	0.82884	1	14.9584		0.78593	1	15.7751
	1.05783	5	11.7203		0.99268	5		12.4896	0.74126	3	16.7258		0.70228	4	17.654
	1.05730	2	11.7262		0.99218	3		12.4959	0.74072	2	16.7378		0.70173	3	17.6678
	1.04500	3	11.8642		0.97992	5		12.6522	0.72864	4	17.0154		0.68693	4	17.970
	1.0488	1	11.822		0.9843	1		12.595	0.7345	1	16.879		0.6959	1	17.815
	8.929	1	1.3884		8.321†	9		1.490	0.72776	5	17.036		0.68601	5	17.994
	10.734	1	1.1550		9.962	1		1.2446	0.0186	3	2.0600		5.6681	3	2.1873
9.4141	8	1.3170		8.7358	5	1.41923		5.9832	3	2.0722		5.6330	3	2.2010	
11.072	1	1.1198		10.294	1	1.2044	5.2830	3	2.3468		4.9536	3	2.5029		
9.6709	8	1.2820		8.9900	5	1.37910	7.0406	3	1.76095		6.9069	3	1.87654		
α _{1,2} $L_{III}M_{IV,V}$ M _V N _{III}	230				230			6.2120	3	1.99584		5.8360	3	2.1244	
	35 Bromine						γ _{2,3} $L_{II}N_{II,III}$ γ ₁ $L_{II}M_I$ β ₁ $L_{III}M_{IV}$ γ ₂ $L_{II}N_I$ γ ₁ $L_{III}N_{IV}$ γ ₁ $L_{III}M_I$ α ₁ $L_{III}M_{IV}$ α ₁ $L_{III}M_V$ β ₁ $L_{III}N_I$	36 Krypton							
	1.04382	2	11.8776		0.9841	1		12.598	5.8754	3	2.1102		5.4977	3	2.2551
	1.03974	2	11.9242		0.9801	1		12.649	7.3563	3	1.68536		5.3843	3	2.2551
	0.93327	5	13.2845		0.8790	1		14.104	6.4558	3	1.92047		6.9185	3	1.79201
	0.93279	2	13.2914		0.8785	1		14.112	6.4488	2	1.92256		6.0778	3	2.0399
	0.92046	2	13.4695		0.8661	1		14.315	6.0942	3	2.0344		6.0705	2	2.04236
	0.9255	1	13.396		0.8708	2		14.238					5.7101	3	2.1712
					0.8653	2		14.328					5.5863	3	2.2194

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Transition	87 Rubidium			88 Strontium			41 Niobium			42 Molybdenum			
	Wavelength	Intensity	Energy Level	Wavelength	Intensity	Energy Level	Wavelength	Intensity	Energy Level	Wavelength	Intensity	Energy Level	
$\beta_4 L_1 M_{II}$				7.304	5	1.997	$M_{III} M_{IV}$	81.5	2	0.1522	76.7	2	0.1617
$\beta_5 L_1 M_{III}$				7.264	5	1.707	$M_{III} N_I$	46.48	9	0.267	80.9	3	0.1533
$\beta_{3,4} L_1 M_{III,III}$				7.576†	3	1.5366	$M_{III} M_V$	48.5	2	0.256			
$\eta L_{II} M_I$	7.767†	9	1.596	7.279	5	1.703	$M_{III} N_I$	86.5	2	0.1434			
$\beta_1 L_{II} M_{IV}$	9.255	1	1.3396	7.817†	3	1.5860	$M_{III} M_{IV}, V$	93.4	2	0.1328	82.1	2	0.1511
$\eta_5 L_{II} M_{IV}$	8.1251	5	1.52590	7.510	4	1.5510	$M_{IV}, V, O_{III,III}$		2		70.0	4	0.177
η_5	9.585	1	1.2935	7.250	5	1.710	$\alpha_2 KL_{II}$		1	16.5210			
$L L_{III} M_I$	8.3746	5	1.48043				$\alpha_1 KL_{III}$	0.75044	1	16.6151	0.715590	6	17.3743
$\alpha_{1,2} L_{III} M_{IV}, V$							$\beta_3 KM_{II}$	0.74620	1	18.6063	0.709300	1	17.47934
β_6							$\beta_1 KM_{III}$	0.66634	3	18.6225	0.632872	9	19.5903
$L_{III} N_{III}$	184.6	3	0.0672				$\beta_2 I$	0.66576	2	18.953	0.632288	9	19.6083
$M_I M_{II}$	164.7	3	0.0753				$\beta_2 KN_{II,III}$	0.65416	4	18.981	0.62107	5	19.963
$M_I M_{III}$	109.4	3	0.1133				$\beta_4 KN_{IV}, V$	0.65318	5		0.62099	2	19.9652
$M_{II} M_{IV}$	76.9	2	0.1613				$\beta_5 I KM_{IV}$						
$M_{II} N_I$	113.8	3	0.1089				$\beta_6 I KM_V$						
$M_{III} M_{IV}, V$	79.8	3	0.1554				$\beta_4 KN_{IV}, V$						
$\zeta_2 M_{IV} N_{II}$	191.1	2	0.06488				$\beta_5 I KM_V$						
$M_{IV} N_{III}$	189.5	3	0.0654				$\beta_4 L_I M_{II}$	5.3455	3	2.3194	5.0488	3	2.4557
$\zeta_1 M_V N_{II}$	192.6	2	0.06437				$\beta_3 L_I M_{III}$	5.3102	3	2.3348	5.0133	3	2.4730
							$\gamma_{2,3} L_I N_{II,III}$	4.6542	2	2.6638	4.3800	2	2.8306
							$\eta L_{II} M_I$	6.2109	3	1.99620	5.8475	3	2.1202
							$\beta_1 L_{II} M_{IV}$	5.4923	3	2.2574	5.17708	8	2.39481
							$\gamma_5 L_{II} N_I$	5.1517	3	2.4066	4.8369	2	2.5632
							$\gamma_1 L_{III} N_{IV}$	5.0361	3	2.4618	4.7258	2	2.6235
							$L L_{III} M_I$	6.5176	3	1.90225	6.1508	3	2.01568
							$\alpha_2 L_{III} M_{IV}$	5.7319	3	2.1630	5.41437	8	2.28985
							$\alpha_1 L_{III} M_V$	5.7243	2	2.3125	5.40655	8	2.29316
							$\beta_6 L_{III} N_I$	5.3613	3	2.3670	4.9232	2	2.5183
							$\beta_{2,15} L_{III} N_{IV}, V$	5.2379	3	2.3670	4.9232	2	0.1798
							$M_{III} M_{IV}$	72.1	3	0.1718	68.9	2	0.351
							$M_{III} N_I$	38.4	3	0.323	35.3	3	
							$M_{III} N_{IV}$	33.1	2	0.375			
							$M_{III} M_V$	78.4	2	0.1582	74.9	1	0.1656
							$M_{III} N_I$	40.7	2	0.305	37.5	2	0.331
							$\gamma M_{III} N_{IV}, V$	34.9	2	0.356			
							$\zeta M_{IV}, V N_{II,III}$	72.19	9	0.1717	64.38	7	0.1926
							$M_{IV}, V O_{III,III}$	61.9	2	0.2002	54.8	2	0.2252

TABLE 7I-1. X-RAY WAVELENGTHS IN Å* UNITS AND IN KEV (Continued)

Designation	Wave-length, Å*	p.e.†	keV	Wave-length, Å*	p.e.†	keV	Designation	Wave-length, Å*	p.e.†	keV	Wave-length, Å*	p.e.†	keV
	<i>43 Technetium</i>			<i>44 Ruthenium</i>				<i>47 Silver (Cont.)</i>			<i>48 Cadmium (Cont.)</i>		
α_2 KLII	0.67932†	3	18.2508	0.647408	5	19.1504	β_4 KNIV,V	0.48598	3	25.512	3.68203	9	3.36719
α_1 KLIII	0.67802†	3	18.3671	0.643083	4	19.2792	β_3 L _I MII	3.87023	5	3.20346	3.6495	9	3.40145
β_3 KMII	0.60188†	4	20.599	0.573067	4	21.6346	β_3 L _I MIII	3.83313	9	3.23446	3.1377	2	3.9513
β_1 KMII	0.60130†	4	20.619	0.572482	4	21.6568	γ_2 L _I NII	3.31216	9	3.7432	4.19315	9	2.95675
β_2 KNII,III	0.59024†	5	21.005	0.56166	3	22.074	γ_1 L _I NIII	3.30635	9	3.7498	3.42551	4	3.61935
$\beta_{3,II}$ KMIV				0.5680	2	21.829	η L _{II} M _I	4.4183	2	2.8061	3.73823	9	3.12691
$\beta_{3,I}$ KMV				0.56785	9	21.834	β_1 L _{III} M _{IV}	3.93473	3	3.15094	3.42832	4	3.71686
β_4				0.56089	9	22.104	γ_5 L _{III} N _I	3.61638	9	3.51959	3.33804	6	2.76735
β_1 L _I V _{IV}				4.5230	2	2.7411	γ_1 L _{III} N _{IV}	3.52260	4	2.6337	4.48014	9	3.12691
β_3 L _I III,III				4.4866	3	2.7634	l L _{III} M _I	4.7076	2	2.97821	3.96496	6	3.13373
$\gamma_{2,3}$ L _I NII,III				3.8977	2	3.1809	α_2 L _{III} M _{IV}	4.16294	5	2.98431	3.95935	4	3.42994
η L _{III} M _I				5.2050	2	2.38197	α_1 L _{III} M _V	4.15445	3	3.25603	3.61467	9	3.52812
β_1 L _{III} M _{IV}				4.62058	3	2.68323	β_6 L _{III} N _I	3.80774	9	3.34781	3.51408	4	3.6075
γ_6 L _{III} N _I				4.2873	2	2.8918	$\beta_{2,15}$ L _{III} N _{IV,V}	3.70335	9	3.43287	3.4337	2	3.61445
γ_1 L _{III} N _{IV}				4.1822	2	2.9645	β_9 L _{II} M _V	3.61158	9	3.43917	52.0	2	0.2384
l L _{III} M _I				5.5035	3	2.2528	β_1 L _{II} M _V	3.60497	9	0.658	22.9	2	0.540
α_2 L _{III} M _{IV}				4.85381	7	2.55431	M_1 N _{II,III}	18.8	2	0.2295	19.40	7	0.639
α_1 L _{III} M _V				4.84575	5	2.55855	M_{II} M _{IV}	54.0	1	0.600	58.7	2	0.2111
β_6 L _{III} N _I				4.3718	3	2.7634	M_{III} N _I	20.66	7	0.2048	24.5	1	0.507
$\beta_{2,15}$ L _{III} N _{IV,V}				4.3718	2	2.8360	M_{III} N _{IV}	60.5	1	0.478	20.47	7	0.606
M_{II} M _{IV}				62.2	1	0.1992	M_{III} N _I	26.0	1	0.568	30.4	1	0.408
M_{II} N _I				32.3	2	0.384	γ M _{III} N _{IV,V}	21.82	7	0.3117	36.8	1	0.3371
M_{III} N _{IV}				25.50	9	0.486	M_{IV} O _{II,III}	39.77	7	0.509	30.8	1	0.403
M_{III} M _V				68.3	1	0.1814	ζ M _{IV,V} N _{II,III}	24.4	2	0.370			
γ M _{III} N _{IV,V}				26.9	1	0.462	M_{IV} N _I	33.5	3				
ζ M _{IV,V} N _{II,III}				52.34	7	0.2369	M_{IV} O _{III}						
$M_{IV,V}$ O _{II,III}				44.8	1	0.2768							
	<i>45 Rhodium</i>			<i>46 Palladium</i>				<i>49 Indium</i>			<i>50 Tin</i>		
α_2 KLII	0.617630	4	20.0737	0.589821	3	21.0201	α_2 KLII	0.516544	3	24.0020	0.465053	3	25.0440
α_1 KLIII	0.613279	4	20.2161	0.585445	3	21.1771	α_1 KLIII	0.512113	3	24.2007	0.460599	3	25.2712

TABLE 7f-1. X-RAY WAVELENGTHS IN Å* UNITS AND IN KEV (Continued)

Designation	Wave-length, Å*	p.e.†	keV	Wave-length, Å*	p.e.†	keV	Designation	Wave-length, Å*	p.e.†	keV	Wave-length, Å*	p.e.†	keV											
	<i>59 Praseodymium (Cont.)</i>						<i>60 Neodymium (Cont.)</i>						<i>63 Europium (Cont.)</i>						<i>64 Cadolinium (Cont.)</i>					
γ_2 $L_{II}N_{II}$	1.8791	4	6.598	1.8013	4	6.883	γ_2 $L_{II}N_{II}$	1.5961	2	7.7677	1.5331	2	8.087											
γ_3 $L_{II}N_{III}$	1.8740	4	6.616	1.7964	4	6.902	γ_3 $L_{II}N_{III}$	1.5903	2	7.7961	1.5297	2	8.105											
γ_4 $L_{II}O_{II,III}$	1.8193	4	6.815	1.7445	4	7.107	γ_4 $L_{II}O_{II,III}$	1.5439	1	8.0304	1.4839	2	8.355											
γ $L_{II}M_I$	2.512	3	4.935	2.4094	4	5.1457	γ $L_{II}M_I$	2.1315	2	5.8166	2.0494	1	6.0495											
β_1 $L_{II}M_{IV}$	2.2588	3	5.4889	2.1669	2	5.7216	β_1 $L_{II}M_{IV}$	1.9203	2	6.4564	1.8468	2	6.7132											
γ_5 $L_{III}N_I$	2.0205	4	6.136	1.9355	4	6.406	γ_5 $L_{III}N_I$	1.7085	2	7.2566	1.6412	2	7.5543											
γ_1 $L_{III}N_{IV}$	1.9611	3	6.321	1.8779	2	6.6021	γ_1 $L_{III}N_{IV}$	1.6574	2	7.4803	1.5924	2	7.7858											
γ_8 $L_{III}O_I$	1.9362	4	6.403	1.8552	4	6.683	γ_8 $L_{III}O_I$	1.6346	2	7.5849	1.5707	2	7.894											
l $L_{III}M_I$	2.7841	4	4.4532	2.6760	4	4.6330	γ_6 $L_{III}O_{IV}$	1.6282	2	7.6147	1.5644	2	7.925											
α_2 $L_{III}M_{IV}$	2.4729	3	5.0135	2.3807	3	5.2077	l $L_{III}M_I$	2.3948	2	5.1772	2.3122	2	5.3621											
α_1 $L_{III}M_V$	2.4630	2	5.0337	2.3704	2	5.2304	α_2 $L_{III}M_{IV}$	2.1315	2	5.8166	2.0578	2	6.0250											
β_6 $L_{III}N_I$	2.1906	4	5.600	2.1039	3	5.8930	α_1 $L_{III}M_V$	2.1209	2	5.8457	2.0468	2	6.0572											
$\beta_{2,15}$ $L_{III}N_{IV,V}$	2.1194	4	5.850	2.0360	3	6.0894	β_6 $L_{III}N_I$	1.8737	2	6.6170	1.8054	2	6.8671											
β_7 $L_{III}O_I$	2.0919	4	5.927	2.0092	3	6.1708	$\beta_{2,15}$ $L_{III}N_{IV,V}$	1.8118	2	6.8432	1.7555	2	7.1028											
β_{10} $L_I M_{IV}$	2.1071	4	5.884	2.0237	3	6.1265	β_7 $L_{III}O_I$	1.7851	2	6.9453	1.7203	2	7.2071											
β_9 $L_I M_V$	2.1004	4	5.903	2.0165	3	6.1484	β_5 $L_{III}O_{IV,V}$	1.7772	2	6.9763	1.7130	2	7.2374											
γ $M_{III}N_{IV,V}$	10.998	9	1.1273	10.505	9	1.180	β_{10} $L_I M_{IV}$	1.7993	3	6.890	1.7315	3	7.160											
β $M_{IV}N_{VI}$	13.06	2	0.950	12.44	2	0.997	β_9 $L_I M_V$	1.7916	3	6.920	1.7240	3	7.192											
ξ M_VN_{III}	17.38	4	0.714	16.46	4	0.753	$L_I O_{IV,V}$	9.211	9	1.346	1.4807	3	8.373											
α $M_VN_{VI,VII}$	13.343	5	0.9292	12.68	2	0.978	γ $M_{III}N_{IV,V}$	10.750	7	1.1533	8.844	9	1.402											
$N_{IV,V,VI,VII}$	113	1	0.1095	107	1	0.116	β $M_{IV}N_{VI}$	14.22	2	0.872	10.254	6	1.2091											
$N_{IV,V,VI,III}$	136.5	4	0.0908	128.9	7	0.0962	ξ M_VN_{III}	10.96	3	1.131	13.57	2	0.914											
	<i>61 Promethium</i>						<i>62 Samarium</i>						<i>65 Terbium</i>						<i>66 Dysprosium</i>					
α_2 KL_{II}	0.324803	4	38.1712	0.313698	2	39.5224	α_2 KL_{II}	0.283423	2	43.7441	0.274247	2	45.2078											
α_1 KL_{III}	0.320160	4	38.7247	0.309040	2	40.1181	α_1 KL_{III}	0.278724	2	44.4816	0.269533	2	45.9984											
β_3 KM_{II}	0.28363†	4	43.713	0.27376	2	45.289	β KM_{II}	0.24683	2	50.229	0.23862	2	51.957											
β_1 KM_{III}	0.28290†	3	43.826	0.27301	2	45.413	β_1 KM_{III}																	
β_2 $KN_{II,III}$	0.2759 †	1	44.94	0.2662	1	46.58	β_2 $KN_{II,III}$																	
$KO_{II,III}$				0.26491	3	46.801	β KM_{II}																	

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Transition	1.06192	11.6752	1.0250	2	12.095	Transition	1.17218	5	10.5770	1.13353	5	10.9376
L ₁ O _{IV} v	1.43048	8.6671	1.3387	2	9.261	β ₁₀ L ₁ M _{IV}	1.16487	4	10.6433	1.12637	6	11.0071
L ₁ M _{III}	1.3864	8.9428	1.2728	2	9.741	β ₉ L ₁ M _V	1.0420	1	11.899	0.9772	3	12.687
β ₁₀ L ₁ M _{III}	1.31897	9.3998	1.1218	3	11.052	L ₁ N _I	1.0119	1	12.252	0.9765	3	12.696
L ₁ M _V	1.1600	10.688	1.1149	2	11.120	L ₁ N _{IV}	0.9965	1	12.442	0.96318	7	12.8721
L ₁ N _{III}	1.1553	10.7316	1.0771	2	11.510	γ ₁₁ L ₁ N _V	0.9900	1	12.524	0.95003	5	12.9683
L ₁ N _V	1.13687	10.9055	1.0792	1	11.488	L ₁ O _{IV} v	1.3366	1	9.2761	1.2934	2	9.586
ν L ₁ N _{VI}	1.1158	11.1113	1.6244	2	7.632	L ₁ M _{III}	1.2927	1	9.5910	1.2480	2	9.934
L ₁ O _{III}	1.11789	11.0907	1.6244	3	7.926	β ₁₇ L ₁ M _{III}	1.2305	1	10.0753	1.18577	7	10.4205
L ₁ O _{III}	1.11693	11.1001	1.5642	3	7.632	L ₁ M _V	1.0839	1	11.438	1.03873	5	11.9243
ε L ₁ M _{III}	1.67265	7.4123	1.2765	2	9.712	L ₁ N _{III}	1.0767	1	11.515	1.0050	2	12.337
ε L ₁ M _{III}	1.61264	7.6881	1.2672	2	9.784	ν L ₁ N _{VI}	1.0404	1	11.917	1.0057	2	12.340
L ₁ N _{III}	1.3167	9.4158	1.21868	5	10.1733	L ₁ O _{III}	1.0397	1	11.925	1.5387	2	8.079
L ₁ N _{III}	1.3086	9.4742	1.2211	2	10.153	ε L ₁ M _{III}	1.5789	1	7.8525	1.4735	2	8.414
ν L ₁ N _{VI} , VII	1.25778	9.8572	5.172	9	2.397	ε L ₁ M _{III}	1.5178	1	8.1682	1.20086	7	10.3244
L ₁ O _{III} , III	1.2601	9.839	4.44	2	2.79	L ₁ N _I	1.2283	1	10.0933	1.14837	7	10.8245
M ₁ N _{III}	5.40	2.295	6.28	2	2.97	L ₁ N _{III}	1.1815	1	10.4931	4.79	2	2.59
M ₁ O _{III} , III			5.357	2	1.973	ν L ₁ N _{VI} , VII				4.79	2	2.59
M ₁ N _I			6.28	2	2.314	M ₁ N _{III}				5.81	2	2.133
M ₁ N _{IV}	5.570	2.226	7.300	4	1.684	M ₁ N _I				4.955	4	2.502
M ₁ N _V	7.612	1.629	6.134	8	1.684	M ₁ N _{IV}				6.89	2	1.798
M ₁ N _{VI}	6.353	1.951	6.092	4	2.021	M ₁ N _V				5.724	5	2.166
M ₁ N _{VII}	6.312	1.964	5.628	3	2.035	M ₁ N _{VI}				5.682	4	2.182
γ M ₁ N _V	5.83	2.126	8.993	5	1.3787	M ₁ N _{VII}				8.359	5	1.4831
M ₁ O _{IV} v	5.67	2.19	8.573	8	1.446	γ M ₁ N _V	5.931	5	2.090			
ξ ₁ M ₁ N _{III}	9.330	1.3288	8.993	5	1.3787	ξ ₁ M ₁ N _V	5.885	2	2.1067			
M ₁ N _{III}	8.90	1.393	6.757	1	1.8349	ξ ₂ M ₁ N _{III}	8.664	2	1.4310			
M ₁ N _{VI}	7.023	1.7655	6.806	9	1.822	M ₁ N _{III}	8.239	8	1.505			
M ₁ O _{II}	7.09	1.748	8.962	4	1.3835	β M ₁ N _{VI}	6.504	1	1.9061			
ξ ₁ M ₁ N _{III}	9.316	1.3308	6.992	2	1.7731	γ M ₁ N _{VI}	8.629	4	1.4368			
α M ₁ N _{VI} , VII	7.252	1.7096	6.992	2	1.7731	α M ₁ N _{VI} , VII	6.729	1	1.8425			
α ₁ M ₁ N _{VI}			6.983	1	1.7754	N ₁ N _{VI}				51.9	1	0.2388
M ₁ N _{VII}			7.005	9	1.770	N ₁ N _{VII}				54.7	2	0.2266
N ₁ N _{III}	7.30	1.700	54.0	2	0.2295	α ₂ K _L II	0.195904	2	63.2667			
N ₁ N _{IV}	58.2	0.2130	55.8	1	0.2221	α ₁ K _L III	0.191647	2	64.8956			
N ₁ N _{VI}	61.1	0.2028	59.5	3	0.208	β ₁ K _M II	0.169367	2	73.2027			
N ₁ N _{VI} , VII			58.4	1	0.2122	β ₁ K _M III	0.168342	2	73.5608			
N ₁ N _{VII}												

78 Platinum

77 Iridium

TABLE 7f-1. X-RAY WAVELENGTHS IN Å* UNITS AND IN KEV (Continued)

Designation	77 Iridium (Cont.)		78 Platinum (Cont.)		Designation	79 Gold (Cont.)		80 Mercury (Cont.)	
	Wave-length, Å*	p.e.† keV	Wave-length, Å*	p.e.† keV		Wave-length, Å*	p.e.† keV	Wave-length, Å*	p.e.† keV
$\beta_2^{II} KN_{II}$	0.16415	75.529	0.15939	77.785	$\beta_1 KM_{III}$	0.158982	77.984	0.154487	80.253
$\beta_1^I KN_{III}$	0.163956	75.619	0.15920	77.878	$\beta_2^{II} KN_{II}$	0.15483	80.08	0.15040	82.43
$KO_{II,III}$	0.163019	76.053	0.15826	78.341	$\beta_2^I KN_{III}$	0.154618	80.185	0.15020	82.54
$\beta_1^{II} KM_{IV}$	0.16759	73.980	0.16271	76.199	$KO_{II,III}$	0.153694	80.667	0.14931	83.04
$\beta_3^I KM_V$	0.167373	74.075	0.16255	76.27	KL_I	0.18672	66.40		
$\beta_1 KM_{IV,V}$	0.16352	75.821	0.15881	78.069	$\beta_2^{II} KM_{IV}$	0.158052	78.438		
$\beta_4 L_I M_{II}$	1.17958	10.5106	1.14223	10.8543	$\beta_1^I KM_V$	0.157880	78.529		
$\beta_4 L_I M_{III}$	1.14085	10.8674	1.10394	11.2308	$\beta_4 KM_{IV,V}$				
$\beta_3 L_I M_{II}$	0.96545	12.8418	0.93427	13.2704	$\beta_3 KM_{IV,V}$	0.154224	80.391	0.15353	80.75
$\gamma_2 L_I N_{II}$	0.95931	12.9240	0.92791	13.3613	$\beta_4 KN_{IV,V}$	1.10651	11.2047	0.14978	82.78
$\gamma_2 L_I N_{III}$	0.92831	13.3555	0.89747	13.8145	$\beta_4 L_I M_{II}$	1.06785	11.6103	1.07222	11.5630
$\gamma_1^I L_I O_{II}$	0.92744	13.3681	0.89659	13.8281	$\beta_3 L_I M_{III}$	0.90434	13.7095	1.03358	11.9953
$\gamma_4 L_I O_{III}$	1.28448	9.6522	1.2429	9.975	$\gamma_2 L_I N_{II}$	0.89783	13.8090	0.87544	14.162
$\beta_1 L_{II} M_{IV}$	1.15781	10.7083	1.11990	11.0707	$\gamma_3 L_I N_{III}$	0.86815	14.2809	0.86915	14.265
$\gamma_3 L_{II} N_I$	1.02176	12.1342	0.9877	12.552	$\gamma_4^I L_I O_{II}$	0.86703	14.2896	0.84013	14.757
$\gamma_3 L_{II} N_{IV}$	0.99085	12.5126	0.95797	12.9420	$\gamma_1 L_I O_{III}$	0.83894	14.778	0.83894	14.778
$\gamma_3 L_{II} O_I$	0.97409	12.7279	0.9411	13.173	$\eta L_{II} M_I$	1.20273	10.3083	1.1640	10.6512
$\gamma_3 L_{II} O_{IV}$	0.96708	12.8201	0.9342	13.271	$\beta_1 L_{II} M_{IV}$	1.08353	11.4423	1.04868	11.8225
$l L_{III} M_I$	1.54094	8.0458	1.4995	8.268	$\gamma_3 L_{II} N_I$	0.95559	13.9743	0.92453	13.410
$\alpha_3 L_{III} M_{IV}$	1.36250	9.0995	1.32432	9.3618	$\gamma_3 L_{II} N_{IV}$	0.92650	13.3817	0.89646	13.8301
$\beta_1 L_{III} M_V$	1.35128	9.1751	1.31304	9.4423	$\gamma_3 L_{II} O_I$	0.90989	13.6260	0.87995	14.090
$\beta_3 L_{III} N_I$	1.17796	10.5251	1.14355	10.8418	$\gamma_3 L_{II} O_{IV}$	0.90297	13.7304	0.87319	14.199
$\beta_3 L_{III} N_{IV}$	1.13707	10.9036			$l L_{III} M_I$	1.45964	8.4939	1.4216	8.7210
$\beta_3 L_{III} N_V$	1.13632	10.9203	1.10200	11.2505	$\alpha_2 L_{III} M_{IV}$	1.2772	9.6280	1.25264	9.8976
$\beta_1 L_{III} O_I$	1.11489	11.1205	1.08168	11.4619	$\beta_3 L_{III} M_V$	1.2640	9.7133	1.24120	9.9888
$\beta_1 L_{III} O_{IV}$	1.10585	11.2114	1.0724	11.561	$\beta_3 L_{III} N_I$	1.11092	11.1602	1.07975	11.4824
$L_I M_I$	1.2102	10.245	1.16962	10.6001	$\beta_3 L_{III} N_{IV}$	1.07188	11.5667	1.04151	11.9040
$\beta_{10} L_I M_{IV}$	1.09702	11.3016	1.06183	11.6762	$\beta_2 L_{III} N_V$	1.04974	11.5847	1.03975	11.9241
$\beta_3 L_I M_V$	1.08975	11.3770	1.05446	11.7577	$\beta_1 L_{III} O_I$	1.04044	11.8106	1.01937	12.1625
$L_I N_I$	0.9766	12.695	0.9455	13.113	$\beta_3 L_{III} O_{IV,V}$	1.00987	11.9163	1.00987	12.2769
$L_I N_{IV}$	0.9459	13.108			$L_I M_I$	1.13525	10.9210	1.0999	11.272
					$\beta_{10} L_I M_{IV}$	1.02789	12.0617	0.9962	12.446

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Transition	79 Gold	80 Mercury	Energy (eV)	Wavelength (Å)	Intensity	Other Wavelengths (Å)	Other Intensities
$\gamma_1 L_1 N_V$	0.9446	0.9143	13.560	12.1474	7	0.9871	12.560
$L_1 O_1 V, V$	0.9243	0.8995	13.784	13.578	1	0.8827	14.045
$L_1 O_1$		0.8943	13.864	13.909	7		
$L_1 O_1 V$		0.8934	13.878	14.020	7		
$L_1 O_1 V, V$		1.213	10.225	14.2385	5	0.85657	14.474
$L_{II} M_{II}$	1.2502	1.1667	10.265	14.3497	5	0.8452	14.670
$\beta_1 L_{II} M_{III}$	1.2069	1.1129	11.140	14.5892	5	0.8350	10.888
$L_{II} M_V$	1.1489	0.97173	12.661	10.9915	5	1.0916	11.358
$L_{II} N_{II}$	1.0120	0.9792	12.7588	11.526	2		
$L_{II} N_{III}$	1.0054	0.97173	12.7588	13.186	2	0.90894	13.640
$\nu L_{II} N_{VI}$	0.97161	0.93931	13.1992	13.6487	5	0.87885	14.107
$L_{II} O_{III}$	0.96979		8.533	13.662	7	0.8784	14.114
$L_{II} O_{III}$	1.4930	1.4530	8.923	13.679	7	0.8758	14.156
$t L_{III} M_{II}$	1.4318	1.3895	8.923	3.7702	2	1.3746	9.019
$g L_{III} M_{III}$	1.16545	1.1310	10.962	3.7702	7	1.3112	9.455
$L_{III} N_{II}$	1.1560	1.1226	11.044	9.1749	2	1.0649	11.642
$L_{III} N_{III}$	1.1560	1.1226	11.044	11.2743	2	1.0585	11.713
$u L_{III} N_{VI, VII}$	1.11145	1.07896	11.4908	11.3717	7		
$L_{III} O_{II, III}$	1.10923	1.0761	11.521	11.3717	5	1.01769	12.1826
$M_{II} N_{III}$	4.631†	4.460	2.780	11.8357	7	1.01674	12.1940
$M_{II} N_{IV}$	4.780	4.601	2.695		2	1.01558	
$M_{III} N_I$	6.669	6.455	1.921	11.865	7	1.01404	12.2079
$M_{III} N_{IV}$	5.540	5.357	2.314		7		
$\gamma M_{III} N_V$	5.500	5.319	2.331		7		
$M_{III} O_I$		4.876	2.543	11.9355	7		
$M_{III} O_{IV, V}$	4.869	4.694	2.641	2.883	9		
$\zeta_1 M_{IV} N_{II}$	8.065	7.790	1.592	2.797	4		
$M_{IV} N_{III}$	7.645	7.371	1.682	1.981	9		
$\beta M_{IV} N_{VI}$	6.038	5.828	2.1273	2.391	5	6.09	2.036
$\zeta_1 M_V N_{III}$	8.021	7.738	1.6022	2.410	4		
$\alpha_1 M_V N_{VI}$	6.275	6.058	2.047	2.636	2	4.984†	2.4875
$\alpha_1 M_V N_{VII}$	6.262	6.047	2.0505	2.742	6		
$M_V O_{III}$		5.987	2.071	1.648	9		
$N_{IV} N_{VI}$	50.2	48.1	0.258	1.746	5	6.87	1.805
$N_V N_{VI, VII}$	52.8	50.9	0.2436	2.2046	8	5.4318†	2.2825
				1.6605	1		
				2.118	4		
				2.1229	1		
				2.150	9		
				0.265	2		
				0.2510	1		
					9		
					3		
					3		

79 Gold

80 Mercury

$\alpha_1 K L_{II}$
 $\alpha_1 K L_{III}$
 $\beta_1 K M_{II}$

TABLE 7f-1. X-RAY WAVELENGTHS IN Å* UNITS AND IN KEV (Continued)

Designation	Wave-length, Å*	p.e.f	keV	82 Lead		Designation	81 Thallium (Cont.)		82 Lead (Cont.)	
				Wave-length, Å*	p.e.f		keV	Wave-length, Å*	p.e.f	keV
α ₂ K _{LII}	0.175036	2	70.8319	0.170294	2	72.8042	α ₂ M _V N _{VI}	5.472	2	2.2656
α ₁ K _{LII}	0.170136	2	72.8715	0.165376	2	74.9694	α ₁ M _V N _{VII}	5.460	1	2.2706
β ₃ K _{MII}	0.150980	6	82.118	0.146810	4	84.450	M _V O _{III}			
β ₁ K _{MII}	0.150142	5	82.576	0.145970	6	84.936	N _{IV} N _{VI}			
β ₂ ^{II} K _{NII}	0.14614	1	84.836	0.14212	2	87.23	N _V N _{VII}	46.5	2	0.267
β ₂ ^I K _{NII}	0.14595	1	84.946	0.14191	1	87.364	N _{VI} O _{IV}	115.3	2	0.1075
KO _{III,III}	0.14509	1	85.451	0.141012	8	87.922	N _{VII} O _V	113.0	1	0.10968
KP	0.14509	1	85.451	0.1408	1	88.06		117.7	1	0.10530
β ₂ K _{MIV,V}	0.14917	1	83.114							
β ₂ ^{II} K _{MIV}				0.14512	2	85.43				
β ₂ ^I K _{MV}				0.14495	3	85.53				
β ₁ K _{NIV,V}	0.14553	2	85.19	0.14155	3	87.59				
β ₁ L _I M _{III}	1.03918	3	11.9306	1.0075	1	12.306	α ₂ K _{LII}			
β ₂ L _I M _{III}	1.00062	3	12.3904	0.9691	7	12.7933	α ₁ K _{LII}	0.165717	2	74.8148
γ ₂ L _I N _{III}	0.84773	5	14.6251	0.8210	2	15.101	β ₃ K _{MII}	0.160789	2	77.1079
γ ₁ L _I N _{III}	0.84130	4	14.7368	0.8147	1	15.218	β ₁ K _{MIII}	0.142779	7	86.834
γ' ₁ L _I O _{III}	0.81308	5	15.2482	0.78706	7	15.752	β ₁ ^{II} K _{VII}	0.141948	3	87.343
γ ₁ L _I O _{III}	0.81184	5	15.2716	0.7858	1	15.777	β ₂ ^I K _{VII}	0.13817	1	89.733
γ ₁ L _{II} M _I	1.12769	3	10.9943	1.09241	7	11.3493	β ₂ ^{II} K _{VII}	0.13797	1	89.864
γ ₁ L _{III} M _{IV}	1.01513	4	12.2133	0.98291	3	12.6137	γ ₁ K _{MIV,V}	0.13709	1	90.435
γ ₁ L _{III} N _I	0.89500	4	13.8526	0.86655	5	14.3075	β ₄ K _{NIV,V}	0.14111	1	87.860
γ ₁ L _{III} O _I	0.86752	3	14.2915	0.83973	3	14.7644	β ₁ L _I M _{III}	0.13759	2	90.11
γ ₁ L _{III} O _I	0.8513	2	14.564	0.82365	5	15.0527	β ₂ L _I M _{III}	0.97690	4	12.6912
γ ₁ L _{III} O _I	0.8442	2	14.685	0.81683	5	15.1783	γ ₂ L _I N _{III}	0.93855	3	13.2098
L _{III} P _I				0.81583	5	15.1969	γ ₃ L _I N _{III}	0.79565	3	15.5824
L _{III} M _I	1.38477	3	8.9532	0.81583	5	15.1969	γ' ₁ L _I O _{III}	0.78917	5	15.7102
α ₁ L _{III} M _{IV}	1.21875	3	10.1728	1.34960	7	9.1845	γ ₁ L _I O _{III}	0.76198	3	16.2709
α ₁ L _{III} M _V	1.20739	4	10.2685	1.18648	5	10.4495	γ ₂ L _I O _{III}	0.76687	3	16.2947
β ₁ L _{III} N _I	1.04963	5	11.8118	1.17501	2	10.5515	γ ₃ L _I P _{III,III}	0.75690	3	16.3802
β ₁ L _{III} N _{IV}	1.01201	3	12.2510	1.0210	1	12.143	η L _{III} M _I	1.05856	3	11.7122
β ₁ L _{III} N _V	1.01031	3	12.2715	0.98389	7	12.6011	β ₁ L _{III} M _{IV}	0.951978	9	13.0235
β ₁ L _{III} O _I	0.99017	5	12.5212	0.98221	7	12.6226	γ ₁ L _{III} M _I	0.89323	5	14.7732
				0.9620	1	12.888	γ ₁ L _{III} N _{IV}	0.81311	2	15.2477
							γ ₁ L _{III} O _I	0.7973	1	15.551

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β_5 $L_{III}O_{IV,V}$	0.98058	3	12.6436	0.9526	1	13.015	γ_6 $L_{III}O_{IV}$	0.79043	3	15.6853	0.7645	2	16.218
$L_{II}M_I$	1.0644	2	11.648	1.0323	2	12.010	$L_{II}M_I$	1.31610	7	9.4204	1.2829	5	9.664
β_{10} $L_I M_{IV}$	0.96389	7	12.8626	0.9339	2	13.275	α_2 $L_{III}M_{IV}$	1.15536	1	10.73091	1.125481	5	11.0158
β_9 $L_I M_V$	0.95675	7	12.9585	0.9268	1	13.377	α_1 $L_{III}M_V$	1.14386	2	10.8388	1.11386	4	11.1308
$L_{II}N_I$	0.8549	1	14.503	0.82859	7	14.963	β_6 $L_{III}M_I$	0.99331	3	12.4816	0.9672	2	12.819
$L_{II}N_{IV}$	0.83001	7	14.937	0.80364	7	15.427	β_{15} $L_{III}N_{IV}$	0.95792	5	12.9549	0.9312	2	13.314
γ_{11} $L_I N_V$	0.82879	5	14.9593	0.80233	9	15.453	β_2 $L_{III}N_V$	0.95518	4	12.9799	0.92937	5	13.3404
$L_{II}N_{VI,VII}$				0.7884	1	15.725	β_7 $L_{III}O_I$	0.93595	5	13.2593			
$L_{II}O_I$	0.8158	1	15.198	0.7897	1	15.699	β_6 $L_{III}O_{IV,V}$	0.92556	3	13.3953	0.8906	2	13.782
$L_{II}O_{IV,V}$	0.80861	5	15.3327	0.78257	7	15.843	$L_{II}M_I$	1.0005	9	12.39			
$L_{III}M_{II}$	1.0997	1	11.274	1.0644	2	11.648	β_{10} $L_{II}M_{IV}$	0.90495	4	13.7002			
β_{17} $L_{II}M_{III}$	1.05609	7	11.7397	1.0223	1	12.127	β_9 $L_{II}M_V$	0.89731	3	13.8077			
$L_{II}M_V$	1.00722	5	12.3093	0.9747	1	12.720	$L_{II}N_I$	0.8022	1	15.456			
$L_{II}N_I$	0.882	2	14.057	0.8585	3	14.442	$L_{II}N_{IV}$	0.7795	5	15.904			
$L_{II}N_{III}$	0.87996	5	14.0893	0.85192	7	14.553	γ_{11} $L_{II}N_V$	0.77728	5	15.951			
$L_{II}N_V$				0.8382	2	14.791	$L_{II}N_{VI,VII}$	0.7641	5	16.23			
α $L_{II}N_{VI}$	0.85048	5	14.5777	0.82327	7	15.060	$L_{II}O_{IV,V}$	0.75791	5	16.358			
$L_{III}O_{II}$	0.8490	1	14.604				$L_{II}M_{II}$	1.0346	9	11.98			
$L_{III}O_{III}$				0.8200	1	15.120	β_{17} $L_{II}M_{III}$	0.98913	5	12.5344			
$L_{III}M_{II}$	1.34154	5	9.2417	1.30767	7	9.4811	$L_{II}M_V$	0.94419	5	13.1310			
α $L_{III}M_{III}$	1.27807	5	9.7007	1.24385	7	9.9675	$L_{II}N_{II}$	0.8344	9	14.86			
$L_{III}N_{II}$				1.01040	7	12.2705	$L_{II}N_{III}$	0.8248	1	15.031			
$L_{III}N_{III}$	1.0286	1	12.053	1.0005	1	12.392	β $L_{II}N_{VII}$	0.79721	9	15.552			
α $L_{III}N_{VI,VII}$	0.9888	1	12.538	0.96133	7	12.8968	$L_{II}O_{III}$	0.79384	5	15.6178			
$L_{III}O_{II}$	0.98738	5	12.5566	0.9586	1	12.934	t $L_{III}M_{II}$	1.2748	1	9.7252			
$L_{III}O_{III}$	0.98538	5	12.5820	0.9578	1	12.945	s $L_{III}M_{III}$	1.2105	1	10.2421			
$M_{II}N_{III}$	0.97926	5	12.6607	0.95118	7	13.0344	β $M_{II}N_{II}$	0.98280	5	12.6151			
$M_{II}N_I$	4.013	9	3.089	3.872	9	3.202	$L_{III}N_{III}$	0.97321	5	12.7394			
$M_{II}N_{IV}$				4.655	8	2.664	α $L_{III}N_{VI,VII}$	0.93505	5	13.2593			
$M_{III}N_I$	4.116	4	3.013	3.968	5	3.124	$L_{III}O_{II}$	0.9323	2	13.298			
$M_{III}N_{IV}$	5.894	8	2.107	5.704	8	2.174	$L_{III}O_{III}$	0.9302	2	13.328			
$M_{III}N_V$	4.865	5	2.548	4.715	3	2.630	$L_{III}P_{III}$	0.92418	4	13.4159			
γ $M_{III}N_V$	4.823	4	2.571	4.674	1	2.6527	$M_{II}N_{II}$	3.892	9	3.185			
$M_{III}O_I$				4.244	9	2.921	$M_{II}N_{III}$	3.740	9	3.315			
$M_{III}O_{IV,V}$	4.216	6	2.941	4.069	6	3.047	$M_{II}N_{IV}$	3.834	4	3.234			
ξ_1 $M_{IV}N_{II}$	7.032	5	1.763	6.802	5	1.823	$M_{III}N_I$	5.537	8	2.239			
$M_{IV}N_{III}$				6.384	7	1.942	$M_{III}N_{IV}$	4.571	5	2.712			
β $M_{IV}N_{VI}$	5.249	1	2.3621	5.076	1	2.4427	γ $M_{III}N_V$	4.532	2	2.735			
$M_{IV}O_{II}$	5.196	9	2.386	5.004	9	2.477	$M_{III}O_I$	4.105	9	3.021			
ξ_1 $M_{V}N_{III}$	6.974	4	1.778	6.740	3	1.8395	$M_{III}O_{IV,V}$	3.932	6	3.153			

TABLE 7f-1. X-RAY WAVELENGTHS IN Å* UNITS AND IN KEV (Continued)

Designation	Wave-length, Å*	p.e.†	keV	Wave-length, Å*	p.e.†	keV	Designation	Wave-length, Å*	p.e.†	keV	Wave-length, Å*	p.e.†	keV
ζ ₁ M _{IV} N _{II}	6.585	5	1.883				α ₂ K _{LII}	0.14141†	2	87.67	0.137829	2	89.953
M _{IV} N _{III}	6.102	8	2.012				α ₁ K _{LIII}	0.136417†	8	90.884	0.132813	2	93.350
β M _{IV} N _{VI}	4.909	1	2.5255				β ₂ K _{MII}	0.12143†	2	102.10	0.118268	3	104.831
M _{IV} O _{II}	4.823	3	2.571				β ₁ K _{MIII}	0.12055†	2	102.85	0.117396	9	105.609
M _{IV} P _{II,III}	4.59	2	2.70				β ₂ ¹ K _{NII}	0.11732†	2	105.67	0.11426	1	108.511
ζ ₁ M _V N _{III}	6.521	4	1.901				β ₂ ¹ K _{NIII}	0.11711†	2	105.86	0.114040	9	108.717
α ₁ M _V N _{VI}	5.130	2	2.4170				K _{OII,III}				0.11322	1	109.500
α ₁ M _V N _{VII}	5.118	1	2.4226				β ₁ K _{M_{IV}V}				0.11667	9	106.269
N _P H _{II,III}	13.30	6	0.932				β ₂ K _{N_{IV}V}				0.11366	2	109.08
N _V O _{IV}	91.6	1	0.1354				β ₁ L _I M _{II}	0.77822	9	15.931	0.79287	4	15.6429
N _{VII} O _V	93.2	1	0.1330				β ₂ L _I M _{III}				0.75479	3	16.4258
							γ ₂ L _{II} N _{II}				0.64221	4	19.305
							γ ₂ L _{II} N _{III}				0.63559	4	19.507
							γ ¹ L _I O _{II}				0.61251	4	20.242
							γ ₂ L _I O _{III}				0.61058	4	20.292
							γ ₁ L _I P _{II,III}				0.60705	8	20.424
							γ L _{III} M _I				0.85446	4	14.5099
α ₂ K _{LII}	0.15705†	2	78.95				β ₁ L _{II} M _{IV}	0.78903	9	15.713	0.785210	9	16.2022
α ₁ K _{LIII}	0.15210†	2	81.52				γ ₂ L _{II} N _I				0.67481	4	18.370
β ₂ K _{MII}	0.13517†	4	91.72				γ ₂ L _{II} N _{IV}				0.65313	3	18.9825
β ₁ K _{MIII}	0.13432†	4	92.30				γ ₂ L _{II} O _I				0.63898	5	19.403
β ₂ ¹ K _{NII}	0.13072†	4	94.84				γ ₂ L _{II} O _{IV}				0.63258	4	19.599
β ₂ ¹ K _{NIII}	0.13062†	4	94.99				L _{III} P _I				0.6316	1	19.629
β ₁ L _I M _{III}	0.88135†	9	14.067				l L _{III} M _I				0.62981	9	19.682
β ₁ L _{II} M _{IV}	0.89349†	9	13.876				α ₂ L _{III} M _{IV}	0.99178	5	12.5008	1.11508	4	11.1866
γ ₁ L _{II} N _{IV}	0.76289†	9	16.251				α ₁ L _{III} M _V	0.97993	5	12.6520	0.96788	2	12.8096
α ₂ L _{III} M _{IV}	1.09671†	5	11.3048				β ₂ L _{III} N _I				0.95600	3	12.9687
α ₁ L _{III} M _V	1.08500†	5	11.4268				β ₁ L _{III} N _{IV}				0.82780	8	14.975
							β ₂ L _{III} N _V				0.79539	5	15.5875
							β ₁ L _{III} O _I				0.79354	3	15.6237
							β ₂ L _{III} O _{IV}				0.77437	4	16.0105
											0.76468	5	16.213

TABLE 7i-1. X-RAY WAVELENGTHS IN Å* UNITS AND IN KEV (Continued)

Designation	89 Actinium (Cont.)		90 Thorium (Cont.)		Designation	91 Protactinium (Cont.)		92 Uranium (Cont.)	
	Wave-length, Å*	p.e.† keV	Wave-length, Å*	p.e.† keV		Wave-length, Å*	p.e.† keV	Wave-length, Å*	p.e.† keV
ζ_1 MvN _{III}			5.245	2.364	M _I N _{II}			2.92	4.25
α_1 MvN _{VI}			4.151	2.987	M _I N _{III}			2.753	4.50
α_1 MvN _{VII}			4.1381	2.9961	M _I O _{III}			2.304	5.38
MvP _{III}			3.760	3.298	M _I P _{III}			2.253	5.50
N _I P _{II}			9.44	1.313	M _{II} N _I	3.441	5	3.329	4
N _I P _{III}			9.40	1.319	M _{II} N _{IV}	2.910	2	2.817	2
N _{II} O _{IV}			11.56	1.072	M _{II} O _{IV}	2.527	4	2.443	4
N _{II} P _I			11.07	1.120	M _{III} N _I	4.450	4	4.330	2
N _{III} O _V			13.8	0.897	M _{III} N _{IV}	3.614	2	3.521	2
N _{IV} N _{VI}			33.57	0.3693	γ M _{III} N _V	3.577	1	3.4657	1
N _V N _{VI} .VII			36.32	0.3414	M _{III} O _I	3.245	9	3.115	7
N _{VI} O _V			49.5	0.2505	M _{III} O _{IV} .V	3.038	2	2.948	2
N _{VI} O _V			48.2	0.2572	ζ_1 M _{IV} N _{II}	5.193	2	5.050	2
N _{VII} O _V			50.0	0.2479	M _{IV} N _{III}	3.827	1	3.716	1
O _{III} P _{IV} .V			68.2	0.1817	β M _{IV} N _{VI}	3.691	2	3.576	1
O _{IV} .VQ _{II} .III			181	0.068	M _{IV} O _{II}	5.092	2	4.946	2
					ζ_1 M _V N _{III}	4.035	3	3.924	1
					α_1 M _V N _{VI}	4.022	1	3.910	1
					α_1 M _V N _{VII}			10.09	7
					N _I O _{III}			8.81	7
α_1 KL _I	9 92.287		0.130968	94.665	N _I P _{II}			8.76	7
α_1 KL _{II}	3 95.868		0.125947	98.439	N _I P _{III}			10.40	7
β_3 KM _{II}	2 107.60		0.112296	110.406	N _{II} P _I			12.90	9
β_1 KM _{III}	8 108.427		0.111394	111.300	N _{III} O _V			31.8	1
β_2 KM _{II}	2 111.40		0.10837	114.40	N _V N _{VI} .VII			34.8	1
β_3 KN _{III}	2 111.62		0.10818	114.60	N _{IV} O _{IV}			43.3	2
KO _{II} .III			0.10744	115.39	N _{VI} O _V			42.1	2
β_5 KM _{IV} .V			0.11069	112.01	N _{IV} P _{IV} .V			8.60	7
β_4 KN _{IV} .V			0.10780	115.01					
β_4 L _I M _{II}	1 16.104		0.747985	16.5753					
β_3 L _I M _{III}	5 16.530		0.71029	17.4550					

	94 Plutonium	93 Neptunium	95 Americium
$\gamma_2 L_{II} N_{II}$	0.65239	20.4847	$\beta_4 L_{II} M_{II}$
$\gamma_3 L_{II} N_{III}$	0.51699	20.7127	$\beta_3 L_{II} M_{III}$
$\gamma' L_{II} O_{II}$	0.5937	21.4984	$\gamma_2 L_{II} N_{II}$
$\gamma_2 L_{II} O_{III,III}$	0.57499	21.562	$\beta_1 L_{II} M_{IV}$
$\gamma_3 L_{II} N_{III}$	0.5706	21.729	$\gamma_2 L_{II} N_{II}$
γ_1	0.80509	15.3997	$\beta_1 L_{II} M_{IV}$
$\eta L_{II} M_I$	0.719984	17.2200	$\gamma_3 L_{II} N_{III}$
$\beta_1 L_{II} M_{IV}$	0.63557	19.5072	$\gamma' L_{II} M_I$
$\gamma_3 L_{II} N_{II}$	0.614770	20.1671	$\beta_1 L_{II} M_{IV}$
$\gamma_1 L_{II} N_{IV}$	0.60125	20.621	$\beta_1 L_{II} M_{IV}$
$\gamma_2 L_{II} O_I$	0.594845	20.8426	$\gamma_3 L_{II} N_{II}$
$\gamma_3 L_{II} O_{IV}$	0.59203	20.942	$\gamma_1 L_{II} N_{IV}$
$L_{III} P_{IV}$	1.06712	11.6183	$\gamma_3 L_{II} O_{IV}$
$\alpha L_{III} M_I$	0.922558	13.4388	$\gamma_3 L_{II} O_{IV}$
$\alpha L_{III} M_{IV}$	0.910639	13.6147	$L_{III} M_I$
$\alpha L_{III} M_V$	0.78838	15.7260	$\alpha L_{III} M_{IV}$
$\beta_6 L_{III} N_I$	0.756642	15.3857	$\alpha L_{III} M_V$
$\beta_1 L_{III} N_{IV}$	0.754681	15.4283	$\beta_6 L_{III} N_I$
$\beta_3 L_{III} N_V$	0.73602	15.845	$\beta_3 L_{III} N_{IV}$
$\beta_2 L_{III} O_I$	0.726305	17.0701	$\beta_2 L_{III} N_V$
$\beta_3 L_{III} O_{IV, V}$	0.72521	17.096	$\beta_3 L_{III} N_{IV}$
$L_{III} P_I$	0.72240	17.162	$\beta_2 L_{III} O_I$
$L_{III} P_{IV, V}$	0.68760	18.031	$\beta_3 L_{III} O_{IV, V}$
$\beta_{10} L_{III} M_V$	0.681014	18.2054	$\beta_{10} L_{III} M_{IV}$
$\beta_3 L_{III} M_V$	0.59096	20.979	$\beta_9 L_{III} M_V$
$L_{II} N_{IV}$	0.58986	21.019	$u L_{III, IV, VI, VII}$
$\gamma_1 L_{II} N_V$	0.5725	21.657	
$L_{II} O_{IV, V}$	0.74503	16.641	$\beta_4 L_{II} M_{II}$
$\beta_{11} L_{II} M_{III}$	0.6228	19.907	$\beta_3 L_{II} M_{III}$
$L_{II} N_{III}$	0.6031	20.556	$\gamma_2 L_{II} N_{II}$
$v L_{II} N_{VI}$	0.59728	20.758	$\beta_1 L_{II} M_{IV}$
$L_{II} O_{II}$	0.5930	20.906	$\gamma_1 L_{II} N_{IV}$
$L_{II} P_{III, III}$	1.0347	11.982	$\gamma_3 L_{II} O_{IV}$
$t L_{II} M_{II}$	0.9636	12.866	$L_{II} M_I$
$s L_{II} M_{III}$	0.78017	13.892	$\alpha L_{II} M_{IV}$
$L_{II} N_{II}$	0.7691	16.120	$\alpha L_{II} M_V$
$L_{III} N_{III}$	0.738603	16.7859	$\beta_5 L_{II} N_I$
$u L_{III, IV, VI, VII}$	0.7333	16.907	$\beta_3 L_{II} N_{IV}$
$L_{III} O_{II}$	0.7309	16.962	$\beta_3 L_{II} N_V$
$L_{III} O_{III}$	0.72426	17.118	$\beta_3 L_{II} O_{IV, V}$

	94 Plutonium	93 Neptunium	95 Americium
$\beta_4 L_{II} M_{II}$	0.70620	0.7267	0.68639
$\beta_3 L_{II} M_{III}$	0.66871	0.68920†	0.64891
$\gamma_2 L_{II} N_{II}$	0.57098	0.5873	0.5544
$\gamma_3 L_{II} N_{III}$	0.564001	0.5810	0.657655
γ_1	0.5432	0.5585	0.561886
$\eta L_{II} M_I$	0.5415	0.5585	0.54311
$\beta_1 L_{II} M_{IV}$	0.7591	0.7809	1.0012
$\gamma_3 L_{II} N_{III}$	0.67772	0.698478	0.860266
$\beta_1 L_{II} M_{IV}$	0.5988	0.616	0.848187
$\gamma_3 L_{II} N_{II}$	0.578882	0.596498	0.73418
$\gamma_1 L_{II} N_{IV}$	0.5658	0.596498	0.70341
γ_3	0.55973	0.57699	0.701350
$\gamma_4 L_{II} O_{IV}$	0.55973	0.57699	0.67383
$L_{III} M_I$	1.0226	1.0428	
$\alpha L_{III} M_{IV}$	0.88028	0.901045	
$\alpha L_{III} M_V$	0.86830	0.889128	
$\beta_6 L_{III} N_I$	0.75148	0.769	
$\beta_3 L_{III} N_{IV}$	0.7205	0.736230	
$\beta_2 L_{III} N_V$	0.71851	0.736230	
$\beta_3 L_{III} O_I$	0.7003	0.70814	
$\beta_3 L_{III} O_{IV, V}$	0.69068	0.70814	
$\beta_{10} L_{III} M_{IV}$	0.6482		
$\beta_9 L_{III} M_V$	0.6415		
$u L_{III, IV, VI, VII}$	0.7031		

	94 Plutonium	93 Neptunium	95 Americium
$\gamma_2 L_{II} N_{II}$	17.5560	17.0607	18.0627
$\gamma_3 L_{II} N_{III}$	18.5405	17.989	19.1059
$\gamma' L_{II} O_{II}$	21.7251	21.11	22.361
$\gamma_2 L_{II} O_{III,III}$	21.9824	21.34	18.8520
$\gamma_3 L_{II} N_{III}$	22.823	22.20	22.0652
γ_1	22.891	15.876	22.8282
$\eta L_{II} M_I$	22.891	17.7502	12.384
$\beta_1 L_{II} M_{IV}$	16.333	18.2937	9.4119
$\gamma_3 L_{II} N_{II}$	18.2937	20.12	4.6172
$\gamma_1 L_{II} N_{IV}$	20.704	16.13	16.8870
$\gamma_2 L_{II} O_I$	21.4173	16.13	17.6258
$\gamma_3 L_{II} O_{IV}$	21.914	16.13	17.6765
$L_{III} P_{IV}$	22.1502	16.8400	18.3996
$\alpha L_{III} M_I$	12.124	21.488	
$\alpha L_{III} M_{IV}$	12.124	11.890	
$\alpha L_{III} M_V$	14.0842	13.7597	
$\beta_6 L_{III} N_I$	14.2786	13.9441	
$\beta_1 L_{III} N_{IV}$	16.4983	13.9441	
$\beta_3 L_{III} N_V$	17.208	16.13	
$\beta_3 L_{III} O_I$	17.208	16.13	
$\beta_3 L_{III} O_{IV, V}$	17.208	16.13	
$L_{III} P_I$	17.705	16.8400	
$L_{III} P_{IV, V}$	17.705	16.8400	
$\beta_{10} L_{III} M_{IV}$	19.126		
$\beta_9 L_{III} M_V$	19.323		
$L_{II} N_{IV}$	17.635		

TABLE 11-2. WAVELENGTHS OF X-RAY EMISSION LINES AND ABSORPTION EDGES: IN NUMERICAL ORDER

Wavelength, Å*	p.e.†	Element	Designation	keV	Wavelength, Å*	p.e.†	Element	Designation	keV
0.10723	1	92 U	K	115.62	0.14512	2	88 Rn	K _{LII}	85.43
0.10744	1	92 U	Abs. edge	115.39	0.14553	2	81 Tl	K _{NIV,V}	85.19
0.10780	2	92 U	K _{β₁}	115.01	0.14595	1	81 Tl	K _{NIII}	84.946
0.10818	1	92 U	K _{β₂I}	114.60	0.145970	6	82 Pb	K _{MIII}	84.936
0.10837	1	92 U	K _{β₂II}	114.40	0.14614	1	81 Tl	K _{NII}	84.836
0.11069	1	92 U	K _{β₃}	112.01	0.146810	4	82 Pb	K _{MII}	84.450
0.11107	2	91 Pa	K _{β₂I}	111.62	0.14798	3	86 Rn	K _{LIII}	83.78
0.11129	2	91 Pa	K _{β₂II}	111.40	0.14896	3	87 Fr	K _{LII}	83.23
0.111394	5	92 U	K _{β₁}	111.300	0.14917	1	81 Tl	K _{MIV,V}	83.114
0.112296	4	92 U	K _{β₃}	110.406	0.14918	1	80 Hg	Abs. edge	83.109
0.11307	1	90 Th	K	109.500	0.14931	2	80 Hg	K _{OII,III}	83.04
0.11322	2	90 Th	Abs. edge	109.500	0.14978	2	80 Hg	K _{NIV,V}	82.78
0.11366	1	90 Th	K _{OII,III}	109.08	0.150142	5	81 Tl	K _{MII}	82.576
0.114040	2	90 Th	K _{NIV,V}	108.717	0.15020	2	80 Hg	K _{NIII}	82.54
0.11426	1	90 Th	K _{NII}	108.511	0.15040	2	80 Hg	K _{NII}	82.43
0.114345	8	91 Pa	K _{β₂II}	108.427	0.150980	6	81 Tl	K _{MII}	82.118
0.11523	2	91 Pa	K _{β₁}	107.60	0.15210	2	85 At	K _{LII}	81.52
0.116667	9	90 Th	K _{β₃}	106.269	0.15294	3	86 Rn	K _{LII}	81.07
0.11711	2	89 Ac	K _{β₂I}	105.86	0.15353	2	80 Hg	K _{MIV,V}	80.75
0.11732	2	89 Ac	K _{β₂II}	105.67	0.153593	5	79 Au	Abs. edge	80.720
0.117396	9	90 Th	K _{β₁}	105.609	0.153694	7	79 Au	K _{OII,III}	80.667
0.118268	3	90 Th	K _{β₃}	104.831	0.154224	5	79 Au	K _{NIV,V}	80.391
0.12029	3	88 Ra	K _{β₂I}	103.07	0.154487	3	80 Hg	K _{MIII}	80.253
0.12050	3	88 Ra	K _{β₂II}	102.89	0.154618	9	79 Au	K _{NIII}	80.185
0.12055	2	89 Ac	K _{β₁}	102.85	0.15483	2	79 Au	K _{NII}	80.08
0.12143	2	89 Ac	K _{β₃}	102.10	0.155321	3	80 Hg	K _{MII}	79.822
0.12358	5	87 Fr	K _{β₂I}	100.33	0.15636	1	84 Po	K _{LIII}	79.290
0.12379	5	87 Fr	K _{β₂II}	100.16	0.15705	2	85 At	K _{LII}	78.95
0.12382	3	88 Ra	K _{β₁}	100.13	0.157880	5	79 Au	K _{MV}	78.529
0.12409	3	88 Ra	K _{β₃}	99.439	0.158062	7	79 Au	K _{MIV}	78.438
0.125947	3	92 U	K _{LIII}	98.433	0.15818	1	78 Pt	Abs. edge	78.381
0.12698	5	86 Rn	K _{β₂I}	97.64	0.15826	1	78 Pt	K _{OII,III}	78.341
0.12719	5	86 Rn	K _{β₂II}	97.47	0.15881	2	78 Pt	K _{NIV,V}	78.069
0.12719	5	87 Fr	K _{β₁}	97.47	0.158982	3	79 Au	K _{MIII}	77.984

0.12807	5	87 Fr	K β_3	KM _{II}	96.81	0.15920	1	78 Pt	K β_2^I	KN _{III}	77.878
0.129325	3	91 Pa	K α_1	KL _{III}	95.868	0.15939	1	78 Pt	K β_2^{II}	KN _{II}	77.785
0.13052	4	85 At	K β_2^I	KN _{III}	94.99	0.159810	2	79 Au	K β_3	KM _{II}	77.580
0.13069	5	86 Rn	K β_1	KM _{III}	94.87	0.160789	2	83 Bi	K α_1	KL _{III}	77.1079
0.13072	4	85 At	K β_2^{II}	KN _{II}	94.84	0.16130	1	84 Po	K α_2	KL _{II}	76.862
0.130968	4	92 U	K α_2	KL _{II}	94.665	0.16255	3	78 Pt	K β_5^I	KM _V	76.27
0.13155	5	86 Rn	K β_3	KM _{II}	94.24	0.16271	2	78 Pt	K β_5^{II}	KM _{IV}	76.199
0.132813	2	90 Th	K α_1	KL _{III}	93.350	0.16292	1	77 Ir	K	Abs. edge	76.101
0.13418	2	84 Po	K β_2^I	KN _{III}	92.40	0.163019	5	77 Ir	KO _{II,III}	KO _{II,III}	76.053
0.13432	4	85 At	K β_1	KN _{III}	92.30	0.16352	2	77 Ir	KN _{IV,V}	KN _{IV,V}	75.821
0.134343	9	91 Pa	K α_2	KM _{III}	92.287	0.163675	3	78 Pt	K β_1	KM _{III}	75.748
0.13438	2	84 Po	K β_2^{II}	KL _{II}	92.26	0.163956	7	77 Ir	K β_2^I	KN _{III}	75.619
0.13517	4	85 At	K β_3	KN _{II}	91.72	0.16415	1	77 Ir	K β_2^{II}	KN _{II}	75.529
0.136417	8	89 Ac	K α_1	KM _{II}	90.884	0.164501	3	78 Pt	K β_3	KM _{II}	75.368
0.13694	1	83 Bi	K	KL _{III}	90.534	0.165376	2	82 Pb	K α_1	KL _{III}	74.9694
0.13709	1	83 Bi	K β_4	Abs. edge	90.435	0.165717	2	83 Bi	K α_2	KL _{II}	74.8148
0.13759	2	83 Bi	K α_2	KO _{II,III}	90.11	0.167373	9	77 Ir	K β_5^I	KL _{II}	74.075
0.137829	2	90 Th	K β_2^I	KN _{V,V}	89.953	0.16759	2	77 Ir	K β_5^{II}	KM _V	74.075
0.13797	1	83 Bi	K β_1	KL _{II}	89.864	0.16787	1	76 Os	K	KM _{IV}	73.980
0.13807	2	84 Po	K β_2^{II}	KN _{III}	89.80	0.16798	1	76 Os	Abs. edge	Abs. edge	73.856
0.13817	1	83 Bi	K β_1	KM _{III}	89.733	0.16842	2	76 Os	KO _{II,III}	KO _{II,III}	73.808
0.13892	2	84 Po	K β_3	KN _{II}	89.25	0.168542	2	77 Ir	KN _{IV,V}	KN _{IV,V}	73.615
0.14014	2	88 Ra	K α_1	KM _{II}	88.47	0.168906	6	76 Os	K β_2^I	KM _{III}	73.5608
0.1408	1	82 Pb	K	KL _{III}	88.06	0.16910	1	76 Os	K β_2^{II}	KN _{III}	73.402
0.140880	5	82 Pb	Abs. edge	KP	88.05	0.169367	2	77 Ir	K β_3	KN _{II}	73.318
0.141012	8	82 Pb	KO _{II,III}	Abs. edge	87.922	0.170136	2	81 Tl	K α_1	KM _{II}	73.2027
0.14111	1	83 Bi	K β_5	KO _{II,III}	87.860	0.170294	2	82 Pb	K α_2	KL _{III}	72.8715
0.14141	2	89 Ac	K α_2	KM _{IV,V}	87.67	0.17245	1	76 Os	K β_5^I	KL _{II}	72.8042
0.14155	3	82 Pb	K β_4	KL _{II}	87.59	0.17262	1	76 Os	K β_5^{II}	KM _V	71.895
0.14191	1	82 Pb	K β_2^I	KN _{IV,V}	87.364	0.17302	1	75 Re	K	KM _{IV}	71.824
0.141948	3	83 Bi	K β_1	KN _{III}	87.343	0.17308	1	75 Re	Abs. edge	Abs. edge	71.658
0.14212	2	82 Pb	K β_2^{II}	KM _{III}	87.33	0.173611	3	75 Os	KO _{II,III}	KO _{II,III}	71.633
0.142779	7	83 Bi	K β_3	KN _{II}	86.834	0.17362	2	75 Re	KM _{III}	KM _{III}	71.410
0.14399	3	87 Fr	K α_1	KM _{II}	86.10	0.174054	6	75 Re	KN _{IV,V}	KN _{IV,V}	71.232
0.14495	1	81 Tl	K	KL _{III}	85.533	0.17425	1	75 Os	K β_2^I	KN _{III}	71.151
0.14495	3	82 Pb	K β_5^I	Abs. edge	85.53	0.174431	3	75 Os	K β_2^{II}	KN _{II}	71.077
0.14509	1	81 Tl	KM _V	KM _V	85.451	0.175036	2	81 Tl	K α_2	KM _{II}	70.8319
0.14512	2	82 Pb	K β_5^{II}	KO _{II,III}	85.43	0.175068	3	80 Hg	K α_1	KL _{II}	70.819
				KM _{IV}						KL _{III}	

† See footnote to Table 7f-1, p. 7-99.

0.195904	77 Ir	K α_2	KL _{II}	63.2867	0.264332	5	63 Eu	K β_3	KM _{II}	46.9036
0.19607	72 Hf	K β_1	KM _{III}	63.284	0.26464	5	62 Sm	K	Abs. edge	46.849
0.196794	76 Os	K α_1	KL _{II}	63.0005	0.26491	3	62 Sm	K α_2	KO _{II,III}	46.801
0.19686	72 Hf	K β_2	KM _{II}	62.98	0.265486	2	67 Ho	K α_1	KL _{II}	46.6997
0.1969	71 Lu	K β_3	KN _{II,III}	62.97	0.2662	1	62 Sm	K β_2	KN _{II,I}	46.57
0.20084	71 Lu	K β_5	KM _{IV,V}	61.732	0.269533	2	66 Dy	K α_1	KL _{II}	45.9984
0.201639	76 Os	K α_2	KL _{II}	61.4867	0.27111	3	62 Sm	K β_6	KM _{IV,V}	45.731
0.20224	70 Yb	K	Abs. edge	61.30	0.27301	2	62 Sm	K β_1	KM _{III}	45.413
0.20226	70 Yb		KO _{II,III}	61.298	0.27376	2	62 Sm	K β_3	KM _{II}	45.289
0.20231	71 Lu	K β_1	KM _{III}	61.283	0.274247	2	66 Dy	K α_2	KL _{II}	45.2078
0.202781	75 Re	K α_1	KL _{II}	61.1403	0.27431	5	61 Pm	K	Abs. edge	45.198
0.20309	71 Lu	K β_3	KM _{II}	61.05	0.2759	1	61 Pm	K β_2	KN _{II,III}	44.93
0.2033	70 Yb	K β_2	KN _{II,III}	60.89	0.278724	2	65 Tb	K α_1	KL _{II}	44.4816
0.20739	70 Yb	K β_5	KM _{IV,V}	59.782	0.28290	3	61 Pm	K β_1	KM _{III}	43.826
0.207611	75 Re	K α_2	KL _{II}	59.779	0.283423	3	65 Tb	K α_2	KL _{II}	43.7441
0.20880	69 Tm	K	Abs. edge	59.38	0.28363	4	61 Pm	K β_3	KM _{II}	43.713
0.20884	70 Yb	K β_1	KM _{III}	59.37	0.28453	4	60 Nd	K	Abs. edge	43.574
0.20891	69 Tm		KO _{II,III}	59.346	0.2861	5	60 Nd	K β_2	KN _{II,III}	43.32
0.2090100	74 W	K α_1	KL _{II}	59.31824	0.288353	1	60 Nd	K α_1	KN _{II,III}	42.9962
0.2096	70 Yb	K β_3	KM _{II}	59.14	0.293338	2	64 Gd	K α_2	KL _{II}	42.3089
0.2098	69 Tm	K β_2	KN _{II,III}	59.09	0.293299	2	60 Nd	K β_1	KM _{III}	42.2713
0.213828	74 W	K α_2	KL _{II}	57.9817	0.294227	2	60 Nd	K β_3	KM _{II}	42.1665
0.21404	69 Tm	K β_5	KM _{IV,V}	57.933	0.29518	3	60 Nd	K	Abs. edge	42.002
0.215497	73 Ta	K α_1	KL _{II}	57.532	0.29679	2	59 Pr	K β_2	KN _{II,III}	41.773
0.21556	69 Tm	K β_1	KM _{III}	57.517	0.298446	2	63 Eu	K α_1	KL _{II}	41.5422
0.21567	68 Er	K	Abs. edge	57.487	0.303118	2	63 Eu	K α_2	KL _{II}	40.9019
0.21581	68 Er		KO _{II,III}	57.480	0.304261	4	59 Pr	K β_1	KM _{III}	40.7482
0.21592	74 W	K β_3	KL _I	57.42	0.304975	5	59 Pr	K β_3	KM _{II}	40.6529
0.21636	69 Tm	K β_2	KM _{II}	57.304	0.30648	5	58 Ce	K	Abs. edge	40.453
0.2167	68 Er	K β_5	KN _{II,III}	57.21	0.30638	2	58 Ce	K β_4^I	KO _{II,III}	40.427
0.220305	73 Ta	K α_2	KL _{II}	56.277	0.30737	2	58 Ce	K β_2	KN _{IV,V}	40.337
0.22124	68 Er	K β_6	KM _{IV,V}	56.040	0.30816	2	58 Ce	K β_1	KN _{II,III}	40.233
0.222227	72 Hf	K α_1	KL _{II}	55.7902	0.309040	1	62 Sm	K α_1	KL _{II}	40.1181
0.22266	68 Er	K β_1	KM _{III}	55.681	0.31342	2	58 Ce	K β_5^I	KM _V	39.558
0.22291	67 Ho	K	Abs. edge	55.619	0.31357	2	58 Ce	K β_5^{II}	KM _{IV}	39.539
0.22305	67 Ho		KO _{II,III}	55.584	0.313698	2	62 Sm	K α_2	KL _{II}	39.5224
0.22341	68 Er	K β_3	KM _{II}	55.464	0.315816	2	58 Ce	K β_1	KM _{III}	39.2573
0.2241	67 Ho	K β_2	KN _{II,III}	55.32	0.316520	4	58 Ce	K β_3	KM _{II}	39.1701
0.227024	72 Hf	K α_2	KL _{II}	54.6114	0.31844	5	57 La	K	Abs. edge	38.934

TABLE 7f-2. WAVELENGTHS OF X-RAY EMISSION LINES AND ABSORPTION EDGES: IN NUMERICAL ORDER (Continued)

Wavelength, Å*	p.e.†	Element	Designation	keV	Wavelength, Å*	p.e.†	Element	Designation	keV
0.31864	2	57 La	K β_4^I	38.909	0.451295	3	52 Te	K α_1	27.4723
0.31931	2	57 La	K β_2	38.828	0.454545	4	49 In	K M_{III}	27.2759
0.320117	7	57 La	K α_1	38.7299	0.455181	4	49 In	K M_{II}	27.2377
0.320160	4	61 Pm	K L_{III}	38.7247	0.455784	3	52 Te	K L_{II}	27.2017
0.324803	4	61 Pm	K α_2	38.1712	0.46407	1	48 Cd	Abs. edge	26.7159
0.32546	2	57 La	K β_5^I	38.094	0.465328	7	48 Cd	K $N_{II,III}$	26.6438
0.32563	2	57 La	K β_5^{II}	38.074	0.470354	3	51 Sb	K L_{III}	26.3591
0.327983	3	57 La	K β_1	37.8010	0.474827	3	51 Sb	K L_{II}	26.1108
0.328686	4	57 La	K β_3	37.7202	0.475105	6	48 Cd	K M_{III}	26.0955
0.33104	1	56 Ba	K	37.452	0.475730	5	48 Cd	K M_{II}	26.0612
0.33127	2	56 Ba	Abs. edge	37.426	0.48589	1	47 Ag	K	25.5165
0.331846	2	60 Nd	K α_1	37.3610	0.4859	9	47 Ag	K β_4	25.512
0.33229	2	56 Ba	K β_4^{II}	37.311	0.487032	4	47 Ag	K β_2	25.4564
0.33277	1	56 Ba	K β_2	37.257	0.490599	3	50 Sn	K α_1	25.2713
0.336472	2	60 Nd	K α_2	36.8474	0.49306	2	47 Ag	K β_5	25.145
0.33814	2	56 Ba	K β_5^I	36.666	0.495053	3	50 Sn	K α_2	25.0440
0.33835	2	56 Ba	K β_5^{II}	36.643	0.497069	4	47 Ag	K β_1	24.9424
0.340811	3	56 Ba	K β_1	36.3782	0.497685	4	47 Ag	K β_3	24.9115
0.341507	4	56 Ba	K β_3	36.3040	0.5092	1	46 Pd	K	24.348
0.344140	2	59 Pr	K α_1	36.0263	0.5093	2	46 Pd	K β_4	24.346
0.34451	1	55 Cs	K	35.987	0.510228	4	46 Pd	K β_2	24.2991
0.34611	2	55 Cs	K β_2	35.822	0.512113	3	49 In	K L_{III}	24.2097
0.348749	2	59 Pr	K α_2	35.5502	0.516544	3	49 In	K L_{II}	24.0020
0.354364	7	55 Cs	K β_1	34.9869	0.51670	9	46 Pd	K $M_{IV,V}$	23.995
0.355050	4	55 Cs	K β_3	34.9194	0.520520	4	46 Pd	K M_{III}	23.8187
0.357092	2	58 Ce	K α_1	34.7197	0.521123	4	46 Pd	K M_{II}	23.7911
0.3584	5	54 Xe	K	34.59	0.53395	1	45 Rh	K	23.2198
0.36026	3	54 Xe	K β_2	34.415	0.53401	9	45 Rh	Abs. edge	23.217
0.361683	2	58 Ce	K α_2	34.2789	0.535010	3	48 Cd	K $N_{IV,V}$	23.1736
0.36872	2	54 Xe	K β_1	33.624	0.53503	2	45 Rh	K $L_{III,II}$	23.1728
0.36941	2	54 Xe	K β_3	33.562	0.53513	5	45 Rh	K $N_{II,III}$	23.168
0.370737	2	57 La	K α_1	33.4418	0.5365	1	94 Pu	K N_{II}	23.109
0.37381	1	53 I	K	33.1665	0.539422	3	48 Cd	Abs. edge	22.9841
			Abs. edge					K L_{II}	

0.37523	2	53 I	K β_2	KN _{II,III}	33.042	0.54101	9	45 Rh	K β_1^I	KM _V	22.917
0.375313	2	57 La	K α_2	KL _{II}	33.0341	0.54118	9	45 Rh	K β_2^{II}	KM _{IV}	22.909
0.383905	4	53 I	K β_1	KM _{III}	32.2947	0.5416	1	94 Pu	L γ_4	L _I O _{III}	22.891
0.384564	4	53 I	K β_3	KM _{II}	32.2394	0.54311	2	95 Am	L γ_6	L _{II} O _{IV}	22.8282
0.385111	4	56 Ba	K α_1	KL _{III}	32.1936	0.5432	1	94 Pu	L γ_4'	L _I O _{II}	22.823
0.389668	5	56 Ba	K α_2	KL _{II}	31.8171	0.545605	4	45 Rh	K β_1	KM _{III}	22.7236
0.38974	1	52 Te	K	KO _{II,III}	31.8114	0.546200	4	45 Rh	K β_3	KM _{II}	22.6989
0.38974	1	52 Te	K	Abs. edge	31.8114	0.5544	2	95 Am	L γ_2	L _I N _{II}	22.361
0.391102	6	52 Te	K β_2	KN _{II,III}	31.7004	0.5572	1	94 Pu	L _{II}	Abs. edge	22.253
0.399995	5	52 Te	K β_1	KM _{III}	30.9957	0.5585	5	93 Np	L γ_4	L _I O _{II,III}	22.20
0.400290	4	55 Cs	K α_1	KL _{III}	30.9728	0.5594075	6	47 Ag	K α_1	KL _{III}	22.16292
0.400659	4	52 Te	K β_3	KM _{II}	30.9443	0.55973	2	94 Pu	L γ_6	L _{II} O _{IV}	22.1562
0.404835	4	55 Cs	K α_2	KL _{II}	30.6251	0.56051	1	44 Ru	K	Abs. edge	22.1163
0.40666	1	51 Sb	K	KO _{II,III}	30.4875	0.56089	9	44 Ru	K β_4	KN _{IV,V}	22.104
0.40668	1	51 Sb	K	Abs. edge	30.4860	0.56166	3	44 Ru	K β_2	KN _{II,III}	22.074
0.40702	1	51 Sb	K β_4^I	KN _{IV,V}	30.4604	0.561886	9	95 Am	L γ_1	L _{II} N _{IV}	22.0652
0.407973	5	51 Sb	K β_2	KN _{II,III}	30.3895	0.563798	4	47 Ag	K α_2	KL _{II}	21.9903
0.41378	1	51 Sb	K β_5^I	KM _V	29.9632	0.564001	9	94 Pu	L γ_3	L _I N _{III}	21.9824
0.41388	1	51 Sb	K β_5^{II}	KM _{IV}	29.9560	0.5658	1	94 Pu	L γ_8	L _{II} O _I	21.914
0.41634	2	54 Xe	K α_1	KL _{II}	29.779	0.56785	9	44 Ru	K β_5^I	KM _V	21.834
0.417085	3	51 Sb	K β_1	KM _{III}	29.7256	0.5680	2	44 Ru	K β_5^{II}	KM _{IV}	21.829
0.417737	4	51 Sb	K β_3	KM _{II}	29.6792	0.5695	1	92 U	L _I	Abs. edge	21.771
0.42087	2	54 Xe	K α_2	KL _{II}	29.458	0.5706	1	92 U	L γ_{13}	L _I P _{II,III}	21.729
0.42467	3	50 Sn	K	KO _{II,III}	29.195	0.57068	2	94 Pu	L γ_2	L _I N _{II}	21.1251
0.42467	1	50 Sn	K	Abs. edge	29.1947	0.572482	4	44 Ru	K β_1	KM _{III}	21.6568
0.42495	3	50 Sn	K β_4^I	KN _{IV,V}	29.175	0.5725	1	92 U	K β_1	L _I O _{IV,V}	21.657
0.425915	8	50 Sn	K β_2	KN _{II,III}	29.1093	0.573067	4	44 Ru	K β_2	KM _{II}	21.6346
0.43175	3	50 Sn	K β_5^I	KM _V	28.716	0.57499	9	92 U	L γ_4	L _I O _{II}	21.562
0.43184	3	50 Sn	K β_5^{II}	KM _{IV}	28.710	0.575700	9	92 U	L γ_4'	L _I O _{II}	21.4984
0.433318	5	53 I	K α_1	KL _{III}	28.6120	0.57699	5	93 Np	L γ_6	L _{II} O _{IV}	21.488
0.435236	5	50 Sn	K β_1	KM _{III}	28.4860	0.578882	9	94 Pu	L γ_1	L _{II} N _{IV}	21.4173
0.435877	5	50 Sn	K β_3	KM _{II}	28.4440	0.5810	5	93 Np	L γ_3	L _I N _{III}	21.34
0.437829	7	53 I	K α_2	KL _{II}	28.3172	0.585448	3	43 Pd	K α_1	KL _{II}	21.1771
0.44371	1	49 In	K	Abs. edge	27.9420	0.5873	5	93 Np	L γ_2	L _I N _{II}	21.11
0.44374	3	49 In	KO _{II,III}	KO _{II,III}	27.940	0.58906	1	43 Te	K	Abs. edge	21.0473
0.44393	4	49 In	KN _{IV,V}	KN _{IV,V}	27.928	0.589821	3	43 Pd	K α_2	KL _{II}	21.0201
0.44500	1	49 In	KN _{II,III}	KN _{II,III}	27.8608	0.58986	5	92 U	L γ_{11}	L _I N _V	21.019
0.45086	2	49 In	KM _V	KM _V	27.499	0.59024	5	43 Te	K β_2	KN _{II,III}	21.005
0.45098	2	49 In	K β_5^{II}	KM _{IV}	27.491	0.59096	5	92 U	L _I N _{IV}	L _I N _{IV}	20.979

TABLE 7f-2. WAVELENGTHS OF X-RAY EMISSION LINES AND ABSORPTION EDGES: IN NUMERICAL ORDER (Continued)

Wavelength, Å*	p.e.†	Element	Designation	keV	Wavelength, Å*	p.e.†	Element	Designation	keV	Wavelength, Å*	p.e.†	Element	Designation	keV
0.5919	1	92 U	L _{II}	20.945	0.66576	2	41 Nb	Kβ ₁	18.6225					
0.59203	5	92 U	Abs. edge	20.942	0.66534	3	41 Nb	Kβ ₃	18.6063					
0.5930	2	92 U	L _{II} P _{IV}	20.906	0.6656	1	83 Ra	L _{II} N _{IV}	18.600					
0.5937	1	91 Pa	L _{II} P _{II,III}	20.882	0.66871	2	94 Pu	L _I M _{III}	18.5405					
0.594845	9	92 U	L _{II} O _{I,III}	20.8426	0.6707	1	83 Ra	Abs. edge	18.486					
0.596498	9	93 Np	L _{II} O _{IV}	20.7848	0.6714	1	83 Ra	L _{II} P _{III,II}	18.466					
0.59728	5	92 U	L _{II} O _{III}	20.758	0.6724	1	83 Ra	L _{II} P _I	18.439					
0.598574	9	92 U	L _I N _{III}	20.7127	0.67328	5	83 Ra	L _{II} O _{IV}	18.414					
0.5988	1	94 Pu	L _{II} N _I	20.704	0.67351	9	89 Ac	L _{II} N _{IV}	18.408					
0.60125	5	92 U	L _{II} O _I	20.621	0.67383	2	95 Am	L _{III} O _{IV,V}	18.3996					
0.60130	4	43 Tc	Kβ ₁	20.619	0.67491	4	90 Th	L _{II} N _I	18.370					
0.60188	4	43 Tc	Kβ ₃	20.599	0.67502	3	43 Tc	Kα ₁	18.3671					
0.6031	1	92 U	L _{II} N _{VI}	20.556	0.67538	5	88 Ra	L _I N _{III}	18.357					
0.605237	9	92 U	L _I N _{II}	20.4847	0.6764	1	88 Ra	L _{II} O _{III}	18.330					
0.6059	1	90 Th	Abs. edge	20.464	0.67772	2	94 Pu	L _{II} O _{III}	18.2937					
0.60705	8	90 Th	L _I P _{II,III}	20.424	0.6780	1	88 Ra	L _{II} M _{IV}	18.286					
0.6083	1	90 Th	L _I O _{IV,V}	20.383	0.67932	3	43 Tc	L _{II} O _{II}	18.2508					
0.61098	4	90 Th	L _I O _{III}	20.292	0.6801	1	88 Ra	L _{II} O _I	18.230					
0.61251	4	90 Th	L _I O _{II}	20.242	0.681014	8	92 U	L _I M _V	18.2054					
0.6133	1	91 Pa	L _{II} O _{IV}	20.216	0.68199	5	88 Ra	L _I N _{II}	18.179					
0.613279	4	45 Rh	KL _{III}	20.2161	0.68639	2	95 Am	L _I M _{II}	18.0627					
0.6146	1	90 Th	L _I O _I	20.174	0.6867	1	94 Pu	Abs. edge	18.054					
0.614770	9	92 U	L _{II} N _{IV}	20.1671	0.6874	1	88 Ra	L _I N _I	18.036					
0.6160	1	90 Th	L _I N _{VI,VII}	20.128	0.68760	5	92 U	L _I M _{IV}	18.031					
0.616	1	93 Np	L _{II} N _I	20.12	0.68883	1	40 Zr	Abs. edge	17.9989					
0.6169	1	91 Pa	L _{II} N _{III}	20.098	0.68901	5	40 Zr	Kβ ₄	17.994					
0.617630	4	45 Rh	Kα ₂	20.0737	0.68920	9	93 Np	L _I M _{III}	17.989					
0.61978	1	42 Mo	K	20.0039	0.68993	4	40 Zr	Kβ ₂	17.970					
0.62001	9	42 Mo	Abs. edge	19.996	0.69068	2	94 Pu	L _{III} O _{IV,V}	17.9506					
0.62099	2	42 Mo	Kβ ₄ ^I	19.9652	0.6932	1	88 Ra	L _{II} N _V	17.884					
0.62107	5	42 Mo	Kβ ₂	19.963	0.69463	5	88 Ra	L _{II} N _{IV}	17.849					
0.6228	1	92 U	Kβ ₂ ^{II}	19.907	0.6959	1	40 Zr	Kβ ₅	17.815					
0.6239	1	91 Pa	L _{II} N _{III}	19.872	0.698478	9	93 Np	L _{II} M _{IV}	17.7502					

0.62636	90 Th	L _{II} N _V	19.794	0.7003	1	94 Pu	L _{II} O _I	17.705
0.62692	42 Mo	KM _V	19.776	0.701390	9	95 Am	L _{III} N _V	17.6765
0.62708	42 Mo	KM _{IV}	19.771	0.70173	3	40 Zr	Kβ _{III}	17.6678
0.6276	90 Th	L _{II} N _{IV}	19.755	0.7018	1	91 Pa	L _I M _V	17.667
0.6299	90 Th	Abs. edge	19.683	0.70228	4	40 Zr	Kβ _{II}	17.654
0.62991	90 Th	L _{II} P _{IV}	19.682	0.7031	1	94 Pu	Kβ _I	17.635
0.6312	90 Th	L _{III} P _{III,III}	19.642	0.70341	2	95 Am	L _{III} N _{VI,VII}	17.6258
0.6316	90 Th	L _{III} P _I	19.629	0.7043	2	88 Ra	L _{III} N _{IV}	17.604
0.632288	42 Mo	Kβ _{III}	19.6083	0.70620	1	94 Pu	L _{II} M _{II}	17.5560
0.63258	90 Th	L _{III} O _{IV}	19.599	0.70814	2	93 Np	L _{III} O _{IV,V}	17.5081
0.632872	42 Mo	Kβ _{II}	19.5903	0.7088	2	91 Pa	L _I M _{IV}	17.492
0.63358	91 Pa	L _{III} N _{IV}	19.568	0.709300	1	42 Mo	Kα _I	17.47934
0.63557	92 U	L _{III} N _I	19.5072	0.71029	2	42 Mo	Kα _{II}	17.4550
0.63559	90 Th	L _{II} N _{III}	19.507	0.713590	6	42 Mo	Kα ₂	17.3743
0.6356	90 Th	L _{III} O _{III}	19.506	0.71652	9	87 Fr	L _{II} N _{IV}	17.303
0.6369	90 Th	L _{III} O _{II}	19.466	0.71774	5	88 Ra	L _{II} N _I	17.274
0.63898	90 Th	L _{III} O _I	19.403	0.71851	8	94 Pu	L _{III} N _V	17.2553
0.64064	90 Th	L _{III} N _{VI}	19.353	0.719984	8	94 Pu	L _{III} M _{IV}	17.2200
0.6416	94 Pu	L _I M _V	19.323	0.7205	1	94 Pu	L _{III} N _{IV}	17.208
0.64221	44 Ru	L _{II} N _{II}	19.305	0.7223	1	92 U	Abs. edge	17.165
0.643083	44 Ru	Kα _I	19.2792	0.72240	5	92 U	L _{III} P _{IV,V}	17.162
0.6445	88 Ra	L _I	19.236	0.7234	1	90 Th	L _I M _V	17.139
0.64513	88 Ra	L _{II}	19.218	0.72426	5	92 U	L _{III} P _I	17.118
0.6468	88 Ra	L _{III}	19.167	0.72521	5	92 U	L _{III} P _{II,III}	17.096
0.647408	44 Ru	Kα ₂	19.1504	0.726305	2	92 U	L _{III} O _{IV,V}	17.0701
0.64755	90 Th	Lβ ₁₀	19.146	0.72671	9	93 Np	L _I M _{II}	17.038
0.6482	94 Pu	Lβ ₉	19.126	0.72766	5	39 Y	Abs. edge	17.036
0.64891	95 Am	Lβ ₈	19.1059	0.72776	5	39 Y	Kβ ₄	17.0154
0.64965	88 Ra	Lγ ₄	19.084	0.72864	4	39 Y	Kβ ₃	16.981
0.65131	88 Ra	Lγ ₄ '	19.036	0.7301	1	90 Th	L _I M _{IV}	16.962
0.6521	90 Th	K	19.014	0.7309	1	92 U	L _{III} O _{III}	16.930
0.65298	41 Nb	Lγ ₁	18.9869	0.73230	5	91 Pa	L _I M _{III}	16.907
0.65313	90 Th	Kβ ₄	18.9825	0.7333	1	92 U	L _{III} O _{II}	16.8870
0.65318	41 Nb	Kβ ₃	18.981	0.73418	2	95 Am	L _{III} N _I	16.879
0.65416	41 Nb	Kβ ₂	18.953	0.7345	2	39 Y	Kβ ₅	16.845
0.6550	91 Pa	Lγ ₅	18.930	0.73602	6	92 U	L _{III} O _I	16.840
0.657655	95 Am	Lβ ₁	18.8520	0.736230	9	93 Np	L _{III} N _V	16.800
0.6620	90 Th	Lγ ₁₁	18.729	0.738603	9	92 U	L _{III} N _{VI,VII}	16.7859
0.6654	88 Ra	Lγ ₁₁	18.633	0.73928	9	86 Rn	L _{III} N _{IV}	16.770

TABLE 7I-2. WAVELENGTHS OF X-RAY EMISSION LINES AND ABSORPTION EDGES: IN NUMERICAL ORDER (Continued)

Wavelength, \AA^*	p.e.†	Element	Designation	keV	Wavelength, \AA^*	p.e.†	Element	Designation	keV
0.74072	2	39 Y	K β_1	16.7378	0.7973	1	83 Bi	L γ_1	15.551
0.74126	3	39 Y	K β_2	16.7258	0.8022	1	83 Bi	L γ_2	15.456
0.74232	5	91 Pa	L γ_1	16.702	0.80233	9	82 Pb	L γ_{11}	15.453
0.74503	5	92 U	L β_1	16.641	0.80273	5	88 Ra	L β_1	15.4449
0.7452	2	91 Pa	L β_2	16.636	0.8028	1	88 Ra	L β_2	15.444
0.74620	1	41 Nb	K α_1	16.6151	0.80364	7	82 Pb	Abs. edge	15.427
0.747985	9	92 U	L β_1	16.5753	0.8038	1	88 Ra	L γ_1	15.425
0.75044	1	41 Nb	K α_2	16.5210	0.80509	1	88 Ra	L γ_2	15.402
0.75148	2	94 Pu	L β_1	16.4983	0.80527	2	92 U	L γ_1	15.3997
0.7546	2	91 Pa	L β_2	16.431	0.8079	5	88 Ra	L β_1	15.3771
0.754681	9	92 U	L β_1	16.4283	0.8081	1	91 Pa	L β_2	15.347
0.75479	3	90 Th	L β_2	16.4258	0.8082	1	81 Th	L β_1	15.341
0.756642	9	92 U	L β_1	16.3857	0.80861	5	81 Th	Abs. edge	15.3327
0.75690	3	83 Bi	L γ_1	16.3802	0.81163	9	90 Th	L γ_1	15.276
0.7571	1	83 Bi	L γ_2	16.376	0.81184	5	81 Th	L γ_2	15.2716
0.7579	1	90 Th	L γ_1	16.359	0.81308	5	81 Th	L γ_1	15.2482
0.75791	5	83 Bi	L γ_2	16.358	0.81311	2	83 Bi	L γ_2	15.2477
0.7591	1	94 Pu	L γ_1	16.333	0.81375	5	88 Ra	L γ_1	15.2358
0.7607	1	90 Th	L γ_2	16.299	0.8147	1	82 Pb	L γ_2	15.218
0.76087	9	90 Th	Abs. edge	16.295	0.81538	5	82 Pb	Abs. edge	15.2053
0.76087	3	83 Bi	L γ_1	16.2947	0.8154	2	37 Rb	K β_1	15.205
0.76198	3	83 Bi	L γ_2	16.2709	0.81554	5	37 Rb	K	15.198
0.7625	2	90 Th	L γ_1	16.260	0.8158	1	81 Th	L γ_1	15.1969
0.76289	9	85 At	L γ_1	16.251	0.81583	5	82 Pb	L γ_1	15.190
0.76338	5	90 Th	L γ_2	16.241	0.8162	1	88 Ra	L β_1	15.1854
0.7641	5	83 Bi	L γ_1	16.23	0.81645	3	37 Rb	K β_2	15.1783
0.7645	2	84 Po	L γ_1	16.218	0.81683	5	82 Pb	L γ_1	15.146
0.76468	5	90 Th	L β_1	16.213	0.8186	1	88 Ra	L γ_2	15.138
0.765210	9	90 Th	L β_2	16.2022	0.8190	2	90 Th	L γ_1	15.120
0.76857	5	88 Ra	L β_1	16.131	0.8200	1	82 Pb	L γ_1	15.101
0.769	1	93 Np	L β_1	16.13	0.8210	2	82 Pb	L γ_2	15.085
0.7690	1	90 Th	L β_2	16.123	0.8219	1	37 Rb	K β_1	
0.7691	1	92 U	L β_1	16.120					

0.76973	38 Sr	K	Abs. edge	16.107	0.82327	7	82 Pb	$L_{II}N_{VI}$	15.060
0.7699	91 Pa	$L\beta_4$	$L_{II}M_{II}$	16.104	0.82365	5	82 Pb	$L_{III}O_1$	15.0527
0.76989	38 Sr	$K\beta_4$	$KN_{IV,V}$	16.104	0.8248	1	83 Bi	$L_{III}N_{III}$	15.031
0.77081	38 Sr	$K\beta_3$	$KN_{II,III}$	16.0846	0.82789	9	87 Fr	$L_I M_{III}$	14.976
0.7713	90 Th		$L_{III}O_{II}$	16.074	0.82790	8	90 Th	$L_{III}M_{II}$	14.975
0.772	84 Po	$L\gamma_3$	$L_{II}N_{II}$	16.07	0.82859	7	82 Pb	$L_{II}N_1$	14.963
0.7737	91 Pa	$L\beta_2$	$L_{III}N_{IV}$	16.024	0.82868	2	37 Rb	$K M_{III}$	14.9613
0.77437	90 Th	$L\beta_1$	$L_{III}O_1$	16.0105	0.82879	5	81 Tl	$L_{II}N_7$	14.9593
0.77546	88 Ra	$L\beta_{10}$	$L_I M_{IV}$	15.988	0.82884	1	39 Y	$K L_{II}$	14.9584
0.7764	38 Sr	$K\beta_5$	$K M_{IV,V}$	15.969	0.82921	3	37 Rb	$K M_{II}$	14.9517
0.77661	90 Th	$L\alpha$	$L_{II}N_{VI,VII}$	15.964	0.8295	1	91 Pa	$L_{II}M_1$	14.946
0.77728	83 Bi	$L\gamma_{II}$	$L_{II}N_V$	15.951	0.83001	7	81 Tl	$L_{II}N_{IV}$	14.937
0.77822	89 Ac	$L\beta_3$	$L_I M_{III}$	15.931	0.83005	1	39 Y	$K L_{II}$	14.8829
0.77954	83 Bi		$L_{II}N_{IV}$	15.904	0.8338	1	90 Th	$L_{II}M_{II}$	14.869
0.78017	92 U		$L_{III}N_{II}$	15.892	0.8344	9	83 Bi	$L_{II}N_{II}$	14.86
0.7809	93 Np	$L\eta$	$L_{II}M_1$	15.876	0.8350	2	80 Hg	$L_{II}O_{IV,V}$	14.847
0.78196	82 Pb	L_I	Abs. edge	15.855	0.8353	1	80 Hg	Abs. edge	14.842
0.78257	82 Pb		$L_{II}O_{IV,V}$	15.843	0.83537	5	88 Ra	$L_{III}N_7$	14.8414
0.78292	38 Sr	$K\beta_1$	$K M_{III}$	15.8357	0.83722	5	88 Ra	$L_{III}M_{IV}$	14.8086
0.78345	38 Sr	$K\beta_3$	$K M_{II}$	15.8249	0.8382	2	82 Pb	$L_{II}N_V$	14.791
0.7858	82 Pb	$L\gamma_4$	$L_I O_{III}$	15.777	0.83894	7	80 Hg	$L_{II}O_{II}$	14.778
0.78593	40 Zr	$K\alpha_1$	$K L_{III}$	15.7751	0.83923	5	83 Bi	$L_{II}N_1$	14.7732
0.78706	82 Pb	$L\gamma_3'$	$L_I O_{II}$	15.752	0.83940	9	87 Fr	$L_{II}M_{IV}$	14.770
0.78748	84 Po	$L\gamma_{II}$	$L_{II}N_{IV}$	15.744	0.83973	3	82 Pb	$L_{II}N_{IV}$	14.7644
0.78838	92 U	$L\beta_5$	$L_{III}N_1$	15.7260	0.84013	7	80 Hg	$L_{II}N_V$	14.757
0.7884	82 Pb		$L_I N_{VI,VII}$	15.725	0.84071	5	88 Ra	$L_I M_{II}$	14.7472
0.7887	83 Bi	L_{II}	Abs. edge	15.719	0.84130	4	81 Tl	$L_{II}N_{III}$	14.7368
0.78903	89 Ac	$L\beta_1$	$L_{II}M_{IV}$	15.713	0.8434	1	81 Tl	Abs. edge	14.699
0.78917	83 Bi	$L\gamma_2$	$L_{II}N_{III}$	15.7102	0.8438	1	88 Ra	$L_{II}M_{III}$	14.692
0.7897	82 Pb		$L_I O_1$	15.699	0.8442	2	81 Tl	$L_{II}O_{IV}$	14.685
0.79015	40 Zr	$K\alpha_2$	$K L_{II}$	15.6909	0.8452	2	80 Hg	$L_I O_1$	14.670
0.79043	83 Bi	$L\gamma_6$	$L_{II}O_{IV}$	15.6853	0.84773	5	81 Tl	$L_I N_{II}$	14.6251
0.79257	90 Th	$L\beta_4$	$L_I M_{II}$	15.6429	0.848187	9	95 Am	$L_{III}M_V$	14.6172
0.79257	40 Th	$L\beta_{17}$	$L_{II}M_{III}$	15.629	0.8490	1	81 Tl	$L_{II}O_{II}$	14.604
0.79354	90 Th	$L\beta_2$	$L_{III}M_V$	15.6237	0.85048	5	81 Tl	$L_{II}N_{VI}$	14.5777
0.79384	83 Bi		$L_{II}O_{III}$	15.6178	0.8512	1	88 Ra	$L_{III}N_{III}$	14.566
0.79539	90 Th	$L\beta_{15}$	$L_{III}N_{IV}$	15.5875	0.8513	2	81 Tl	$L_{II}O_1$	14.564
0.79565	83 Bi	$L\gamma_2$	$L_I N_{II}$	15.5824	0.85192	7	82 Pb	$L_{II}N_{III}$	14.553
0.79721	83 Bi	$L\beta_2$	$L_{II}N_{VI}$	15.552	0.85436	9	86 Rn	$L_I M_{III}$	14.512

TABLE 7i-2. WAVELENGTHS OF X-RAY EMISSION LINES AND ABSORPTION EDGES: IN NUMERICAL ORDER (Continued)

Wavelength, Å*	p.e.†	Element	Designation	keV	Wavelength, Å*	p.e.†	Element	Designation	keV
0.85446	4	90 Th	L _{II} M _I	14.5099	0.9234	1	83 Bi	L _{III}	13.426
0.8549	1	81 Tl	L _{II} N _I	14.503	0.9236	1	77 Ir	Abs. edge	13.423
0.85657	7	80 Hg	L _I N _V	14.474	0.92413	4	83 Bi	L _{III} P _{II,III}	13.4159
0.858	2	87 Fr	L _{III} N _V	14.45	0.9243	3	77 Ir	L _I O _{IV,V}	13.413
0.8585	3	82 Pb	L _{III} N _{II}	14.442	0.92453	7	80 Hg	L _{II} N _I	13.410
0.860266	9	95 Am	L _{III} N _{IV}	14.4119	0.9255	1	35 Br	KM _{IV,V}	13.396
0.8618	1	88 Ra	L _{III} N _{VII}	14.387	0.925553	9	37 Rb	KL _{II}	13.3953
0.86376	5	79 Au	Abs. edge	14.3537	0.92556	3	83 Bi	L _{III} O _{IV,V}	13.3817
0.86460	5	79 Au	L _I O _{IV,V}	14.3497	0.92650	3	79 Au	L _{II} N _{IV}	13.377
0.8653	2	36 Kr	K _{N_{IV,V}}	14.328	0.9268	1	82 Pb	L _I M _V	13.377
0.86552	1	36 Kr	Abs. edge	14.3244	0.92744	3	77 Ir	L _I O _{II}	13.3681
0.86645	9	86 Rn	L _{III} M _{IV}	14.316	0.92791	5	78 Pt	L _I N _{III}	13.3613
0.8661	1	36 Kr	K _{N_{II,III}}	14.315	0.92831	3	77 Ir	L _I O _{II}	13.3555
0.86635	5	82 Pb	L _{III} N _I	14.3075	0.92937	5	84 Po	L _{II} N _V	13.3404
0.86703	4	79 Au	L _I O _{II}	14.2996	0.92969	1	37 Rb	KL _{II}	13.3358
0.86752	3	81 Tl	L _{II} N _{IV}	14.2915	0.9302	2	83 Bi	L _{III} O _{II}	13.328
0.86816	4	79 Au	L _I O _{II}	14.2809	0.9312	2	84 Po	L _{III} N _{IV}	13.314
0.86830	2	94 Pu	L _{III} M _V	14.2786	0.9323	2	83 Bi	L _{III} O _{II}	13.298
0.86915	7	80 Hg	L _I N _{III}	14.265	0.93279	2	35 Br	Kβ _I	13.2914
0.87074	5	79 Au	L _I O _I	14.2385	0.93284	5	91 Pa	L _{ca}	13.2907
0.8708	2	36 Kr	KM _{IV,V}	14.238	0.93327	5	35 Br	Kβ ₂	13.2845
0.87088	5	88 Ra	L _{III} N _I	14.2362	0.9339	2	82 Pb	Lβ ₁₀	13.275
0.8722	1	80 Hg	Abs. edge	14.215	0.93414	5	78 Pt	L _{II}	13.2723
0.87319	7	83 Hg	L _{III} O _{IV}	14.199	0.9342	2	78 Pt	L _{III} O _{IV}	13.271
0.87526	1	38 Sr	KL _{III}	14.1650	0.93427	5	78 Pt	L _I N _{II}	13.2704
0.87544	7	80 Hg	L _I N _{II}	14.162	0.93505	5	83 Bi	L _{III} O _I	13.2593
0.8758	1	80 Hg	L _{III} O _{II}	14.156	0.93505	5	83 Bi	L _{III} N _{VI,VII}	13.2593
0.8784	1	80 Hg	L _{III} O _{II}	14.114	0.93855	3	83 Bi	L _I M _{III}	13.2098
0.8785	1	36 Kr	KM _{III}	14.112	0.93931	5	78 Pt	L _{III} N _{VI}	13.1992
0.87885	7	80 Hg	L _V	14.107	0.9402	2	79 Au	L _{II} N _{III}	13.186
0.8790	1	36 Kr	Kβ ₃	14.104	0.9411	1	78 Pt	L _{III} O _I	13.173
0.87943	1	38 Sr	KL _{II}	14.0979	0.94419	5	83 Bi	L _{III} M _V	13.1310
0.87995	7	80 Hg	L _{II} O _I	14.090	0.9446	2	77 Ir	L _I N _V	13.126

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0.87096	81 Tl	$L_{III}N_{III}$	14.0893	5	91 Pa	$L_{\alpha 1}$	13.1222
0.88028	94 Pu	$L_{III}M_{IV}$	14.0842	2	78 Pt	$L_{III}N_I$	13.113
0.88135	85 At	$L_{II}M_{III}$	14.067	2	77 Ir	$L_{II}N_{IV}$	13.108
0.8827	80 Hg	$L_I N_I$	14.045	3	84 Po	$L_I M_{II}$	13.086
0.88433	79 Au	$L_I N_V$	14.020	3	82 Pb	Abs. edge	13.0406
0.88563	79 Au	$L_I N_{IV}$	13.999	5	82 Pb	$L_{III}P_{II,III}$	13.0344
0.8862	81 Tl	$L_{II}M_{II}$	13.959	7	82 Pb	$L_{II}M_{IV}$	13.0235
0.889128	93 Np	$L_{III}M_{V}$	13.9441	9	83 Bi	$L_{III}O_{V,V}$	13.015
0.8931	78 Pt	Abs. edge	13.883	1	82 Pb	$L_{III}N_V$	12.9799
0.8934	78 Pt	$L_I O_V$	13.878	4	83 Bi	$L_I N_I$	12.9743
0.89349	85 At	$L_{II}M_{IV}$	13.876	3	79 Au	Abs. edge	12.972
0.8943	78 Pt	$L_{II}N_{IV}$	13.864	1	76 Os	$L_{II}M_V$	12.9687
0.89500	81 Tl	$L_{II}N_I$	13.8526	3	76 Os	$L_I O_{IV,V}$	12.9683
0.89500	80 Hg	$L_{II}N_I$	13.8526	5	76 Os	$L_I M_V$	12.9585
0.89646	80 Hg	$L_{II}N_{IV}$	13.8301	7	81 Tl	$L_I M_V$	12.9549
0.89659	78 Pt	$L_{II}O_{III}$	13.8281	5	83 Bi	$L_{II}O_{III}$	12.945
0.89747	78 Pt	$L_{II}O_{II}$	13.8145	1	82 Pb	$L_{II}O_{III}$	12.9420
0.89783	79 Au	$L_I N_{III}$	13.8090	3	78 Pt	$L_{II}N_{IV}$	12.934
0.89791	83 Bi	$L_I M_V$	13.8077	1	82 Pb	$L_{II}O_{II}$	12.934
0.8995	78 Pt	$L_I O_I$	13.784	1	77 Ir	$L_{II}N_{III}$	12.9240
0.8996	84 Po	$L_{III}O_{IV,V}$	13.782	5	76 Os	$L_I N_{III}$	12.923
0.901045	93 Np	$L_{III}M_{IV}$	13.7597	8	76 Os	$L_I O_{III}$	12.910
0.90259	79 Au	Abs. edge	13.7361	7	82 Pb	$L_I O_{II}$	12.8963
0.90297	79 Au	L_{II}	13.7304	1	82 Pb	$L_{III}N_{VI, VII}$	12.888
0.90434	79 Au	$L_{II}O_{IV}$	13.7095	7	76 Os	$L_{III}O_I$	12.8721
0.90495	83 Bi	$L_I N_{II}$	13.7002	1	92 U	$L_{III}M_{III}$	12.866
0.90638	79 Au	$L_I M_{IV}$	13.679	7	81 Tl	$L_I M_{IV}$	12.8626
0.90742	88 Ra	$L_{II}O_{III}$	13.6630	3	77 Ir	$L_I N_{II}$	12.8418
0.90746	79 Au	$L_{II}M_I$	13.662	4	77 Ir	$L_{II}O_{IV}$	12.8201
0.90837	79 Au	$L_{II}O_{II}$	13.6487	1	77 Ir	Abs. edge	12.820
0.90894	80 Hg	$L_{II}N_{VI}$	13.640	1	84 Po	$L_{III}N_I$	12.819
0.9091	84 Po	$L_{II}N_{III}$	13.638	2	90 Th	$L_{III}M_{IV}$	12.8096
0.90989	79 Au	$L_I M_{III}$	13.6260	7	82 Pb	$L_I M_{III}$	12.7933
0.910639	92 U	$L_{III}M_V$	13.6147	5	77 Ir	$L_{II}O_{III}$	12.7843
0.9131	79 Au	$L_I N_I$	13.578	6	77 Ir	$L_{II}N_{VI}$	12.7603
0.9143	78 Pt	$L_I N_V$	13.560	4	78 Pt	$L_{II}N_{VI}$	12.7588
0.9204	35 Br	Abs. edge	13.470	5	83 Bi	$L_{III}N_{III}$	12.7394
0.92046	35 Br	$K N_{II,III}$	13.4695	3	77 Ir	$L_{III}O_I$	12.7270
0.9220	84 Po	$L_{II}M_{IV}$	13.447	1	82 Pb	$L_{II}M_V$	12.720
0.922558	92 U	$L_{III}M_{IV}$	13.4388	3	76 Os	$L_I N_V$	12.696

TABLE 7f-2. WAVELENGTHS OF X-RAY EMISSION LINES AND ABSORPTION EDGES: IN NUMERICAL ORDER (Continued)

Wavelength, Å*	p.e.†	Element	Designation	keV	Wavelength, Å*	p.e.†	Element	Designation	keV	Wavelength, Å*	p.e.†	Element	Designation	keV
0.9766	2	77 Ir	L ₁ N ₁	12.895	1.0250	2	74 W	L ₁ O _{1v,v}	12.095	1.02775	7	79 Au	L ₁ M _{1v}	12.053
0.97690	4	83 Bi	L ₁ M _{1v}	12.8912	1.02503	5	76 Os	L ₁ N _{1v}	12.0953	1.02836	1	81 Tl	L ₁ O _{1v}	12.0530
0.9772	3	76 Os	L ₁ N _{1v}	12.687	1.02613	7	75 Re	L ₁ N _{1v}	12.0824	1.03049	5	87 Fr	L ₁ M _{1v}	12.0313
0.9792	2	78 Pt	L ₁ N _{1v}	12.661	1.02775	3	74 W	L ₁ O _{1v}	12.0634	1.0317	3	74 W	L ₁ M _{1v}	12.017
0.97926	5	81 Tl	L ₁ N _{1v}	12.6607	1.02789	7	79 Au	L ₁ M _{1v}	12.0617	1.03233	5	75 Re	L ₁ N _{1v}	12.0098
0.9793	1	81 Tl	Abs. edge	12.660	1.02836	1	81 Tl	Abs. edge	12.053	1.03358	7	80 Hg	L ₁ M _{1v}	12.010
0.97974	1	34 Se	Abs. edge	12.6545	1.02863	3	74 W	L ₁ O _{1v}	12.0530	1.0346	9	83 Bi	L ₁ M _{1v}	11.9953
0.97992	5	34 Se	KN _{1v,1v}	12.6522	1.03049	5	87 Fr	L ₁ M _{1v}	12.0313	1.03699	1	92 U	L ₁ M _{1v}	11.982
0.97993	5	89 Ac	L ₁ N _{1v}	12.6520	1.0317	3	74 W	L ₁ O _{1v}	12.017	1.0371	1	75 Re	L ₁ O _{1v}	11.954
0.9801	1	30 Kr	L ₁ N _{1v}	12.649	1.03233	5	75 Re	L ₁ N _{1v}	12.0098	1.0376	7	79 Au	L ₁ M _{1v}	11.925
0.98058	3	81 Tl	L ₁ N _{1v}	12.6436	1.03233	2	82 Pb	L ₁ M _{1v}	12.010	1.03876	3	81 Tl	L ₁ N _{1v}	11.9243
0.98221	7	82 Pb	L ₁ N _{1v}	12.6226	1.03358	7	80 Hg	L ₁ M _{1v}	11.9953	1.03918	1	75 Re	L ₁ N _{1v}	11.9242
0.98280	5	83 Bi	L ₁ N _{1v}	12.6151	1.0346	9	83 Bi	L ₁ M _{1v}	11.982	1.03973	1	75 Re	L ₁ N _{1v}	11.9241
0.98291	3	82 Pb	L ₁ N _{1v}	12.6137	1.0346	1	92 U	L ₁ M _{1v}	11.956	1.03974	2	35 Br	L ₁ N _{1v}	11.9212
0.98389	7	82 Pb	L ₁ N _{1v}	12.6011	1.0346	1	75 Re	L ₁ O _{1v}	11.954	1.03975	7	80 Hg	L ₁ N _{1v}	11.917
0.9841	1	36 Kr	KL _{1v}	12.598	1.03699	1	75 Re	Abs. edge	11.925	1.04000	5	75 Re	L ₁ N _{1v}	11.9163
0.9843	1	34 Se	KL _{1v}	12.595	1.0371	1	75 Re	Abs. edge	11.925	1.04044	3	79 Au	L ₁ N _{1v}	11.9040
0.98538	5	81 Tl	KL _{1v}	12.5820	1.0376	7	79 Au	Abs. edge	11.925	1.04151	7	80 Hg	L ₁ N _{1v}	11.899
0.9871	2	80 Hg	L ₁ M _{1v}	12.560	1.03918	1	75 Re	L ₁ N _{1v}	11.9243	1.0420	1	75 Re	L ₁ N _{1v}	11.8950
0.9877	5	81 Tl	L ₁ M _{1v}	12.552	1.03973	1	75 Re	L ₁ N _{1v}	11.9243	1.04230	5	87 Fr	L ₁ N _{1v}	11.890
0.9888	1	81 Tl	L ₁ N _{1v}	12.538	1.03974	2	35 Br	L ₁ N _{1v}	11.9242	1.0428	6	93 Np	L ₁ N _{1v}	11.8776
0.98913	5	83 Bi	L ₁ N _{1v}	12.5344	1.03975	7	80 Hg	L ₁ N _{1v}	11.9241	1.04382	2	35 Br	KL _{1v}	11.8758
0.9894	1	75 Re	L ₁ N _{1v}	12.530	1.04000	1	75 Re	Abs. edge	11.917	1.04398	5	75 Re	L ₁ O _{1v}	11.865
0.9900	1	75 Re	L ₁ N _{1v}	12.524	1.04044	3	79 Au	Abs. edge	11.9163	1.0450	2	79 Au	L ₁ O _{1v}	11.865
0.99017	5	81 Tl	L ₁ O _{1v}	12.5212	1.04151	7	80 Hg	L ₁ N _{1v}	11.9040	1.0450	1	33 As	Abs. edge	11.865
0.99085	3	77 Ir	L ₁ N _{1v}	12.5126	1.0420	1	75 Re	L ₁ N _{1v}	11.899	1.0450	1	33 As	Abs. edge	11.865
0.99178	5	89 Ac	L ₁ N _{1v}	12.5008	1.04230	5	87 Fr	L ₁ N _{1v}	11.8950	1.0450	1	33 As	Abs. edge	11.865
0.99186	5	76 Os	L ₁ N _{1v}	12.4998	1.0428	6	93 Np	L ₁ N _{1v}	11.890	1.0450	1	33 As	Abs. edge	11.865
0.99218	3	34 Se	KL _{1v}	12.4959	1.04382	2	35 Br	KL _{1v}	11.8776	1.0450	1	33 As	Abs. edge	11.865
0.99249	5	75 Re	L ₁ O _{1v}	12.4920	1.04398	5	75 Re	L ₁ O _{1v}	11.8758	1.0450	1	33 As	Abs. edge	11.865
0.99268	5	34 Se	KL _{1v}	12.4896	1.0450	2	79 Au	L ₁ O _{1v}	11.865	1.0450	1	33 As	Abs. edge	11.865
0.99331	3	83 Bi	L ₁ N _{1v}	12.4816	1.0450	1	33 As	Abs. edge	11.865	1.0450	1	33 As	Abs. edge	11.865

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0.99334	75 Re	$L\gamma'$	12.4813	1.04500	3	33 As	$K\beta_2$	11.8642	$K_{II,III}$
0.9962	80 Hg	$L\beta_{10}$	12.446	1.0458	1	74 W	$L\gamma_{II}$	11.856	$L_{II}N_V$
0.9965	75 Re	$L\gamma_2$	12.442	1.0468	2	74 W		11.844	$L_{II}N_{IV}$
0.99805	76 Os		12.4224	1.04752	5	79 Au	$L\alpha$	11.8357	$L_{III}N_{VI,VII}$
1.0005	82 Pb	$L\beta_8$	12.392	1.04868	5	80 Hg	$L\beta_1$	11.8226	$L_{III}M_{IV}$
1.00062	83 Bi	$L\beta_9$	12.39	1.0488	1	33 As	$K\beta_5$	11.822	$K_{M_{IV},V}$
1.00107	81 Tl	$L\beta_6$	12.3904	1.04963	5	81 Tl	$L\beta_7$	11.8118	$L_{III}N_I$
1.0012	76 Os	$L\beta_7$	12.3848	1.04974	8	79 Au	$L\beta_8$	11.8106	$L_{III}O_I$
1.0014	95 Am	$L\beta_5$	12.384	1.05446	5	78 Pt	$L\beta_9$	11.7577	$L_{II}M_V$
1.0047	76 Os	$L\beta_4$	12.381	1.05609	7	81 Tl	$L\beta_{11}$	11.7397	$L_{II}M_{III}$
1.00473	76 Os	$L\beta_3$	12.340	1.05693	5	76 Os	$L\gamma_6$	11.7303	$L_{II}N_I$
1.0050	88 Ra	$L\beta_2$	12.3397	1.05723	5	86 Rn	$L\alpha_1$	11.7270	$L_{III}M_V$
1.0054	76 Os	$L\beta_1$	12.337	1.05730	2	33 As	$K\beta_1$	11.7262	$K_{M_{III}}$
1.00722	77 Ir	$L\beta_9$	12.332	1.05783	5	33 As	$K\beta_3$	11.7203	$K_{M_{II}}$
1.0075	81 Tl	$L\beta_8$	12.3093	1.0585	1	80 Hg	$L\eta$	11.713	$L_{III}N_{III}$
1.00788	82 Pb	$L\beta_7$	12.306	1.05856	3	83 Bi	$L\gamma_1$	11.7122	$L_{II}M_I$
1.0091	76 Os	$L\beta_6$	12.3012	1.06099	5	75 Re	$L\gamma_1$	11.6854	$L_{II}N_{IV}$
1.00987	80 Hg	$L\beta_5$	12.286	1.0613	1	73 Ta	$L\gamma_1$	11.682	Abs. edge
1.01031	81 Tl	$L\beta_4$	12.2769	1.06183	7	78 Pt	$L\beta_{10}$	11.6762	$L_{II}M_{IV}$
1.01040	82 Pb	$L\beta_3$	12.2715	1.06192	9	73 Ta	$L\beta_{10}$	11.6752	$L_{II}O_{IV,V}$
1.0108	75 Re	$L\beta_2$	12.2705	1.06200	6	74 W	$L\gamma_3$	11.6743	$L_{II}N_{III}$
1.0112	90 Th	$L\beta_1$	12.266	1.06357	9	73 Ta		11.6570	$L_{II}N_{VI,VII}$
1.0119	75 Re	$L\beta_{11}$	12.261	1.0644	2	82 Pb		11.648	$L_{II}M_{II}$
1.0120	77 Ir	$L\beta_{10}$	12.252	1.0644	2	81 Tl		11.648	$L_{II}M_I$
1.01201	81 Tl	$L\beta_{11}$	12.251	1.06467	3	73 Ta	$L\gamma_4$	11.6451	$L_{II}O_{III}$
1.01404	80 Hg	$L\beta_{10}$	12.2510	1.0649	2	80 Hg		11.642	$L_{III}N_{II}$
1.01513	81 Tl	$L\beta_9$	12.2264	1.06544	3	73 Ta	$L\gamma_4'$	11.6366	$L_{II}O_{II}$
1.01558	80 Hg	$L\beta_8$	12.2133	1.06712	2	92 U	$L\beta_4'$	11.6183	$L_{III}M_I$
1.01656	88 Ra	$L\beta_7$	12.2079	1.06771	9	73 Ta	$L\beta_4$	11.6118	$L_{II}O_I$
1.01674	80 Hg	$L\beta_6$	12.1962	1.06785	9	79 Au	$L\beta_5$	11.6103	$L_{II}M_{III}$
1.01769	80 Hg	$L\beta_5$	12.1940	1.06806	3	74 W	$L\gamma_2$	11.6080	$L_{II}N_{II}$
1.01937	80 Hg	$L\beta_4$	12.1826	1.06899	5	86 Rn	$L\alpha_2$	11.5979	$L_{III}M_{IV}$
1.02063	79 Au	$L\beta_3$	12.1625	1.07022	3	79 Au	$L\beta_2$	11.5847	$L_{III}N_V$
1.0210	82 Pb	$L\beta_2$	12.1474	1.07188	5	79 Au	$L\beta_3$	11.5667	$L_{III}N_{IV}$
1.02175	77 Ir	$L\beta_1$	12.143	1.07222	7	80 Hg	$L\beta_4$	11.5630	$L_{II}M_{II}$
1.0223	82 Pb	$L\beta_{11}$	12.1342	1.0723	1	78 Pt	Abs. edge	11.562	Abs. edge
1.0226	94 Pu	$L\beta_{10}$	12.127	1.0724	2	78 Pt	$L\beta_5$	11.561	$L_{III}O_{IV,V}$
1.02467	74 W	$L\beta_9$	12.124	1.07448	5	74 W	$L\gamma_6$	11.5387	$L_{II}O_{IV}$
		$L\beta_8$	12.0996	1.0745	1	74 W	$L\beta_{11}$	11.538	Abs. edge

TABLE 7I-2. WAVELENGTHS OF X-RAY EMISSION LINES AND ABSORPTION EDGES: IN NUMERICAL ORDER (Continued)

Wavelength, Å*	p.e.†	Element	Designation	keV	Wavelength, Å*	p.e.†	Element	Designation	keV	Element	Designation	keV
1.0756	2	79 Au	$L_{III}M_V$	11.526	1.1353	5	76 Os	$L_{II}M_{IV}$	10.9376	76 Os	$L_{II}M_{IV}$	10.9376
1.0761	3	78 Pt	$L_{III}O_{II,III}$	11.521	1.13525	5	79 Au	$L_{II}M_I$	10.9210	79 Au	$L_{II}M_I$	10.9210
1.0767	1	75 Re	$L_{II}N_{III}$	11.515	1.13532	3	77 Ir	$L_{III}N_V$	10.9203	77 Ir	$L_{III}N_V$	10.9203
1.0771	1	74 W	$L_{III}N_{VI}$	11.510	1.13687	9	73 Ta	$L_{II}N_V$	10.9055	73 Ta	$L_{II}N_V$	10.9055
1.07896	5	78 Pt	$L_{III}N_{VI, VII}$	11.4908	1.13707	3	77 Ir	$L_{III}N_{IV}$	10.9036	77 Ir	$L_{III}N_{IV}$	10.9036
1.0792	2	74 W	$L_{III}O_{II}$	11.488	1.13794	3	73 Ta	$L_{II}N_{IV}$	10.8952	73 Ta	$L_{II}N_{IV}$	10.8952
1.07975	7	80 Hg	$L_{III}N_I$	11.4824	1.13841	5	72 Hf	$L_{II}N_{III}$	10.8907	72 Hf	$L_{II}N_{III}$	10.8907
1.08009	9	90 Th	$L_{III}M_{II}$	11.4788	1.1387	5	80 Hg	$L_{II}M_{II}$	10.888	80 Hg	$L_{II}M_{II}$	10.888
1.08113	4	74 W	$L_{III}O_I$	11.4677	1.1402	1	71 La	Abs. edge	10.8740	71 La	Abs. edge	10.8740
1.08168	3	78 Pt	$L_{III}O_I$	11.4619	1.1405	1	76 Os	$L_{III}O_{IV, V}$	10.8711	76 Os	$L_{III}O_{IV, V}$	10.8711
1.08205	7	73 Ta	$L_{II}N_V$	11.4580	1.1408	1	76 Os	Abs. edge	10.8683	76 Os	Abs. edge	10.8683
1.08353	3	79 Au	$L_{II}M_{IV}$	11.4433	1.14085	3	77 Ir	$L_{II}M_{III}$	10.8674	77 Ir	$L_{II}M_{III}$	10.8674
1.08377	7	73 Ta	$L_{II}N_{IV}$	11.4398	1.14223	5	78 Pt	$L_{II}M_{II}$	10.8543	78 Pt	$L_{II}M_{II}$	10.8543
1.0839	1	75 Re	$L_{II}N_{II}$	11.438	1.1435	1	71 La	$L_{II}O_{II, III}$	10.8425	71 La	$L_{II}O_{II, III}$	10.8425
1.08500	5	85 At	$L_{III}M_V$	11.4268	1.14355	5	78 Pt	$L_{II}N_I$	10.8418	78 Pt	$L_{II}N_I$	10.8418
1.08975	5	77 Ir	$L_{II}M_V$	11.370	1.14386	2	83 Bi	$L_{III}M_V$	10.8388	83 Bi	$L_{III}M_V$	10.8388
1.09026	7	79 Au	$L_{III}N_{III}$	11.377	1.14442	5	72 Hf	$L_{II}N_{II}$	10.8335	72 Hf	$L_{II}N_{II}$	10.8335
1.0908	1	91 Pa	$L_{III}M_I$	11.366	1.14537	7	76 Os	$L_{II}N_{VI, VII}$	10.8245	76 Os	$L_{II}N_{VI, VII}$	10.8245
1.0916	5	80 Hg	$L_{II}M_{III}$	11.358	1.1489	2	77 Ir	$L_{II}M_V$	10.791	77 Ir	$L_{II}M_V$	10.791
1.09241	7	82 Pb	$L_{II}M_I$	11.3493	1.14933	8	76 Os	$L_{III}O_I$	10.7872	76 Os	$L_{III}O_I$	10.7872
1.09388	5	75 Re	$L_{II}N_I$	11.3341	1.1548	1	72 Hf	Abs. edge	10.7362	72 Hf	Abs. edge	10.7362
1.09671	5	85 At	$L_{III}M_{IV}$	11.3048	1.15519	5	72 Hf	$L_{III}O_{IV}$	10.7325	72 Hf	$L_{III}O_{IV}$	10.7325
1.09702	4	77 Ir	$L_{II}M_{IV}$	11.3016	1.1553	1	73 Ta	$L_{II}N_{III}$	10.7316	73 Ta	$L_{II}N_{III}$	10.7316
1.09855	3	74 W	$L_{II}N_{IV}$	11.2859	1.15536	1	83 Bi	$L_{III}M_{IV}$	10.73091	83 Bi	$L_{III}M_{IV}$	10.73091
1.09936	4	73 Ta	$L_{II}N_{II}$	11.2776	1.1560	3	77 Ir	$L_{III}N_{III}$	10.725	77 Ir	$L_{III}N_{III}$	10.725
1.0997	1	81 Tl	Abs. edge	11.274	1.15781	3	77 Ir	$L_{II}N_{VI}$	10.7083	77 Ir	$L_{II}N_{VI}$	10.7083
1.0997	1	72 Hf	$L_{III}N_{II}$	11.273	1.15830	9	72 Hf	$L_{II}M_{IV}$	10.7037	72 Hf	$L_{II}M_{IV}$	10.7037
1.09968	7	79 Au	$L_{III}N_{II}$	11.272	1.1600	2	73 Ta	$L_{II}N_{VI}$	10.688	73 Ta	$L_{II}N_{VI}$	10.688
1.0999	2	80 Hg	$L_{II}M_I$	11.262	1.16107	9	71 La	$L_{II}N_V$	10.6782	71 La	$L_{II}N_V$	10.6782
1.10086	9	72 Hf	$L_{II}O_{IV}$	11.2595	1.16138	5	72 Hf	$L_{II}N_V$	10.6754	72 Hf	$L_{II}N_V$	10.6754
1.10200	3	78 Pt	$L_{III}N_V$	11.2401	1.16227	9	71 La	$L_{III}O_I$	10.6672	71 La	$L_{III}O_I$	10.6672
1.10303	5	72 Hf	$L_{II}O_{III}$	11.2326	1.1640	1	80 Hg	$L_{II}N_{IV}$	10.6512	80 Hg	$L_{II}N_{IV}$	10.6512
1.10376	5	72 Hf	$L_{II}O_{II}$		1.16487	1	75 Re	$L_{II}M_V$	10.6433	75 Re	$L_{II}M_V$	10.6433

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1.10394	5	78 Pt	$L\beta_3$	L_1M_{III}	11.2308	1.16545	5	77 Ir	$L\beta_{II}$	$L_{III}N_{II}$	10.6380
1.10477	2	34 Se	$K\alpha_1$	KL_{III}	11.2224	1.1667	1	78 Pt	$L\alpha$	$L_{III}M_{III}$	10.6265
1.1053	1	73 Ta	$L\gamma_1$	L_1N_{II}	11.217	1.16719	5	88 Ra	$L\beta_1$	$L_{III}M_{II}$	10.6222
1.1058	1	77 Ir	Abs. edge	Abs. edge	11.212	1.16962	5	78 Pt	$L\beta_1$	L_1M_{II}	10.6001
1.10585	3	77 Ir	$L\beta_3$	$L_{III}O_{IV,V}$	11.2114	1.16979	8	76 Os	$L\beta_1$	$L_{III}N_{IV}$	10.5985
1.10651	3	79 Au	$L\beta_4$	L_1M_{II}	11.2047	1.1708	1	79 Au	$L\beta_1$	$L_{III}M_{II}$	10.5892
1.10664	2	72 Hf	$K\alpha_2$	L_1O_1	11.2034	1.17167	1	76 Os	$L\beta_3$	$L_{III}N_{IV}$	10.5816
1.10882	9	34 Se	$K\alpha_2$	KL_{II}	11.1814	1.17218	5	75 Re	$L\beta_{II}$	L_1M_{IV}	10.5770
1.10923	6	77 Ir	$L\beta_6$	$L_{III}O_{II,III}$	11.1772	1.1729	1	73 Ta	$L\gamma_6$	$L_{III}N_{II}$	10.5702
1.11092	3	79 Au	$L\beta_6$	$L_{III}N_1$	11.1602	1.17501	2	82 Pb	$L\alpha_1$	$L_{III}M_{IV}$	10.5515
1.11145	4	77 Ir	Lu	$L_{III}N_{VI,VII}$	11.1549	1.17588	1	33 As	$K\alpha_1$	KL_{III}	10.54372
1.1129	2	78 Pt	$L\beta_1$	$L_{III}M_V$	11.140	1.17721	5	75 Re	$L\beta_3$	$L_{III}O_{IV,V}$	10.5318
1.1137	1	73 Ta	$L\beta_1$	Abs. edge	11.132	1.1773	1	75 Re	Abs. edge	Abs. edge	10.5306
1.11386	4	84 Po	$L\alpha_1$	$L_{III}M_V$	11.1308	1.17788	9	72 Hf	$L\beta_1$	$L_{III}N_V$	10.5258
1.11388	3	73 Ta	$L\gamma_4$	$L_{III}O_V$	11.1306	1.17796	3	77 Ir	$L\beta_1$	$L_{III}N_1$	10.5251
1.11489	3	77 Ir	$L\beta_1$	$L_{III}O_V$	11.1205	1.17900	5	72 Hf	$L\gamma_6$	$L_{III}N_{III}$	10.5158
1.1149	2	74 W	$L\beta_1$	$L_{III}N_{III}$	11.120	1.17953	4	71 Lu	$L\gamma_6$	$L_{III}N_{III}$	10.5110
1.11508	4	90 Th	$L\beta_1$	$L_{III}M_1$	11.1186	1.17955	7	76 Os	$L\beta_1$	L_1M_{III}	10.5108
1.11521	9	73 Ta	$L\beta_1$	L_1N_1	11.1173	1.17958	3	77 Ir	$L\beta_1$	L_1M_{II}	10.5106
1.1158	1	73 Ta	$L\beta_1$	$L_{III}N_{VI}$	11.1113	1.17987	1	33 As	$K\alpha_2$	KL_{II}	10.50799
1.11658	5	32 Ge	K	Abs. edge	11.1036	1.1815	1	75 Re	Lu	$L_{III}N_{VI,VII}$	10.4931
1.11686	2	32 Ge	$K\beta_2$	Abs. edge	11.1008	1.1818	1	70 Yb	Abs. edge	Abs. edge	10.4904
1.11693	9	73 Ta	$K\beta_2$	$L_{III}O_{III}$	11.1001	1.1827	1	70 Yb	$L_1O_{IV,V}$	$L_1O_{IV,V}$	10.4833
1.11789	9	73 Ta	$K\beta_2$	$L_{III}O_{II}$	11.0907	1.1853	1	70 Yb	$L\gamma_4$	$L_1O_{II,III}$	10.4603
1.1195	1	32 Ge	$K\beta_3$	$KM_{IV,V}$	11.0745	1.1853	2	71 Lu	$L\gamma_4$	L_1N_{II}	10.460
1.11990	2	78 Pt	$L\beta_1$	$L_{III}M_{IV}$	11.0707	1.18610	5	75 Re	$L\beta_1$	$L_{III}O_1$	10.4529
1.1205	1	73 Ta	$L\gamma_6$	L_1N_V	11.0546	1.18648	5	82 Pb	$L\alpha_2$	$L_{III}M_{IV}$	10.4495
1.12146	9	72 Hf	$L\gamma_{II}$	L_1N_V	11.0553	1.1886	1	70 Yb	$L\alpha_2$	L_1O_1	10.4312
1.1218	3	74 W	$L\gamma_{II}$	$L_{III}N_{II}$	11.052	1.18977	7	76 Os	K	$L_{II}M_V$	10.4205
1.12250	9	72 Hf	$L\alpha_2$	$L_{III}N_{III}$	11.0451	1.1958	1	31 Ga	Abs. edge	Abs. edge	10.3682
1.1226	2	78 Pt	$L\beta_1$	$L_{III}M_{IV}$	11.044	1.19690	2	31 Ga	$K\beta_2$	$KM_{II,III}$	10.3663
1.12548	5	84 Po	$L\beta_1$	$L_{III}M_{IV}$	11.0158	1.19727	7	76 Os	$L\beta_1$	$L_{III}M_{IV}$	10.3553
1.12637	6	76 Os	$L\beta_1$	L_1M_V	11.0071	1.1981	2	31 Ga	$K\beta_5$	$KM_{IV,V}$	10.3448
1.12769	3	81 Tl	$L\gamma$	$L_{III}M_1$	10.9943	1.1985	1	71 Lu	$L\beta_1$	Abs. edge	10.3448
1.12798	5	79 Au	$L\beta_{II}$	$L_{III}M_{II}$	10.9915	1.1987	1	71 Lu	$L\gamma_6$	$L_{III}O_{IV}$	10.3431
1.12894	2	32 Ge	$K\beta_1$	KM_{III}	10.9821	1.1987	7	76 Os	$L\gamma_6$	$L_{III}N_{II}$	10.3244
1.12936	9	32 Ge	$K\beta_3$	KM_{II}	10.9780	1.20086	1	71 Lu	$L\gamma_6$	$L_{III}N_{II}$	10.3198
1.1310	2	78 Pt	$L\beta_1$	$L_{III}N_{II}$	10.962	1.2014	1	79 Au	$L\gamma$	$L_{III}O_{II,III}$	10.3083
1.13235	3	74 W	$L\gamma_6$	$L_{III}N_1$	10.9490	1.20273	3	71 Lu	$L\gamma$	$L_{III}M_1$	10.2915
						1.2047	1			$L_{II}O_1$	

TABLE 7f-2. WAVELENGTHS OF X-RAY EMISSION LINES AND ABSORPTION EDGES: IN NUMERICAL ORDER (Continued)

Wavelength, Å*	p.e.t	Element	Designation	keV	Wavelength, Å*	p.e.t	Element	Designation	keV	Wavelength, Å*	p.e.t	Element	Designation	keV
1.20479	7	74 W	L ₁ M _v	10.2907	1.2848	1	30 Zn	Kβ ₅	9.6501	1.2848	1	30 Zn	Kβ ₅	9.6501
1.20660	4	75 Re	L _{III} N _v	10.2752	1.28619	5	73 Ta	Lβ ₁₅	9.6394	1.28619	5	73 Ta	Lβ ₁₅	9.6394
1.2069	2	77 Ir	L _{III} M _{III}	10.273	1.28772	3	79 Au	Lα ₁	9.6280	1.28772	3	79 Au	Lα ₁	9.6280
1.20739	4	81 Tl	L _{III} M _v	10.2685	1.2892	1	69 Tm	Lβ ₁	9.6171	1.2892	1	69 Tm	Lβ ₁	9.6171
1.20789	2	31 Ga	Kβ ₁	10.2642	1.28989	7	74 W	Lβ ₁	9.6117	1.28989	7	74 W	Lβ ₁	9.6117
1.20819	5	75 Re	Lβ ₁₅	10.2617	1.29025	9	72 Hf	Lβ ₁	9.6090	1.29025	9	72 Hf	Lβ ₁	9.6090
1.20835	5	31 Ga	Kβ ₂	10.2603	1.2905	2	69 Tm	Lγ ₆	9.607	1.2905	2	69 Tm	Lγ ₆	9.607
1.2102	2	77 Ir	L ₁ M ₁	10.245	1.2927	1	75 Re	Lβ ₁₇	9.5910	1.2927	1	75 Re	Lβ ₁₇	9.5910
1.2105	1	83 Bi	L _{III} M _{III}	10.2421	1.2934	2	76 Os	Kβ _{1,3}	9.586	1.2934	2	76 Os	Kβ _{1,3}	9.586
1.21218	3	74 W	L ₁ M _{IV}	10.2379	1.29525	2	30 Zn	Lβ ₁₁	9.5720	1.29525	2	30 Zn	Lβ ₁₁	9.5720
1.213	1	74 Pt	L _{III} M _{II}	10.225	1.2972	1	72 Hf	Lβ ₁₁	9.5577	1.2972	1	72 Hf	Lβ ₁₁	9.5577
1.21349	5	76 Os	Lβ ₆	10.2169	1.29761	5	72 Hf	Lβ ₁₀	9.5546	1.29761	5	72 Hf	Lβ ₁₀	9.5546
1.21537	5	72 Hf	Lγ ₁	10.2011	1.29819	9	72 Hf	Lβ ₁₀	9.5503	1.29819	9	72 Hf	Lβ ₁₀	9.5503
1.21545	3	74 W	Lβ ₁	10.2004	1.30162	5	74 W	Lβ ₁	9.5252	1.30162	5	74 W	Lβ ₁	9.5252
1.2155	1	74 W	Lβ ₁₁	10.1999	1.30165	9	72 Hf	Lβ ₁₁	9.5249	1.30165	9	72 Hf	Lβ ₁₁	9.5249
1.21844	5	76 Os	Lβ ₄	10.1754	1.30564	5	72 Hf	Lβ ₁	9.4958	1.30564	5	72 Hf	Lβ ₁	9.4958
1.21868	5	74 W	Lβ ₁	10.1733	1.3063	1	70 Yb	Lγ ₆	9.4910	1.3063	1	70 Yb	Lγ ₆	9.4910
1.21875	3	81 Tl	Lα ₁	10.1728	1.30678	3	73 Ta	Lβ ₁	9.4875	1.30678	3	73 Ta	Lβ ₁	9.4875
1.22031	5	75 Re	Lβ ₁	10.1598	1.30767	7	82 Pb	Lβ ₁	9.4811	1.30767	7	82 Pb	Lβ ₁	9.4811
1.2211	4	74 W	Lγ ₁	10.153	1.3086	1	73 Ta	Lβ ₁	9.4742	1.3086	1	73 Ta	Lβ ₁	9.4742
1.22228	4	71 Lu	Lγ ₁	10.1434	1.3112	2	80 Hg	Lα	9.455	1.3112	2	80 Hg	Lα	9.455
1.22232	5	70 Yb	Lγ ₁	10.1431	1.31304	3	78 Pt	Lα ₁	9.4423	1.31304	3	78 Pt	Lα ₁	9.4423
1.22400	4	74 W	Lβ ₁	10.1292	1.3146	1	68 Er	Lγ ₆	9.4309	1.3146	1	68 Er	Lγ ₆	9.4309
1.2250	1	69 Tm	L ₁	10.1206	1.3153	2	69 Tm	Lγ ₁	9.426	1.3153	2	69 Tm	Lγ ₁	9.426
1.2263	3	69 Tm	Abs. edge	10.110	1.31610	7	83 Bi	Lβ ₁	9.4204	1.31610	7	83 Bi	Lβ ₁	9.4204
1.2283	1	75 Re	Lγ ₁	10.0933	1.3167	1	73 Ta	Lβ ₁	9.4158	1.3167	1	73 Ta	Lβ ₁	9.4158
1.22879	7	70 Yb	Lγ ₁	10.0897	1.31897	9	73 Ta	Lβ ₁	9.3998	1.31897	9	73 Ta	Lβ ₁	9.3998
1.2294	2	69 Tm	Lγ ₆	10.084	1.3190	1	67 Ho	L ₁	9.3994	1.3190	1	67 Ho	L ₁	9.3994
1.2305	1	75 Re	Lβ ₁	10.0753	1.3208	3	67 Ho	Lγ ₁	9.387	1.3208	3	67 Ho	Lγ ₁	9.387
1.23858	1	75 Re	Lβ ₁	10.0100	1.3210	2	68 Er	Lγ ₁	9.385	1.3210	2	68 Er	Lγ ₁	9.385
1.24120	5	80 Hg	Lα ₁	9.9388	1.3225	2	67 Ho	Lγ ₁	9.374	1.3225	2	67 Ho	Lγ ₁	9.374
1.24271	3	70 Yb	Lγ ₆	9.9766	1.32432	2	78 Pt	Lα ₁	9.3618	1.32432	2	78 Pt	Lα ₁	9.3618
1.2428	1	70 Yb	Lβ ₁	9.9761	1.32639	5	72 Hf	Lβ ₁	9.3473	1.32639	5	72 Hf	Lβ ₁	9.3473

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1.2429	78 Pt	$L\eta$	$L_{III}M_I$	9.975	1.32698	3	73 Ta	$L\beta_1$	$L_{II}M_{IV}$	9.3431
1.24385	82 Pb	$L\zeta$	$L_{III}M_{III}$	9.9575	1.32783	5	72 Hf	$L\beta_2$	$L_{III}N_{IV}$	9.3371
1.24460	74 W	$L\beta_2$	$L_{III}N_V$	9.9615	1.32785	7	76 Os	$L\eta$	$L_{II}M_I$	9.3370
1.2453	70 Yb		$L_{II}O_{II,III}$	9.9561	1.33094	8	73 Ta	$L\beta_3$	$L_{III}N_I$	9.3153
1.24631	74 W	$L\beta_{15}$	$L_{III}N_{IV}$	9.9478	1.33358	1	71 Lu	$L\beta_4$	$L_I M_V$	9.2816
1.2466	73 Ta	$L\beta_5$	$L_I M_V$	9.946	1.33365	3	74 W		$L_I M_I$	9.277
1.2480	76 Os	$L\beta_{17}$	$L_{II}M_{III}$	9.934	1.33366	1	75 Re		$L_{II}M_{II}$	9.2761
1.24923	70 Yb	$L\gamma_5$	$L_{III}O_I$	9.9246	1.33386	1	68 Er	Abs. edge	Abs. edge	9.2622
1.2502	77 Ir		$L_{II}M_{II}$	9.917	1.33387	2	74 W	$L\beta_{17}$	$L_{II}M_{III}$	9.261
1.25100	75 Re	$L\beta_6$	$L_{III}N_I$	9.9105	1.33397	3	68 Er	$L\gamma_6$	$L_{II}O_{IV}$	9.255
1.25264	80 Hg	$L\alpha_2$	$L_{III}M_{IV}$	9.8976	1.340083	9	31 Ga	$K\alpha_1$	KL_{III}	9.25174
1.25264	73 Ta	$L\beta_{10}$	$L_I M_{IV}$	9.889	1.3405	1	71 Lu	$K\alpha_2$	Abs. edge	9.2490
1.2537	73 Ta	$K\alpha_1$	KL_{II}	9.889	1.34154	5	81 Tl	$L\alpha$	$L_{III}M_{II}$	9.2417
1.254054	32 Ce		Abs. edge	9.88642	1.34183	7	71 Lu	$L\beta_5$	$L_{III}O_{IV,V}$	9.2397
1.2553	73 Ta	$L\eta$	$L_{III}O_{IV,V}$	9.8766	1.34330	2	71 Lu	$L\beta_{10}$	$L_I M_{IV}$	9.232
1.2555	73 Ta	$L\beta_7$	$L_{III}N_{VI,VII}$	9.872	1.34399	1	31 Ga	$K\alpha_3$	KL_{II}	9.22482
1.25778	73 Ta	$L\alpha$	KL_{II}	9.85532	1.34524	9	71 Lu		$L_{III}O_{II,III}$	9.2163
1.258011	32 Ce	$K\alpha_3$	$L_I M_{II}$	9.8463	1.34581	3	73 Ta	$L\beta_1$	$L_I M_{II}$	9.2124
1.25917	75 Re	$L\beta_4$	$L_{III}N_I$	9.8428	1.34949	5	71 Lu	$L\beta_1$	$L_{III}O_I$	9.1873
1.2596	71 Lu	$L\gamma_5$	$L_{III}O_{II,III}$	9.839	1.34990	7	82 Pb	$L\alpha$	$L_{III}M_I$	9.1845
1.2601	73 Ta		$L_I M_{III}$	9.839	1.35063	9	72 Hf	$L\beta_1$	$L_{III}N_{III}$	9.1802
1.26269	74 W	$L\beta_8$	$L_{II}M_{III}$	9.8188	1.35128	3	77 Ir	$L\alpha$	$L_{III}M_V$	9.1751
1.26385	73 Ta	$L\beta_7$	$L_{III}O_I$	9.8098	1.35131	7	79 Au	$L\alpha$	$L_{III}M_{III}$	9.1749
1.2672	74 W		$L_{III}N_{III}$	9.784	1.35300	5	72 Hf	$L\beta_1$	$L_I M_{III}$	9.1634
1.26769	70 Yb	$L\gamma_1$	$L_{II}N_{IV}$	9.7801	1.3558	2	69 Tm	$L\gamma_5$	$L_{II}N_I$	9.144
1.2678	69 Tm	$L\gamma_5$	$L_I N_{III}$	9.779	1.35887	9	72 Hf	$L\alpha$	$L_{III}N_{II}$	9.1239
1.2706	68 Er	L_I	Abs. edge	9.7574	1.36250	5	77 Ir	$L\gamma$	$L_{III}M_{IV}$	9.0995
1.2728	74 W		$L_{II}M_V$	9.741	1.3641	2	68 Er	$L\gamma$	$L_{II}N_{IV}$	9.089
1.2742	69 Tm	$L\gamma_2$	$L_I N_{II}$	9.730	1.3643	2	67 Ho	$L\gamma$	$L_I N_{III}$	9.087
1.2748	83 Bi	$L\alpha$	$L_{II}M_{II}$	9.7252	1.3692	1	66 Dy	L_I	Abs. edge	9.0548
1.2752	68 Er	$L\gamma_4$	$L_I O_{II,III}$	9.722	1.3698	2	67 Ho	$L\gamma$	$L_I N_{II}$	9.051
1.27640	79 Au	$L\alpha_1$	$L_{III}M_V$	9.733	1.37012	3	71 Lu	$L\beta_1$	$L_{III}N_V$	9.0489
1.2765	74 W		$L_{III}N_{II}$	9.712	1.3715	1	71 Lu	$L\beta_{15}$	$L_{III}N_V$	9.0395
1.27807	81 Tl	$L\alpha$	$L_{III}M_{III}$	9.7007	1.37342	5	75 Re	$L\eta$	$L_{III}N_{IV}$	9.0272
1.281809	74 W	$L\beta_1$	$L_{II}M_{IV}$	9.67235	1.37410	5	72 Hf	$L\beta_1$	$L_{III}M_I$	9.0227
1.2829	84 Po	$L\alpha$	$L_{II}M_I$	9.664	1.37410	5	72 Hf	$L\beta_1$	$L_{III}M_{IV}$	9.0227
1.2834	30 Zn	K	Abs. edge	9.6607	1.37410	7	66 Dy	$L\gamma_1$	$L_{III}N_I$	9.0195
1.28372	30 Zn	$K\beta_2$	$KN_{II,III}$	9.6580	1.37459	2	80 Hg	$L\alpha$	$L_I O_{II,III}$	9.019
1.28448	77 Ir	$L\eta$	$L_{II}M_I$	9.6522	1.3746	5	29 Cu	K	$L_{III}M_{II}$	8.9803
1.28454	73 Ta	$L\beta_3$	$L_{II}N_V$	9.6518	1.38059	5			Abs. edge	

TABLE 7f-2. WAVELENGTHS OF X-RAY EMISSION LINES AND ABSORPTION EDGES: IN NUMERICAL ORDER (Continued)

Wavelength, λ^*	p.e.†	Element	Designation	keV	Wavelength, λ^*	p.e.†	Element	Designation	keV	Designation	Element	p.e.†	Wavelength, λ^*	keV
1.38109	3	29 Cu	K β_3	8.9770	1.4941	3	68 Er	L β_1	8.298	L β_1	68 Er	3	1.4941	8.298
1.3838	1	70 Yb	L β_5	8.9597	1.4941	3	68 Er	L β_{10}	8.298	L β_{10}	68 Er	3	1.4941	8.298
1.38477	3	81 Tl	LL	8.9532	1.4995	2	78 Pt	LL	8.268	LL	78 Pt	2	1.4995	8.268
1.3862	1	70 Yb	L β_{11}	8.9441	1.500135	8	28 Ni	K $\beta_{1,3}$	8.26466	K $\beta_{1,3}$	28 Ni	8	1.500135	8.26466
1.3864	1	73 Ta	L β_{11}	8.9428	1.5023	1	65 Tb	L β_{11}	8.2527	Abs. edge	Abs. edge	1	1.5023	8.2527
1.38696	7	70 Yb	L β_5	8.9390	1.5035	2	65 Tb	L β_7	8.246	L β_7	65 Tb	2	1.5035	8.246
1.3895	2	78 Pt	L β_5	8.923	1.5063	2	69 Tm	L β_1	8.231	L β_1	69 Tm	2	1.5063	8.231
1.3898	1	70 Yb	L β_5	8.9209	1.5097	2	65 Tb	L β_1	8.212	L β_1	65 Tb	2	1.5097	8.212
1.3905	1	67 Ho	L β_1	8.9164	1.51389	9	68 Er	L β_{15}	8.1890	L β_{15}	68 Er	9	1.51389	8.1890
1.39121	5	76 Os	L α_1	8.9117	1.5162	2	69 Tm	L β_1	8.177	L β_1	69 Tm	2	1.5162	8.177
1.3915	1	70 Yb	L β_{10}	8.9100	1.5178	1	75 Re	L β_1	8.1682	L β_1	75 Re	1	1.5178	8.1682
1.39220	5	72 Hf	L β_4	8.9054	1.51824	1	66 Dy	L β_1	8.1661	L β_1	66 Dy	1	1.51824	8.1661
1.392218	9	29 Cu	K $\beta_{1,3}$	8.90529	1.52157	7	73 Ta	L α_1	8.1461	L α_1	73 Ta	7	1.52157	8.1461
1.3923	2	67 Ho	L β_7	8.905	1.52325	2	72 Hf	L β_7	8.1393	L β_7	72 Hf	2	1.52325	8.1393
1.3926	1	29 Cu	K β_3	8.9029	1.5297	5	64 Gd	L η	8.105	L η	64 Gd	5	1.5297	8.105
1.3948	1	70 Yb	L β_7	8.8889	1.5303	2	65 Tb	L β_7	8.102	L β_7	65 Tb	2	1.5303	8.102
1.3983	2	67 Ho	L β_7	8.867	1.5304	2	69 Tm	L β_1	8.101	L β_1	69 Tm	2	1.5304	8.101
1.40140	5	71 Lu	L β_5	8.8469	1.53293	2	73 Ta	L α_1	8.0879	L α_1	73 Ta	2	1.53293	8.0879
1.40234	5	76 Os	L α_1	8.8410	1.5331	2	64 Cd	L γ_1	8.087	L γ_1	64 Cd	2	1.5331	8.087
1.4067	3	68 Er	L γ_5	8.814	1.53333	9	71 Lu	L γ_1	8.0858	L γ_1	71 Lu	9	1.53333	8.0858
1.41366	7	79 Au	L β_1	8.7702	1.5347	2	76 Cs	L β_1	8.079	L β_1	76 Cs	2	1.5347	8.079
1.41550	5	70 Yb	L β_{15}	8.7588	1.5368	1	67 Ho	L β_1	8.076	Abs. edge	Abs. edge	1	1.5368	8.076
1.41640	7	66 Dy	L γ_5	8.7532	1.5378	1	67 Ho	L β_5	8.062	L β_5	67 Ho	1	1.5378	8.062
1.4174	2	67 Ho	L γ_1	8.747	1.5381	1	63 Eu	L β_1	8.0607	Abs. edge	Abs. edge	1	1.5381	8.0607
1.4189	1	71 Lu	L β_5	8.7376	1.540562	2	29 Cu	K α_1	8.04778	K α_1	29 Cu	2	1.540562	8.04778
1.42110	3	74 W	L β_1	8.7243	1.54094	3	77 Ir	LL	8.0458	LL	77 Ir	3	1.54094	8.0458
1.4216	1	80 Hg	LL	8.7210	1.5439	1	63 Eu	L γ_4	8.0304	L γ_4	63 Eu	1	1.5439	8.0304
1.4223	1	65 Tb	L β_1	8.7157	1.544390	9	29 Cu	K α_2	8.02783	K α_2	29 Cu	9	1.544390	8.02783
1.42278	7	66 Dy	L γ_2	8.7140	1.5448	2	69 Tm	L β_4	8.026	L β_4	69 Tm	2	1.5448	8.026
1.4228	3	65 Tb	L γ_2	8.714	1.5486	3	67 Ho	L β_{10}	8.006	L β_{10}	67 Ho	3	1.5486	8.006
1.42359	3	71 Lu	L β_1	8.7090	1.5616	1	68 Er	L β_1	7.9392	L β_1	68 Er	1	1.5616	7.9392
1.4276	2	65 Tb	L γ_4	8.685	1.5632	1	64 Cd	L β_1	7.9310	Abs. edge	Abs. edge	1	1.5632	7.9310
1.43025	9	72 Hf	L β_1	8.6685	1.5642	3	74 W	L β_1	7.926	L β_1	74 W	3	1.5642	7.926

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1.43048	73 Ta	$L_{II}M_{II}$	8.6671	1.5644	2	64 Gd	$L\gamma_6$	$L_{II}O_{IV}$	7.925
1.4318	77 Ir	$L_{III}M_{III}$	8.659	1.5671	2	67 Ho	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	7.911
1.43290	75 Re	$L_{III}M_{IV}$	8.6525	1.5675	2	68 Er	$L\beta_6$	$L_{III}N_I$	7.909
1.4334	69 Tm	Abs. edge	8.6496	1.56958	5	72 Hf	$L\alpha_1$	$L_{III}M_{IV}$	7.8990
1.4336	69 Tm	$L_{II}M_{IV}$	8.648	1.5707	2	64 Gd	$L\gamma_6$	$L_{II}O_I$	7.894
1.4349	69 Tm	$L_{III}O_{IV,V}$	8.641	1.5779	1	71 Lu	$L\eta$	$L_{II}M_I$	7.8575
1.435155	30 Zn	KL_{III}	8.63886	1.5787	2	65 Th	$L\gamma_6$	$L_{II}N_I$	7.8535
1.43643	72 Hf	$L_{III}M_{III}$	8.6312	1.5789	1	75 Re	$L\zeta$	$L_{III}M_{II}$	7.8525
1.439000	30 Zn	KL_{II}	8.61578	1.58046	5	72 Hf	$L\alpha_2$	$L_{III}M_{IV}$	7.8446
1.44056	71 Lu	$L_{II}M_{II}$	8.6064	1.58498	7	76 Os	$L\zeta$	$L_{III}M_I$	7.8222
1.4410	69 Tm	$L_{II}M_{IV}$	8.604	1.5873	7	68 Er	$L\beta_1$	$L_{III}M_{IV}$	7.8109
1.44396	75 Re	$L_{III}M_{IV}$	8.5862	1.58837	7	66 Dy	$L\beta_5$	$L_{III}O_{IV,V}$	7.8055
1.4445	66 Dy	Abs. edge	8.5830	1.58844	9	70 Yb	$L\gamma_2$	$L_{III}M_{II}$	7.8052
1.44579	66 Dy	$L_{II}O_{IV}$	8.5753	1.5903	2	63 Eu	$L\gamma_2$	$L_{II}N_{III}$	7.7961
1.45233	70 Yb	$L_{II}M_{III}$	8.5367	1.5916	1	66 Dy	L_{III}	Abs. edge	7.7897
1.4530	78 Pt	$L_{III}M_{II}$	8.533	1.5924	2	64 Gd	$L\gamma_1$	$L_{III}N_{IV}$	7.7858
1.45964	79 Au	$L_{III}M_I$	8.4939	1.5961	2	63 Eu	$L\gamma_2$	$L_{II}N_{II}$	7.7677
1.4618	67 Ho	$L_{II}N_I$	8.481	1.59973	9	66 Dy	$L\beta_9$	$L_{II}M_{IV}$	7.7501
1.4640	69 Tm	$L_{III}N_{IV,V}$	8.468	1.6002	1	62 Sm	$L\zeta$	Abs. edge	7.7478
1.4661	70 Yb	$L_{III}N_I$	8.4563	1.6007	1	68 Er	$L\beta_4$	$L_{II}M_{II}$	7.7453
1.47106	73 Ta	$L_{II}M_I$	8.4280	1.60447	7	66 Dy	$L\beta_7$	$L_{II}O_I$	7.7272
1.4718	85 Tb	$L_{II}N_{II}$	8.423	1.60728	3	62 Sm	$L\gamma_4$	$L_{II}O_{III}$	7.714
1.47266	66 Dy	$L_{III}N_{IV}$	8.4188	1.60743	9	66 Dy	$L\beta_{10}$	$L_{II}M_{IV}$	7.7130
1.4735	76 Os	$L_{III}M_{III}$	8.414	1.60815	1	27 Co	K	Abs. edge	7.70954
1.47565	70 Yb	$L_{III}M_{IV}$	8.4018	1.60891	3	27 Co	$K\beta_5$	$KM_{IV,V}$	7.7059
1.4764	65 Th	$L_{II}N_{IV}$	8.398	1.61264	9	73 Ta	$L\zeta$	$L_{III}M_{III}$	7.6881
1.47639	74 W	$L_{III}M_{IV}$	8.3976	1.61951	3	71 Lu	$L\alpha_1$	$L_{III}M_{IV}$	7.6555
1.4784	64 Gd	Abs. edge	8.3864	1.6203	2	67 Ho	$L\beta_3$	$L_{II}M_{IV}$	7.6519
1.48064	72 Hf	$L_{II}M_{II}$	8.3735	1.62079	2	27 Co	$K\beta_{1,3}$	$KM_{II,III}$	7.64943
1.4807	64 Gd	$L_{II}O_{IV,V}$	8.373	1.6237	2	67 Ho	$L\beta_6$	$L_{III}N_I$	7.6359
1.4835	68 Er	Abs. edge	8.3575	1.62369	7	66 Dy	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	7.6357
1.4839	64 Gd	$L_{II}O_{III,II}$	8.355	1.6244	3	74 W	$L\zeta$	$L_{III}M_{II}$	7.6324
1.4848	68 Er	$L_{III}O_{IV,V}$	8.350	1.6271	1	63 Eu	$L\eta$	Abs. edge	7.6199
1.4855	68 Er	$L_{II}M_{IV}$	8.346	1.6282	2	63 Eu	$L\gamma_6$	$L_{II}O_{IV}$	7.6147
1.48743	74 W	$L_{II}M_{IV}$	8.3352	1.63029	5	71 Lu	$L\alpha_2$	$L_{III}M_{IV}$	7.6049
1.48807	28 Ni	Abs. edge	8.33165	1.63056	5	75 Re	$L\zeta$	$L_{III}M_I$	7.6036
1.48862	28 Ni	$KM_{IV,V}$	8.3286	1.6346	5	63 Eu	$L\gamma_8$	$L_{II}O_I$	7.5849
1.49138	70 Yb	$L_{II}M_{II}$	8.3132	1.63560	5	70 Yb	$L\eta$	$L_{II}M_I$	7.5802
1.4930	77 Ir	$L_{III}M_{II}$	8.304	1.6412	2	64 Gd	$L\gamma_5$	$L_{II}N_I$	7.5543

TABLE 7f-2. WAVELENGTHS OF X-RAY EMISSION LINES AND ABSORPTION EDGES: IN NUMERICAL ORDER (Continued)

Wavelength, Å*	p.e.†	Element	Designation	keV	Wavelength, Å*	p.e.†	Element	Designation	keV
1.6475	2	67 Ho	Lβ ₁	7.5253	1.8450	2	67 Ho	Lα ₁	6.7198
1.6497	1	65 Tb	L _{III}	7.5153	1.8457	1	62 Sm	L _{III}	6.7172
1.6510	2	65 Tb	Lβ ₃	7.5094	1.8468	2	64 Gd	Lβ ₁	6.7126
1.65601	3	62 Sm	Lγ ₃	7.487	1.84730	9	62 Sm	Lβ ₃	6.6871
1.6574	2	63 Eu	Lγ ₁	7.4803	1.8540	2	64 Gd	Lβ ₁	6.683
1.657910	8	28 Ni	Kα ₁	7.47815	1.8552	5	60 Nd	Lγ ₃	6.6795
1.6585	2	65 Tb	Lβ ₁	7.4753	1.8561	2	67 Ho	Lα ₂	6.679
1.6595	2	67 Ho	Lβ ₁	7.4708	1.85626	3	62 Sm	Lβ ₁	6.660
1.66044	6	62 Sm	Lγ ₂	7.467	1.86166	3	62 Sm	Lβ ₁₀	6.634
1.661747	8	28 Ni	Kα ₂	7.46089	1.86590	3	62 Sm	Lβ ₈	6.6170
1.66346	9	72 Hf	Ls	7.4532	1.8737	2	63 Eu	Lβ ₈	6.616
1.6673	3	65 Tb	Lβ ₁₀	7.436	1.8740	4	59 Pr	Lγ ₃	6.6021
1.6674	5	61 Pm	L _I	7.4156	1.8779	2	60 Nd	Lγ ₁	6.598
1.67189	4	70 Yb	Lα ₁	7.4123	1.8791	4	59 Pr	Lγ ₂	6.586
1.67265	9	73 Ta	L _I	7.3878	1.8821	3	62 Sm	Lβ _{2,15}	6.5713
1.6782	1	74 W	L _I	7.3705	1.8857	2	63 Eu	Lβ ₃	6.548
1.68213	7	66 Dy	Lβ ₆	7.3702	1.8934	5	58 Ce	L _I	6.5455
1.6822	2	66 Dy	Lβ ₂	7.3667	1.89415	5	70 Yb	L _I	6.5376
1.68285	5	70 Yb	Lα ₁	7.3673	1.89643	1	25 Mn	K	6.5352
1.6830	2	65 Tb	Lβ _{2,15}	7.3132	1.8971	7	25 Mn	Kβ ₃	6.5342
1.6953	1	62 Sm	L _{II}	7.3088	1.89743	4	66 Dy	Lη	6.528
1.6963	2	69 Tm	Lγ ₄	7.308	1.8991	3	58 Ce	Lγ ₄	6.49045
1.6966	9	62 Sm	Lγ ₃	7.277	1.9021	4	66 Dy	Lα ₁	6.4805
1.7085	2	63 Eu	Lγ ₃	7.2566	1.9191	1	25 Mn	L _{III}	6.4577
1.71062	7	66 Dy	Lβ ₁	7.2477	1.9191	3	66 Dy	Lα ₂	6.4564
1.7117	1	64 Gd	L _{III}	7.2430	1.9203	2	63 Eu	Lβ ₁	6.4389
1.7130	2	64 Gd	Lβ ₁	7.2374	1.9255	2	63 Eu	Lβ ₁	6.439
1.7203	2	64 Gd	Lβ ₁	7.2071	1.9255	5	59 Pr	L _{III}	6.406
1.72103	7	66 Dy	Lβ ₁	7.2039	1.9355	4	60 Nd	Lγ ₃	6.40384
1.72305	9	72 Hf	L _I	7.1954	1.936042	9	26 Fe	Kα ₁	6.403
1.7240	3	64 Gd	Lβ ₁	7.192	1.9362	4	59 Pr	Lγ ₃	6.39084
1.72724	3	62 Sm	Lγ ₄	7.178	1.93980	9	26 Fe	Kα ₂	
1.7268	2	69 Tm	Lα ₁	7.1799					

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1.72841	73 Ta	L_1	1.94643	3	62 Sm	$L\beta_6$	$L_{III}N_1$	6.3683
1.7315	64 Gd	$L\beta_{10}$	1.9550	2	69 Tm	L_1	$L_{III}M_1$	6.3419
1.7381	69 Tm	$L\alpha_3$	1.9553	3	58 Ce	$L\gamma_2$	$L_{II}N_{III}$	6.3409
1.7390	60 Nd	L_1	1.9559	6	61 Pm	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	6.339
1.7422	65 Tb	$L\beta_6$	1.9602	3	58 Ce	$L\gamma_2$	$L_{II}N_1$	6.3250
1.74346	26 Fe	K	1.9611	3	59 Pr	$L\beta_3$	$L_{II}N_{IV}$	6.3221
1.7442	26 Fe	$K\beta_5$	1.96241	3	62 Sm	$L\eta$	$L_{II}M_{II}$	6.318
1.7445	60 Nd	$L\gamma_4$	1.9730	2	65 Tb	$L\eta$	$L_{III}M_1$	6.2839
1.7455	64 Gd	$L\beta_{2,15}$	1.9765	2	65 Tb	$L\alpha_1$	$L_{III}M_V$	6.2728
1.7472	65 Tb	$L\beta_3$	1.9780	5	57 La	L_1	Abs. edge	6.268
1.75661	26 Fe	$K\beta_{1,2}$	1.9830	4	57 La	$L\gamma_4$	$L_1O_{III,III}$	6.252
1.7566	68 Er	$L\eta$	1.9875	4	65 Tb	$L\alpha_2$	$L_{III}M_{IV}$	6.2380
1.7676	61 Pm	L_{II}	1.9967	1	60 Nd	L_{III}	Abs. edge	6.2092
1.7760	71 Lu	L_1	1.99806	3	62 Sm	$L\beta_1$	$L_{II}M_V$	6.2051
1.7761	63 Eu	L_{III}	2.00095	6	62 Sm	$L\beta_4$	$L_{II}M_{II}$	6.196
1.7768	65 Tb	$L\beta_1$	2.0092	3	60 Nd	$L\beta_7$	$L_{III}O_1$	6.1708
1.7772	63 Eu	$L\beta_5$	2.0124	5	58 Ce	L_{II}	Abs. edge	6.161
1.77934	62 Sm	$L\gamma_5$	2.015	1	68 Er	L_1	$L_{III}M_1$	6.152
1.78145	72 Hf	L_1	2.0165	3	60 Nd	$L\beta_9$	$L_{II}M_V$	6.1484
1.78425	68 Er	$L\alpha_1$	2.0205	4	59 Pr	$L\gamma_6$	$L_{II}N_1$	6.136
1.7851	63 Eu	$L\beta_7$	2.0237	4	58 Ce	$L\gamma_8$	$L_{III}O_1$	6.126
1.7864	65 Tb	$L\beta_4$	2.0237	3	60 Nd	$L\beta_{10}$	$L_{II}M_{IV}$	6.1265
1.788965	27 Co	$K\alpha_1$	2.0360	3	60 Nd	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	6.0894
1.7916	63 Eu	$L\beta_8$	2.0410	4	57 La	$L\gamma_3$	$L_{II}N_{III}$	6.074
1.792550	27 Co	$K\alpha_2$	2.0421	4	61 Pm	$L\beta_2$	$L_{II}M_{III}$	6.071
1.7955	68 Er	$L\alpha_2$	2.0460	4	57 La	$L\gamma_2$	$L_{II}N_{II}$	6.060
1.7964	60 Nd	$L\gamma_3$	2.0468	2	64 Gd	$L\alpha_1$	$L_{III}M_V$	6.0572
1.7989	61 Pm	$L\gamma_1$	2.0487	4	58 Ce	$L\gamma_1$	$L_{II}N_{IV}$	6.052
1.7993	63 Eu	$L\beta_{10}$	2.0494	1	64 Gd	$L\eta$	$L_{II}M_1$	6.0495
1.8013	60 Nd	$L\gamma_3$	2.0578	2	64 Gd	$L\alpha_2$	$L_{III}M_{IV}$	6.0250
1.8054	64 Gd	$L\beta_6$	2.0678	5	56 Ba	L_1	Abs. edge	5.996
1.8118	63 Eu	$L\beta_{2,15}$	2.07020	5	24 Cr	K	Abs. edge	5.9888
1.8141	59 Pr	L_1	2.07087	6	24 Cr	$K\beta_5$	$KM_{IV,V}$	5.9869
1.8150	64 Gd	$L\beta_3$	2.0756	3	56 Ba	$L\gamma_4$	$L_1O_{III,III}$	5.9733
1.8193	59 Pr	$L\gamma_4$	2.0791	5	59 Pr	L_{II}	Abs. edge	5.963
1.8264	67 Ho	$L\eta$	2.0797	4	61 Pm	$L\beta_1$	$L_{II}M_V$	5.961
1.83091	70 Yb	L_1	2.08487	2	24 Cr	$K\beta_{1,3}$	$KM_{III,III}$	5.94671
1.8360	71 Lu	L_1	2.0860	2	67 Ho	L_1	$L_{III}M_1$	5.9434
1.8440	60 Nd	L_{II}	2.0919	4	59 Pr	$L\beta_7$	$L_{III}O_1$	5.927

TABLE 7f-2. WAVELENGTHS OF X-RAY EMISSION LINES AND ABSORPTION EDGES: IN NUMERICAL ORDER (Continued)

Wavelength, Å*	p.e.†	Element	Designation	keV	Wavelength, Å*	p.e.†	Element	Designation	keV
2.1004	4	59 Pr	L _{II} M _V	5.903	2.4094	4	60 Nd	L _{II} M _I	5.1457
2.101820	9	25 Mn	KL _{III}	5.89875	2.4105	3	57 La	L _{II} M _{III}	5.1434
2.1039	3	60 Nd	L _{III} N _I	5.8930	2.4174	2	55 Cs	L _{III} N _I	5.1287
2.1053	5	57 La	Abs. edge	5.889	2.4292	1	54 Xe	Abs. edge	5.1037
2.10578	2	25 Mn	KL _{II}	5.88765	2.442	9	90 Th	M _{II} O _{III}	5.08
2.1071	4	59 Pr	L _{II} M _{IV}	5.884	2.443	4	92 U	M _{II} O _{IV}	5.075
2.1103	3	58 Ce	L _{II} N _I	5.8751	2.4475	2	53 I	L _{II} N _{III}	5.0657
2.1194	4	59 Pr	L _{III} N _{IV} V	5.850	2.4493	3	57 La	L _{II} M _{II}	5.0620
2.1209	2	63 Eu	L _{III} M _V	5.8457	2.45891	5	57 La	L _{III} M _{IV}	5.0421
2.1268	2	60 Nd	L _{II} M _{III}	5.8294	2.4630	2	59 Pr	L _{III} M _V	5.0337
2.1315	2	63 Eu	L _{II} M _I	5.8166	2.4729	3	59 Pr	L _{III} M _{IV}	5.0135
2.1315	2	63 Eu	L _{III} M _{IV}	5.8166	2.4740	1	55 Cs	Abs. edge	5.0113
2.1342	2	56 Ba	L _I N _{III}	5.8092	2.4783	2	55 Cs	L _I M _V	5.0026
2.1387	2	56 Ba	L _I N _{II}	5.7969	2.4823	4	62 Sm	L _{III} M _I	4.9945
2.1418	3	57 La	L _{II} N _{IV}	5.7885	2.4826	2	56 Ba	L _{III} N _I	4.9939
2.15377	7	66 Dy	L _{III} M _I	5.7431	2.4849	2	55 Cs	L _{III} O _I	4.9893
2.166	1	58 Ce	Abs. edge	5.723	2.4920	2	55 Cs	L _I M _{IV}	4.9752
2.1669	3	60 Nd	L _I M _{II}	5.7216	2.49734	5	22 Ti	Abs. edge	4.96452
2.1669	2	60 Nd	L _{III} M _{IV}	5.7216	2.4985	2	22 Ti	KM _{IV} V	4.9623
2.1673	5	55 Cs	Abs. edge	5.721	2.50356	2	23 V	KL _{III}	4.95220
2.1701	2	58 Ce	L _{III} O _I	5.7132	2.50738	2	23 V	KL _{II}	4.94464
2.1741	2	55 Cs	L _I O _{III} III	5.7026	2.5099	1	52 Te	Abs. edge	4.9397
2.1885	3	58 Ce	L _I M _V	5.6650	2.5113	2	52 Te	L _I O _{III} III	4.9369
2.1906	4	59 Pr	L _{III} N _I	5.660	2.5118	2	55 Cs	L _{III} N _{IV} V	4.9359
2.1968	5	58 Ce	L _I M _{IV}	5.646	2.512	3	59 Pr	L _{II} M _I	4.935
2.1998	2	62 Sm	L _{III} M _V	5.6361	2.51391	2	22 Ti	KM _{III} III	4.93181
2.2048	1	56 Ba	Abs. edge	5.6233	2.5164	2	56 Ba	L _I M _{III}	4.9269
2.2056	4	57 La	L _{II} N _I	5.621	2.527	4	91 Pa	M _{II} O _{IV}	4.906
2.2087	2	58 Ce	L _{III} N _{IV} V	5.6134	2.5542	5	53 I	Abs. edge	4.8540
2.21062	3	62 Sm	L _{III} M _{IV}	5.6090	2.5553	2	56 Ba	L _I M _{II}	4.8519
2.2172	3	59 Pr	L _I M _{III}	5.5918	2.5615	2	58 Ce	L _{III} M _V	4.8402
2.21824	3	62 Sm	L _{II} M _I	5.589	2.5674	2	52 Te	L _{II} N _{III}	4.8290
2.2328	2	55 Cs	L _I N _{III}	5.5527	2.56821	5	56 Ba	L _{III} M _{IV}	4.82753

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2.2352	65 Th	Ll	5.5467	2.5706	3	58 Ce	L _{III} M _{IV}	4.8230
2.2371	55 Cs	L _{γ1}	5.5420	2.58244	8	53 I	L _{III} N _{IV}	4.8009
2.2415	56 Ba	L _{γ1}	5.5311	2.5926	1	54 Ne	Abs. edge	4.7822
2.253	92 U	L _{β1}	5.50	2.5832	2	55 Cs	L _{III} N _I	4.7811
2.2550	59 Pr	L _{β1}	5.4981	2.618	5	90 Th	M _{III} O _{IV}	4.735
2.2588	59 Pr	L _{β1}	5.4889	2.6203	4	58 Ce	L _{III} M _I	4.7315
2.261	57 La	L _{III}	5.484	2.6285	4	55 Cs	L _{III} M _{III}	4.7167
2.2691	23 V	K	5.4639	2.6388	1	51 Sb	L _I	4.6984
2.26951	23 V	K _{β1}	5.4629	2.6398	2	5 Sb	Abs. edge	4.6967
2.2737	54 Xe	L _I	5.4528	2.65710	9	53 I	L _I O _{III,III}	4.6660
2.275	57 La	L _{β1}	5.450	2.6570	5	57 La	L _{III} N _I	4.65097
2.282	57 La	L _{β1}	5.434	2.6666	5	55 Cs	L _{III} M _V	4.6494
2.2818	58 Ce	L _{β1}	5.4334	2.67533	5	57 La	L _{III} M _{IV}	4.63423
2.2822	61 Pm	L _{β1}	5.4325	2.6760	4	60 Nd	L _{III} M _I	4.6330
2.28440	23 V	K _{β1,2}	5.42729	2.6837	4	55 Cs	L _{III} M _{IV}	4.6198
2.28970	24 Cr	K _{α1}	5.41472	2.6879	1	52 Te	Abs. edge	4.6126
2.290	57 La	L _{β1}	5.415	2.6953	2	51 Sb	L _I N _{III,III}	4.5999
2.2926	61 Pm	L _{α2}	5.4078	2.71241	6	52 Te	L _{III} N _{IV}	4.5709
2.293606	24 Cr	K _{α1}	5.405509	2.71352	9	53 I	L _{III} N _V	4.5690
2.3030	57 La	L _{β2,15}	5.3835	2.7196	5	53 I	L _I M _V	4.5587
2.304	92 U	L _{γ1}	5.38	2.72104	9	53 I	Abs. edge	4.5564
2.3085	56 Ba	L _{γ1}	5.3707	2.7288	3	53 I	L _{III} O _I	4.5435
2.3109	58 Ce	L _{β2}	5.3651	2.740	3	57 La	L _{III} M _I	4.525
2.3122	64 Gd	L _I	5.3621	2.74851	2	22 Ti	K _{LIII}	4.51084
2.3139	55 Cs	L _{III}	5.3581	2.75053	8	53 I	L _{III} N _{IV,V}	4.5075
2.3480	55 Cs	L _{γ1}	5.2804	2.75216	2	22 Ti	M _I N _{III}	4.50486
2.3497	58 Ce	L _{β1}	5.2765	2.753	8	92 U	Abs. edge	4.50
2.3561	58 Ce	L _{β1}	5.2622	2.762	1	21 Sc	K	4.489
2.3629	56 Ba	L _{III}	5.2470	2.7634	3	21 Sc	Abs. edge	4.4865
2.3704	60 Nd	L _{α1}	5.2304	2.77595	5	56 Ba	K _{MIV,V}	4.46626
2.3764	56 Ba	L _{β1}	5.2171	2.7739	1	50 Sn	L _{III} M _V	4.4648
2.3790	57 La	L _{β1}	5.2114	2.7775	2	50 Sn	Abs. edge	4.4638
2.3806	56 Ba	L _{β1}	5.2079	2.7796	2	21 Sc	L _I O _{III,III}	4.4605
2.3807	60 Nd	L _{α2}	5.2077	2.7811	4	59 Pr	K _{MIII,III}	4.4532
2.3869	56 Ba	L _{β10}	5.1941	2.78553	5	56 Ba	L _{III} M _I	4.45090
2.3880	53 I	L _I	5.192	2.79007	9	52 Te	L _{III} N _{IV}	4.4437
2.3913	53 I	L _{γ4}	5.1848	2.817	2	92 U	L _{III} N _I	4.401
2.3948	63 Eu	L _I	5.1772	2.8294	5	51 Sb	Abs. edge	4.3819
2.40435	56 Ba	L _{β2,15}	5.1565	2.8327	2	50 Sn	L _I N _{III,III}	4.3768

TABLE 7f-2. WAVELENGTHS OF X-RAY L_α EMISSION LINES AND ABSORPTION EDGES: IN NUMERICAL ORDER (Continued)

Wavelength, Å*	p.e.†	Element	Designation	keV	Wavelength, Å*	p.e.†	Element	Designation	keV
2.83672	9	53 I	L _{III} N _I	4.3706	3.27404	9	49 In	L _I M _{IV}	3.7868
2.83897	9	52 Te	L _I M _V	4.3671	3.27979	9	53 I	L _{III} M _I	3.7801
2.84679	9	52 Te	L _I M _{IV}	4.3551	3.283	9	90 Th	M _{III} O _I	3.78
2.85159	3	51 Sb	L _{II} N _{IV}	4.34779	3.28920	6	52 Te	L _{III} M _V	3.76933
2.8555	1	52 Te	Abs. edge	4.3418	3.29846	6	52 Te	L _{III} M _{IV}	3.7588
2.8627	3	56 Ba	L _{II} M _I	4.3309	3.30885	3	50 Sn	L _I M _{III}	3.7500
2.8634	3	52 Te	L _{III} O _I	4.3298	3.30635	9	47 Ag	L _I N _{III}	3.7498
2.87429	9	53 I	L _I M _{III}	4.3134	3.31216	9	47 Ag	L _I N _{II}	3.7432
2.88217	8	52 Te	L _{III} N _{IV,V}	4.3017	3.3237	1	49 In	Abs. edge	3.7302
2.884	5	92 U	Abs. edge	4.299	3.324	4	49 In	L _{III} O _I	3.730
2.8917	4	58 Ce	L _{III} M _I	4.2875	3.3257	1	48 Cd	Abs. edge	3.7280
2.8924	2	55 Cs	L _{III} M _V	4.2865	3.329	4	92 U	M _{II} N _I	3.724
2.9020	2	55 Cs	L _{III} M _{IV}	4.2722	3.333	5	92 U	Abs. edge	3.720
2.910	2	91 Pa	M _{II} N _{IV}	4.260	3.33564	6	48 Cd	L _{II} N _{IV}	3.71686
2.91207	9	53 I	L _I M _{II}	4.2575	3.33838	6	49 In	L _{III} N _{IV,V}	3.71381
2.92	2	92 U	M _I N _{II}	4.25	3.34335	9	50 Sn	L _I M _{II}	3.7083
2.9260	1	49 In	Abs. edge	4.2373	3.346	5	81 Tl	M _I	3.705
2.9264	2	49 In	L _I O _{II,III}	4.2367	3.35839	3	20 Ca	K _L III	3.69168
2.93187	9	51 Sb	L _{II} N _I	4.2287	3.359	5	83 Bi	Abs. edge	3.691
2.934	8	90 Th	M _I N _{III}	4.23	3.36166	3	20 Ca	K _L II	3.68809
2.93744	6	53 I	L _{II} M _{IV}	4.22072	3.38487	3	50 Sn	L _{II} M _{IV}	3.68280
2.948	2	92 U	M _{III} O _{IV,V}	4.205	3.42551	9	48 Cd	L _{II} N _I	3.61935
2.97088	9	52 Te	L _{II} N _I	4.1732	3.43015	9	48 Cd	L _I M _V	3.61445
2.97261	9	51 Sb	L _I M _V	4.1708	3.43606	9	49 In	L _{III} N _I	3.60823
2.97917	9	51 Sb	L _I M _{IV}	4.1616	3.4365	1	19 K	Abs. edge	3.6078
2.9800	2	49 In	L _I N _{II,III}	4.1605	3.4367	2	48 Cd	L _I M _{IV}	3.6075
2.9823	1	50 Sn	Abs. edge	4.1573	3.437	1	46 Pd	Abs. edge	3.607
2.9932	2	55 Cs	L _{II} M _I	4.1421	3.43832	9	52 Te	L _{II} M _I	3.60586
3.0003	1	51 Sb	Abs. edge	4.1323	3.43941	4	51 Sb	L _{III} M _V	3.60472
3.00115	3	50 Sn	L _{II} N _{IV}	4.13112	3.44	5	91 Pa	M _{II} N _I	3.603
3.0052	3	51 Sb	L _{III} O _I	4.1255	3.4413	4	19 K	K _M IV,V	3.6027
3.006	3	57 La	L _{II} M _{II}	4.124	3.44840	6	51 Sb	L _{III} M _{IV}	3.59532
3.00893	9	52 Te	L _I M _{III}	4.1204	3.4539	2	19 K	K _M II,III	3.5896

3.011	2	90 Th	$L\alpha_1$	$M_{III}N_{IV}$	4.117	3.46984	9	49 In	$L\beta_3$	$L_{II}M_{III}$	3.57311
3.0166	3	54 Ne	$L\beta_{2,15}$	$L_{III}M_{IV}$	4.1099	3.478	5	80 Hg	M_I	Abs. edge	3.565
3.02335	2	51 Sb	$K\alpha$	$L_{III}N_{IV}, V$	4.10078	3.479	1	92 U	$M\gamma$	$M_{III}N_V$	3.563
3.0309	1	21 Sc	$K\alpha_2$	KL_{III}	4.0906	3.4892	2	46 Pd	$L\gamma_{2,3}$	$L_{II}N_{III}, II$	3.5533
3.0342	1	21 Sc	$K\alpha_1$	KL_{II}	4.0861	3.492	5	82 Pb	M_{II}	Abs. edge	3.550
3.038	2	91 Pa	$L\beta_4$	$M_{III}O_{IV}, V$	4.081	3.507	5	92 U	M_{III}	Abs. edge	3.545
3.04661	9	52 Te	M_{III}	$L_{II}M_{II}$	4.0695	3.5047	1	48 Cd	L_{III}	Abs. edge	3.5376
3.068	5	90 Th	Abs. edge	Abs. edge	4.041	3.50697	9	49 In	$L\beta_4$	$L_{II}M_{II}$	3.53528
3.0703	1	20 Ca	K	Abs. edge	4.0381	3.51408	4	48 Cd	$L\beta_{2,15}$	$L_{III}N_{IV}, V$	3.52812
3.0746	3	20 Ca	$K\beta$	Abs. edge	4.0325	3.5164	1	47 Ag	L_{II}	Abs. edge	3.5258
3.07677	6	52 Te	$L\beta_1$	KM_{IV}, V	4.02958	3.521	2	92 U	$M_{III}N_{IV}$	$M_{III}N_{IV}$	3.521
3.08475	9	50 Sn	$L\gamma_1$	$L_{III}M_{IV}$	4.0192	3.52260	4	47 Ag	$L\gamma_1$	$L_{III}N_{IV}$	3.51959
3.0849	1	48 Cd	$K\beta_{1,3}$	Abs. edge	4.0190	3.537	9	90 Th	$L\beta_1$	$M_{III}N_I$	3.505
3.0897	2	20 Ca	M_I	KM_{III}, III	4.0127	3.55531	4	49 In	M_{IV}	$L_{II}M_{IV}$	3.48721
3.094	5	83 Bi	$L\beta_5$	Abs. edge	4.007	3.557	5	90 Th	Ll	Abs. edge	3.485
3.11513	9	50 Sn	$L\beta_6$	$L_I M_V$	3.9800	3.55754	9	53 I	$M\gamma$	$L_{III}M_I$	3.48502
3.11513	9	51 Sb	$L\beta_7$	$M_{III}N_I$	3.9800	3.576	1	92 U	$L\alpha_1$	$M_{III}O_{II}$	3.4666
3.115	7	92 U	$L\beta_8$	$M_{III}O_I$	3.980	3.577	1	91 Pa	$L\alpha_2$	$M_{III}N_V$	3.4657
3.12170	9	50 Sn	$L\beta_9$	$L_{II}M_{IV}$	3.9716	3.59994	3	50 Sn	$L\eta$	$L_{II}M_V$	3.43917
3.131	3	90 Th	Ll	$M_{III}O_{IV}, V$	3.959	3.60497	9	47 Ag	$L\beta_9$	$L_{II}M_V$	3.43661
3.1355	2	56 Ba	$L\gamma_2$	$L_{III}N_I$	3.9541	3.60765	9	51 Sb	$L\alpha_2$	$L_{III}M_{IV}$	3.43542
3.1377	2	48 Cd	$L\gamma_3$	$L_{II}N_I$	3.9513	3.60891	4	50 Sn	$L\beta_{10}$	$L_{II}M_I$	3.43287
3.1473	1	49 In	$L\gamma_4$	Abs. edge	3.9393	3.61158	9	47 Ag	$L\beta_6$	$M_{III}N_{IV}$	3.430
3.14860	6	53 I	$L\gamma_5$	$L_{III}M_V$	3.93765	3.614	2	91 Pa	$L\gamma_5$	$L_{III}N_I$	3.42994
3.15258	9	51 Sb	$L\gamma_6$	Abs. edge	3.9327	3.61467	9	48 Cd	M_I	$L_{III}N_I$	3.42832
3.1557	1	50 Sn	$L\gamma_7$	Abs. edge	3.9288	3.61638	9	47 Ag	L_I	Abs. edge	3.428
3.1564	3	50 Sn	$L\gamma_8$	$L_{III}O_I$	3.9279	3.616	5	79 Au	M_{II}	Abs. edge	3.417
3.15791	6	53 I	$L\gamma_9$	$L_{III}M_{IV}$	3.92604	3.629	5	45 Rh	M_{II}	Abs. edge	3.412
3.16213	4	49 In	$L\beta_{2,15}$	$L_{III}N_{IV}$	3.92081	3.634	5	81 Tl	M_{II}	Abs. edge	3.40145
3.17505	3	50 Sn	$L\beta_1$	$L_{III}N_{IV}, V$	3.90486	3.64495	9	48 Cd	$L\beta_3$	$L_{II}M_{III}$	3.370
3.19014	9	51 Sb	$L\beta_2$	$L_{II}M_{II}$	3.8364	3.679	2	90 Th	$M\gamma$	$M_{III}N_V$	3.36719
3.217	5	82 Pb	M_I	Abs. edge	3.854	3.68203	9	48 Cd	$L\beta_4$	$L_{II}M_{II}$	3.3640
3.22567	4	51 Sb	$L\beta_3$	$L_{II}M_{IV}$	3.84357	3.6855	2	45 Rh	$L\gamma_{2,3}$	$L_{II}N_{III}, II$	3.359
3.245	9	91 Pa	$L\gamma_8$	$M_{III}O_I$	3.82	3.691	2	91 Pa	L_{III}	$M_{IV}O_I$	3.35096
3.24907	9	49 In	L_I	$L_{III}N_I$	3.8159	3.6999	1	47 Ag	$L\beta_{2,15}$	Abs. edge	3.34781
3.2564	1	47 Ag	Ll	Abs. edge	3.8072	3.70335	3	47 Ag	$M\beta$	$L_{III}N_{IV}, V$	3.3367
3.2670	2	55 Cs	Ll	$L_{III}M_I$	3.7950	3.716	1	92 U	Ll	$M_{IV}N_{VI}$	3.33555
3.26763	9	49 In	$L\beta_9$	$L_{II}M_V$	3.7942	3.71696	9	52 Te		$L_{III}M_I$	3.33555
3.26901	9	50 Sn	$L\beta_8$	$L_{III}N_I$	3.7926	3.718	3	90 Th		$M_{III}N_{IV}$	3.335

TABLE 7f-2. WAVELENGTHS OF X-RAY EMISSION LINES AND ABSORPTION EDGES: IN NUMERICAL ORDER (Continued)

Wavelength, Å*	Element	Designation	keV	Wavelength, Å*	p.e.†	Element	Designation	keV
3.7228	46 Pd	L _{II}	3.33031	4.198	1	81 Tl	M _{III}	2.9535
3.7246	46 Pd	L _{γ₁}	3.3287	4.216	6	81 Tl	M _{III} O.v.v	2.941
3.729	90 Th	M _V	3.325	4.236	5	75 Re	Abs. edge	2.927
3.73823	48 Cd	L _{β₁}	3.31657	4.2417	2	45 Rh	L _{II} N _I	2.9229
3.740	83 Bi	M _I N _{III}	3.315	4.244	9	82 Pb	M _{III} O _I	2.921
3.7414	19 K	K _{α₁}	3.3138	4.2522	2	45 Rh	L _I M _{III}	2.9157
3.7445	19 K	K _{α₂}	3.3111	4.260	5	77 Ir	Abs. edge	2.910
3.760	90 Th	M _V P _{III}	3.298	4.26873	9	49 In	L _{III} M _I	2.90440
3.762	78 Pt	Abs. edge	3.296	4.2873	2	44 Ru	L _{II} N _I	2.8918
3.77192	49 In	L _{III} M _V	3.28694	4.2888	2	45 Rh	L _I M _{II}	2.8908
3.78073	49 In	L _{III} M _{IV}	3.27929	4.300	9	79 Au	M _I N _{III}	2.883
3.783	80 Hg	M _{II}	3.277	4.304	5	42 Mo	Abs. edge	2.881
3.78876	50 Sn	L _γ	3.27234	4.330	2	92 U	M _{III} N _I	2.863
3.7920	46 Pd	L _{β₉}	3.2696	4.355	1	80 Hg	Abs. edge	2.8469
3.7988	46 Pd	L _{β₁₀}	3.2637	4.36767	5	46 Pd	L _{α₁}	2.83861
3.80774	47 Ag	L _{β₆}	3.25603	4.369	1	44 Ru	L _{III}	2.8377
3.808	90 Th	L _{γ₆}	3.256	4.3718	2	44 Ru	L _{β_{2,15}}	2.8360
3.8222	91 Pa	M _{IV} N _I	3.2437	4.37414	4	45 Rh	L _{β₁}	2.83441
3.83313	46 Pd	M _{IV} N _{VI}	3.2397	4.37588	7	46 Pd	L _{α₂}	2.83329
3.834	83 Bi	M _{III} N _{IV}	3.23446	4.3800	2	42 Mo	L _{γ_{2,3}}	2.8306
3.835	44 Ru	Abs. edge	3.234	4.3971	1	17 Cl	K	2.81960
3.87023	47 Ag	L _I M _{II}	3.233	4.4034	3	17 Cl	K _β	2.8156
3.87090	18 A	Abs. edge	3.20346	4.407	5	74 W	M _I	2.813
3.872	82 Pb	M _I N _{III}	3.20290	4.4183	2	47 Ag	L _γ	2.8061
3.872	18 A	K _{β_{1,3}}	3.202	4.432	4	47 Ag	M _{III} N _{IV}	2.797
3.8826	51 Sb	L _I	3.1905	4.433	5	76 Os	Abs. edge	2.797
3.892	83 Bi	M _I N _{II}	3.18860	4.436	1	43 Te	Abs. edge	2.7948
3.8977	44 Ru	L _{γ_{2,3}}	3.185	4.44	2	74 W	M _I O _{III}	2.79
3.904	83 Bi	M _{III}	3.1809	4.450	4	91 Pa	M _{III} N _I	2.786
3.9074	46 Pd	Abs. edge	3.176	4.460	9	78 Pt	M _I N _{III}	2.780
3.90887	46 Pd	L _{III} N _{IV} .v	3.17298	4.48014	9	48 Cd	L _{III} M _I	2.76735
3.910	92 U	M _V N _{VII}	3.17179	4.4866	3	44 Ru	L _I M _{III}	2.7634
			3.1708	4.4866	3	44 Ru	L _{β₆}	2.7634

3.915	77 Ir	M_I	Abs. edge	3.167	4.518	1	79 Au	M_{III}	Abs. edge	2.7439
3.924	92 U	$M_{\alpha 2}$	M_{V-VII}	3.1595	4.522	6	79 Au	$L\beta_4$	$M_{III}O_{IV-V}$	2.742
3.932	83 Bi		$M_{III}O_{IV-V}$	3.153	4.5230	2	44 Ru	$M\gamma$	$L_{II}M_{II}$	2.7411
3.93473	47 Ag	$L\beta_1$	$L_{II}M_{IV}$	3.15094	4.532	2	83 Bi		$M_{III}N_V$	2.735
3.936	79 Au	M_{II}	Abs. edge	3.150	4.568	5	90 Th		$M_{III}N_I$	2.714
3.941	90 Th	$M\beta$	M_{IV-VI}	3.1458	4.571	5	83 Bi	M_{IV}	$M_{III}N_{IV}$	2.712
3.9425	45 Rh	L_{II}	Abs. edge	3.1448	4.572	5	83 Bi		Abs. edge	2.711
3.9437	45 Rh	L_{II}	Abs. edge	3.1438	4.575	5	41 Nb	L_I	Abs. edge	2.710
3.95635	48 Cd	$L_{\alpha 1}$	$L_{II}N_{IV}$	3.13373	4.585	5	73 Ta	M_I	Abs. edge	2.704
3.96496	48 Cd	$L_{\alpha 2}$	$L_{III}M_{IV}$	3.12691	4.59	2	83 Bi		Abs. edge	2.70
3.968	82 Pb		$M_{II}N_{IV}$	3.124	4.59743	9	45 Rh	$L_{\alpha 1}$	$M_{IV}P_{II,III}$	2.69674
3.98327	49 In	$L\eta$	$L_{II}M_I$	3.11254	4.601	9	45 Rh		$L_{III}M_V$	2.695
4.013	81 Tl		$M_{II}N_{III}$	3.089	4.60545	9	78 Pt	$L_{\alpha 2}$	$M_{II}N_{IV}$	2.69205
4.0162	46 Pd	$L\beta_6$	$L_{III}N_I$	3.0870	4.620	9	45 Rh	M_{II}	$L_{III}M_{IV}$	2.684
4.022	91 Pa	$M_{\alpha 1}$	M_{V-NVII}	3.0823	4.62058	5	75 Re	$L\beta_1$	Abs. edge	2.68323
4.0346	46 Pd	$L\beta_3$	$L_I M_{III}$	3.0730	4.625	3	44 Ru		$L_{II}M_{IV}$	2.681
4.035	91 Pa	$M_{\alpha 2}$	M_{V-VI}	3.072	4.630	5	92 U	L_{III}	$M_{IV}N_{III}$	2.6780
4.0451	45 Rh	$L\gamma_5$	$L_{II}N_I$	3.0650	4.631	1	43 Tc		Abs. edge	2.677
4.047	82 Pb	M_{III}	Abs. edge	3.0632	4.6542	9	77 Ir	$L\gamma_{2,3}$	$M_{II}N_{III}$	2.677
4.058	43 Te	L_I	Abs. edge	3.055	4.655	2	41 Nb		$L_I N_{II,III}$	2.6638
4.069	82 Pb		Abs. edge	3.047	4.6605	8	82 Pb	$L\eta$	$M_{II}N_I$	2.664
4.0711	46 Pd	$L\beta_4$	$M_{III}O_{IV-V}$	3.047	4.674	2	46 Pd	$M\gamma$	$L_{II}M_I$	2.6603
4.071	76 Os	M_I	$L_I M_{II}$	3.045	4.686	1	82 Pb		$M_{III}N_V$	2.6527
4.07165	50 Sn	L_I	Abs. edge	3.045	4.694	1	78 Pt	M_{III}	Abs. edge	2.6459
4.093	78 Pt	M_{II}	$L_{III}M_I$	3.04499	4.703	8	78 Pt		$M_{III}O_{IV-V}$	2.641
4.105	83 Bi		Abs. edge	3.029	4.7076	9	79 Au	L_I	$M_{III}O_I$	2.636
4.116	81 Tl		$M_{III}O_I$	3.021	4.715	2	47 Ag	L_{II}	$L_{III}M_I$	2.6337
4.1299	45 Rh		$M_{III}N_{IV}$	3.013	4.719	3	82 Pb		$M_{III}N_{IV}$	2.630
4.1310	45 Rh		Abs. edge	3.0021	4.7258	1	42 Mo	L_{II}	Abs. edge	2.6274
4.1381	90 Th	$L\beta_{2,15}$	$L_{III}N_{IV-V}$	3.0013	4.7278	2	42 Mo	$L\gamma_1$	Abs. edge	2.6235
4.14622	46 Pd	$M_{\alpha 1}$	M_{V-NVII}	2.9961	4.7307	1	17 Cl	$K\alpha_1$	$L_{II}N_{IV}$	2.62239
4.151	46 Pd	$L\beta_1$	$L_{II}M_{IV}$	2.99022	4.757	1	17 Cl	$K\alpha_2$	KL_{II}	2.62078
4.15443	90 Th	$M_{\alpha 2}$	M_{V-VI}	2.987	4.764	5	82 Pb	M_{IV}	KL_{II}	2.606
4.16294	47 Ag	$L_{\alpha 1}$	$L_{III}M_V$	2.98431	4.780	5	83 Bi	M_V	Abs. edge	2.603
4.180	44 Ru	L_{II}	$L_{III}M_{IV}$	2.97821	4.79	4	77 Ir		Abs. edge	2.594
4.1822	44 Ru	L_{II}	Abs. edge	2.9663	4.815	2	76 Os	M_{II}	$M_{II}N_{III}$	2.59
4.19180	18 A	$L\gamma_1$	$L_{II}N_{IV}$	2.9645	4.823	5	74 W		Abs. edge	2.575
4.19315	48 Cd	$K\alpha_1$	KL_{III}	2.95770	4.823	3	83 Bi	M_{II}	Abs. edge	2.571
4.19474	18 A	$L\eta$	$L_{II}M_I$	2.95675	4.8369	4	81 Tl	$M\gamma$	$M_{III}N_V$	2.571
		$K\alpha_2$	KL_{II}	2.95563		2	42 Mo	$L\gamma_5$	$L_{III}N_I$	2.5632

TABLE 71-2. WAVELENGTHS OF X-RAY EMISSION LINES AND ABSORPTION EDGES: IN NUMERICAL ORDER (Continued)

Wavelength, Å*	p.e.†	Element	Designation	keV	Wavelength, Å*	p.e.†	Element	Designation	keV
4.84575	5	44 Ru	L _{III} M _V	2.55855	5.40655	8	42 Mo	L _{III} M _V	2.29316
4.85381	7	44 Ru	L _{III} M _{IV}	2.55431	5.41437	8	42 Mo	L _{III} M _{IV}	2.28985
4.861	1	77 Ir	Abs. edge	2.5505	5.4318	9	80 Hg	M _{IV} N _{VI}	2.2825
4.865	5	81 Tl	M _{III} N _V	2.548	5.435	1	74 W	Abs. edge	2.2811
4.869	9	77 Ir	M _{III} O _{IV,V}	2.546	5.460	1	81 Tl	M _V N _{VII}	2.2706
4.876	9	78 Pt	M _{III} O _I	2.543	5.472	2	81 Tl	M _V N _{VI}	2.2656
4.879	9	40 Zr	Abs. edge	2.541	5.472	2	81 Tl	M _V N _{VI}	2.2656
4.8873	5	40 Zr	L _{III} M _{IV}	2.5398	5.4923	3	41 Nb	L _{III} M _{IV}	2.2574
4.909	8	43 Tc	M _{IV} N _{VI}	2.5355	5.4977	3	40 Zr	L _{III} N _I	2.2551
4.911	1	83 Bi	M _{IV} N _{VI}	2.524	5.500	4	77 Ir	M _{III} N _V	2.254
4.913	5	90 Th	Abs. edge	2.5234	5.5035	3	44 Ru	L _{III} M _I	2.2528
4.913	1	42 Mo	M _{IV} N _{VI}	2.5191	5.537	8	83 Bi	M _{III} N _I	2.239
4.9217	1	45 Rh	Abs. edge	2.5183	5.540	5	77 Ir	M _{III} N _{IV}	2.238
4.9232	2	42 Mo	L _{III} M _I	2.507	5.570	4	73 Ta	M _{III} N _{IV}	2.226
4.946	2	92 U	Abs. edge	2.504	5.579	1	40 Zr	Abs. edge	2.225
4.952	5	81 Tl	M _{IV} N _{VI}	2.5034	5.584	5	79 Au	M _V	2.220
4.9525	3	46 Pd	Abs. edge	2.5029	5.5863	3	40 Zr	L _{III} N _{IV,V}	2.2194
4.9536	3	40 Zr	L _{III} M _I	2.502	5.59	1	78 Pt	Abs. edge	2.217
4.955	4	76 Os	L _{III} N _{IV}	2.502	5.592	5	38 Sr	Abs. edge	2.217
4.955	5	82 Pb	Abs. edge	2.502	5.624	1	79 Au	M _{IV} N _{VI}	2.2046
4.984	2	80 Hg	M _{III} N _V	2.4875	5.628	8	74 W	M _{III} O _I	2.203
5.004	9	82 Pb	M _{IV} O _{II}	2.477	5.6330	3	40 Zr	L _I M _{III}	2.2010
5.0133	3	42 Mo	L _I M _{III}	2.4730	5.645	3	38 Sr	L _I N _{III,III}	2.1965
5.0185	1	16 S	Abs. edge	2.47048	5.6476	9	80 Hg	M _V N _{VII}	2.1953
5.020	5	73 Ta	Abs. edge	2.470	5.650	5	73 Ta	Abs. edge	2.194
5.0233	3	16 S	K _M	2.4681	5.681	3	40 Zr	L _I M _{III}	2.1873
5.031	1	41 Nb	Abs. edge	2.4641	5.67	3	73 Ta	M _{III} O _{IV,V}	2.19
5.0316	2	16 S	K _M	2.46404	5.682	4	76 Os	M _{III} N _V	2.182
5.0361	3	41 Nb	L _{III} N _{IV}	2.4618	5.704	8	82 Pb	M _{III} N _I	2.174
5.043	5	76 Os	Abs. edge	2.458	5.7101	3	40 Zr	L _{III} N _I	2.1712
5.0488	3	42 Mo	L _I M _{III}	2.4557	5.724	5	76 Os	M _{III} N _{IV}	2.166
5.0488	5	42 Mo	L _{III} N _I	2.4557	5.7243	2	41 Nb	L _{III} M _V	2.16589
5.050	2	92 U	M _{IV} N _{VI}	2.4548	5.7319	3	41 Nb	L _{III} M _{IV}	2.1630
5.076	1	82 Pb	M _{IV} N _{VI}	2.4427	5.756	1	39 Y	Abs. edge	2.1540

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5.092	91 Pa	M ζ_1	M _v N _{III}	2.4350	5.767	9	79 Au	K	M _v O _{III}	2.150
5.1148	43 Tc	L α_1	L _{III} M _v	2.4240	5.784	1	15 P	K β	Abs. edge	2.1435
5.118	83 Bi	M α_1	M _v N _{VII}	2.4226	5.795	2	15 P	K β	K M	2.1391
5.130	83 Bi	M α_2	M _v N _{VI}	2.4170	5.81	2	76 Os	M γ	M _{III} N _I	2.133
5.145	79 Au	M γ	M _{III} N _V	2.410	5.81	1	78 Pt	M β	Abs. edge	2.133
5.1517	41 Nb	L γ_3	L _{III} N _I	2.4066	5.828	1	78 Pt	M β	M _{IV} N _{VI}	2.1273
5.153	81 Tl	M ν	Abs. edge	2.406	5.83	1	73 Ta	M ν	M _{III} O _I	2.126
5.157	80 Hg	M ν	Abs. edge	2.404	5.83	1	77 Ir	M ν	Abs. edge	2.126
5.168	82 Pb	M ν	M _v O _{III}	2.399	5.8360	3	40 Zr	L β_1	L _{III} M _{IV}	2.1244
5.172	74 W	L β_1	M _I N _{III}	2.397	5.840	1	79 Au	M α_1	M _v N _{VII}	2.1229
5.17708	42 Mo	L β_1	L _{III} M _{IV}	2.39481	5.8475	3	42 Mo	L γ	L _{III} M _I	2.1202
5.186	79 Au	M ζ_2	M _{III} N _{IV}	2.391	5.854	3	79 Au	M α_2	M _v N _{VI}	2.118
5.193	91 Pa	M ζ_2	M _{IV} N _{II}	2.3876	5.854	3	39 Y	L γ_3	L _{III} N _I	2.1102
5.196	81 Tl	L η	M _{IV} O _{II}	2.386	5.884	8	81 Tl	M γ	M _{III} N _I	2.107
5.2050	44 Ru	L η	Abs. edge	2.38197	5.885	2	75 Re	M γ	M _{III} N _V	2.1067
5.217	39 Y	L η	Abs. edge	2.377	5.931	5	75 Re	L η	M _{III} N _{IV}	2.090
5.2169	45 Rh	L η	Abs. edge	2.3765	5.962	3	39 Y	L η	Abs. edge	2.0794
5.230	41 Nb	L η	Abs. edge	2.3706	5.982	1	39 Y	L η	Abs. edge	2.0722
5.234	75 Re	L η	Abs. edge	2.369	5.987	3	39 Y	L η	L _I M _{III}	2.071
5.2379	41 Nb	L η	L _{III} N _{IV.V}	2.3670	6.008	9	78 Pt	L η	M _v O _{III}	2.071
5.245	90 Th	M ζ_1	M _v N _{III}	2.364	6.0186	5	37 Rb	L η	Abs. edge	2.063
5.249	81 Tl	M β	M _{IV} N _{VI}	2.3621	6.038	3	39 Y	L β_4	L _I M _{II}	2.0600
5.2530	39 Y	L γ_3	L _I N _{II,III}	2.3468	6.0458	1	77 Ir	M β	M _{IV} N _{VI}	2.0535
5.286	82 Pb	M α_1	M _v N _{VII}	2.3455	6.047	3	37 Rb	L γ_3	L _I N _{III,III}	2.0507
5.299	82 Pb	M α_2	M _v N _{VI}	2.3397	6.05	1	78 Pt	M α_1	M _v N _{VII}	2.0505
5.3102	41 Nb	L β_1	L _I M _{III}	2.3348	6.058	1	77 Ir	M ν	Abs. edge	2.048
5.319	78 Pt	M γ	M _{III} N _V	2.331	6.0705	3	78 Pt	M ν	M _v N _{VI}	2.047
5.340	90 Th	M ζ_2	M _{IV} N _{II}	2.322	6.073	2	40 Zr	L α_1	L _{III} M _V	2.04236
5.3455	41 Nb	L β_1	L _I M _{II}	2.3194	6.0778	5	76 Os	M ν	Abs. edge	2.042
5.357	74 W	M ν	M _{III} N _{IV}	2.314	6.09	3	40 Zr	L α_2	L _{III} M _{IV}	2.0399
5.36	80 Hg	L β_1	Abs. edge	2.313	6.092	2	80 Hg	M γ	M _{III} N _I	2.036
5.3613	41 Nb	M ν	L _{III} N _I	2.3125	6.0942	3	74 W	L β_1	M _{III} N _V	2.035
5.37210	16 S	K α_1	K L_{II}	2.30784	6.134	3	39 Y	L β_1	L _{III} N _I	2.0344
5.374	79 Au	M ν	Abs. edge	2.307	6.1503	4	74 W	L β_1	M _{III} N _{IV}	2.021
5.37496	16 S	K α_2	K L_{II}	2.30604	6.157	3	42 Mo	L β_1	L _{III} M _I	2.01568
5.378	40 Zr	L η	Abs. edge	2.3053	6.160	1	15 P	L β_1	K L_{III}	2.0137
5.3843	40 Zr	L γ_1	L _{II} N _{IV}	2.3027	6.162	8	83 Bi	L β_1	K L_{II}	2.0127
5.40	73 Ta	L γ_1	M _I N _{III}	2.295	6.173	1	38 Sr	L η	M _{IV} N _{III}	2.012
					6.2109	3	41 Nb	L γ	Abs. edge	2.0085
									L _{III} M _I	1.99620

TABLE 7f-2. WAVELENGTHS OF X-RAY EMISSION LINES AND ABSORPTION EDGES: IN NUMERICAL ORDER (Continued)

Wavelength, Å*	p.e.†	Element	Designation	keV	Wavelength, Å*	p.e.†	Element	Designation	keV
6.2120	3	39 Y	Lβ ₁	1.99584	7.30	2	73 Ta	MvO _{III}	1.700
6.259	9	79 Au	M _{III} N _I	1.981	7.303	1	72 Hf	M _{IV} N _{VI}	1.6976
6.262	1	77 Ir	MvN _{VII}	1.9799	7.304	5	36 Kr	L _I M _{II}	1.697
6.267	1	76 Os	M _{IV} N _{VI}	1.9783	7.3183	2	37 Rb	L _{III} M _V	1.69413
6.275	3	77 Ir	MvN _{VI}	1.9758	7.3251	3	37 Rb	L _{III} M _{IV}	1.69256
6.28	2	74 W	M _{II} N _I	1.973	7.3563	3	39 Y	L _{III} M _I	1.68536
6.2961	3	38 Sr	L _{II} N _I	1.96916	7.360	8	74 W	M _{III} N _I	1.684
6.30	1	76 Os	Abs. edge	1.967	7.371	8	78 Pt	M _{IV} N _{III}	1.682
6.312	4	73 Ta	M _{III} N _V	1.964	7.392	1	36 Kr	Abs. edge	1.6772
6.33	1	75 Re	M _{IV}	1.958	7.466	4	79 Au	M _V N _{III}	1.6605
6.353	5	73 Ta	M _{III} N _{IV}	1.951	7.503	1	34 Se	Abs. edge	1.6525
6.3672	3	38 Sr	L _I M _{III}	1.94719	7.510	4	36 Kr	Abs. edge	1.6510
6.384	7	82 Pb	M _{IV} N _{III}	1.942	7.5171	3	38 Sr	L _{III} N _I	1.64933
6.387	1	38 Sr	Abs. edge	1.9411	7.523	5	79 Au	M _{IV} N _{II}	1.648
6.4026	3	38 Sr	L _I M _{II}	1.93643	7.539	1	72 Hf	M _V N _{VI,VII}	1.6446
6.4488	2	39 Y	L _{II} M _V	1.92256	7.546	8	68 Er	M _{III} N _V	1.643
6.455	9	78 Pt	M _{III} N _I	1.921	7.576	3	36 Kr	L _{II} M _{IV}	1.6366
6.4558	3	39 Y	L _{III} M _{IV}	1.92047	7.60	1	68 Er	M _{III} N _{IV}	1.632
6.47	1	36 Kr	Abs. edge	1.915	7.601	2	71 Lu	M _{IV} N _{VI}	1.629
6.490	1	76 Os	M _{II}	1.9102	7.612	9	73 Ta	M _{III} N _I	1.622
6.504	1	75 Re	Mβ	1.9061	7.645	8	77 Ir	M _{IV} N _{III}	1.6022
6.5176	3	41 Nb	L _I	1.90225	7.738	4	78 Pt	M _V N _{III}	1.599
6.5191	3	38 Sr	Lβ ₂	1.90181	7.753	5	35 Br	Abs. edge	1.596
6.521	4	83 Bi	M _{III} N _I	1.901	7.767	9	78 Pt	L _I M _{III}	1.592
6.544	4	72 Hf	M _{III} N _V	1.895	7.790	5	78 Pt	M _{IV} N _{II}	1.5860
6.560	5	75 Re	M _V	1.890	7.817	3	36 Kr	L _{III} M _{IV,V}	1.58215
6.585	5	83 Bi	Abs. edge	1.883	7.8362	3	38 Sr	L _{III} M _I	1.5813
6.59	1	74 W	M _{IV} N _I	1.880	7.840	2	71 Lu	M _V N _{VI,VII}	1.576
6.6069	3	40 Zr	Abs. edge	1.87654	7.865	9	57 Ho	M _{III} N _{IV,V}	1.572
6.6239	3	38 Sr	L _{II} M _I	1.87172	7.887	9	72 Hf	M _{III} N _I	1.5675
6.644	1	37 Rb	Lβ ₁	1.8661	7.909	2	70 Yb	M _{IV} N _{VI}	1.55988
6.669	9	77 Ir	Abs. edge	1.859	7.94813	5	13 Al	Abs. edge	1.55745
6.729	1	75 Re	M _{III} N _I	1.8425	7.960	2	13 Al	Kβ	

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6.738	14 Si	K	Abs. edge	1.8400	7.584	5	35 Br	L _{III}	Abs. edge	1.5530
6.740	82 Pb	M _{II} ¹	M _V N _{III}	1.8395	8.621	4	77 Ir	M _{II} ¹	M _V N _{III}	1.5458
6.7530	14 Si	K β	K M	1.83594	8.0415	4	37 Rb	L η	L _{III} M _I	1.54177
6.755	37 Rb	L γ s	L _{III} N _{IV}	1.83532	8.065	5	77 Ir	M ζ ₂	M _{IV} N _{II}	1.5373
6.757	74 W	M β	M _{IV} N _{VI}	1.8349	8.107	1	33 As	L _I	Abs. edge	1.5293
6.768	71 Lu	M γ	M _{III} N _V	1.832	8.1251	5	35 Br	L β ₁	L _{II} M _{IV}	1.52590
6.7876	37 Rb	L β ₁	L _I M _{III}	1.82659	8.144	9	66 Dy	M γ	M _{III} N _{V,V}	1.522
6.802	82 Pb	M ζ ₂	M _{IV} N _{II}	1.823	8.149	5	70 Yb	M α	M _V N _{VI,VII}	1.5214
6.806	74 W	L β ₂	M _{IV} O _{II}	1.822	8.239	8	75 Re	M β	M _{IV} N _{III}	1.505
6.8207	37 Rb	L β ₁	L _I M _{II}	1.81771	8.249	7	69 Tm	M β	M _{IV} N _{VI}	1.503
6.83	74 W	M γ	Abs. edge	1.814	8.310	4	76 Os	M ζ ₁	M _V N _{III}	1.4919
6.862	37 Rb	L _{III}	Abs. edge	1.8067	8.321	9	34 Se	L β _{3,4}	L _I M _{II,III}	1.490
6.8628	38 Sr	L α ₁	L _{III} M _V	1.80656	8.33934	9	13 Al	K α ₁	KL _{III}	1.48670
6.8697	38 Sr	L α ₂	L _{III} M _{IV}	1.80474	8.34173	9	13 Al	K α ₂	KL _{III}	1.48627
6.87	73 Ta	M _{IV}	Abs. edge	1.804	8.359	5	75 Os	M ζ ₂	M _{IV} N _{II}	1.4831
6.87	80 Hg	δ	M _{IV} N _{III}	1.805	8.3636	4	37 Rb	L _{II}	L _{III} M _I	1.48238
6.89	76 Os	L _I	M _{III} N _I	1.798	8.3746	5	35 Br	L α _{1,2}	L _{III} M _{IV}	1.48043
6.9185	40 Zr	L _I	L _{III} M _I	1.79201	8.407	1	34 Se	L _{II}	Abs. edge	1.4747
6.959	35 Br	M ζ ₁	Abs. edge	1.781	8.470	9	70 Yb	M α	M _{III} N _I	1.464
6.974	81 Tl	M α	M _V N _{III}	1.778	8.48	1	69 Tm	M γ	M _V N _{VI,VII}	1.462
6.983	74 W	L β ₂	M _V N _{VII}	1.7754	8.486	9	65 Tb	M γ	M _{III} N _{IV}	1.461
6.9842	37 Rb	L β ₁	L _{III} N _I	1.77517	8.487	5	69 Tm	M γ	Abs. edge	1.4609
6.992	74 W	M α ₁	M _V N _{VI}	1.7731	8.573	8	74 W	M β	M _{IV} N _{III}	1.446
7.005	74 W	M β	M _{VO} _{III}	1.770	8.592	3	68 Er	M β	M _{IV} N _{III}	1.4430
7.023	73 Ta	M γ	M _{IV} N _{VI}	1.7655	8.60	7	92 U	M β	M _{IV} N _{VI}	1.44
7.024	70 Yb	M ζ ₁	M _{III} N _V	1.765	8.601	5	68 Er	M β	N _I P _{V,V}	1.4415
7.032	81 Tl	L η	M _{IV} N _{II}	1.763	8.629	4	75 Re	M ζ ₁	Abs. edge	1.4368
7.0406	37 Rb	L β ₁	L _{II} M _I	1.76095	8.645	5	34 Se	L η	Abs. edge	1.4340
7.0750	73 Ta	M γ	L _{II} M _{IV}	1.75217	8.664	5	75 Re	M ζ ₂	M _{IV} N _{II}	1.4310
7.09	39 Y	L β ₁	M _{IV} O _{II,III}	1.748	8.664	5	34 Se	L β ₁	L _{II} M _{IV}	1.41923
7.101	79 Au	M ν	M _{IV} N _{III}	1.746	8.76	7	92 U	L _I	N _I P _{III}	1.42
7.11	73 Ta	K α ₁	Abs. edge	1.743	8.773	1	32 Ce	L _I	Abs. edge	1.4132
7.12542	14 Si	K α ₂	KL _{III}	1.73998	8.81	7	92 U	N _I P _{II}	N _I P _{II}	1.41
7.12791	14 Si	L _{II}	KL _{III}	1.73938	8.82	1	68 Er	M α	M _V N _{VI,VII}	1.406
7.168	36 Kr	L _{II}	Abs. edge	1.7297	8.844	9	64 Gd	M γ	M _{III} N _{IV,V}	1.402
7.250	36 Kr	L _{II}	L _{II} N _{III}	1.710	8.847	5	68 Er	M ν	Abs. edge	1.4013
7.252	73 Ta	M α	M _V N _{VI,VII}	1.7096	8.90	2	73 Ta	M ν	M _{IV} N _{III}	1.393
7.264	36 Kr	L β ₃	L _I M _{III}	1.707	8.929	1	33 As	L β _{3,4}	L _{II} M _{II,III}	1.3884
7.279	36 Kr	L γ s	L _{II} N _I	1.703	8.962	4	74 W	M ζ ₁	M _V N _{III}	1.3835

TABLE 7f-2. WAVELENGTHS OF X-RAY EMISSION LINES AND ABSORPTION EDGES: IN NUMERICAL ORDER (Continued)

Wavelength, Å*	Element	Designation	keV	Wavelength, Å*	p.e.†	Element	Designation	keV	Designation	keV
8.965	67 Ho	Mβ	1.3830	12.131	1	30 Zn	MivNvi	1.02201	Abs. edge	1.02201
8.9900	34 Se	Lα _{1,2}	1.37910	12.254	3	30 Zn	LiiMiv.v	1.0117	LiiMiv.v	1.0117
8.993	74 W	Mζ ₁	1.3787	12.43	2	66 Dy	MvNiii	0.998	MvNiii	0.998
9.125	33 As	Lii	1.3587	12.44	2	60 Nd	MivNvi	0.997	MivNvi	0.997
9.20	67 Ho	Mα	1.348	12.459	5	60 Nd	Abs. edge	0.9842	Abs. edge	0.9842
9.211	63 Eu	Mγ	1.346	12.597	2	31 Ga	LiiM _i	0.978	LiiM _i	0.978
9.255	35 Br	Lη	1.3396	12.68	2	60 Nd	MvNvi.vii	0.9734	MvNvi.vii	0.9734
9.316	73 Ta	Mζ ₁	1.3308	12.737	5	60 Nd	Abs. edge	0.973	Abs. edge	0.973
9.330	73 Ta	Mβ	1.3288	12.75	3	56 Ba	MiiiNiv.v	0.961	MiiiNiv.v	0.961
9.357	66 Dy	Mβ	1.3250	12.90	9	92 U	NiiiOv	0.9572	NiiiOv	0.9572
9.367	33 As	Liii	1.3235	12.953	2	31 Ga	LiiM _i	0.955	LiiM _i	0.955
9.40	90 Th	Lβ ₁	1.319	12.98	2	65 Tb	MvNiii	0.95288	MvNiii	0.95288
9.4141	33 As	Lβ ₁	1.3170	13.014	1	29 Cu	Abs. edge	0.9498	Abs. edge	0.9498
9.44	90 Th	K	1.313	13.053	3	29 Cu	LiiMiv	0.950	LiiMiv	0.950
9.5122	12 Mg	L _i	1.30339	13.06	5	59 Pr	Mβ	0.9448	Mβ	0.9448
9.517	31 Ga	Kβ	1.3022	13.122	2	59 Pr	Miv	0.941	Miv	0.941
9.521	12 Mg	Lβ ₁	1.3028	13.18	2	28 Ni	Lβ _{1,4}	0.93306	Lβ _{1,4}	0.93306
9.581	32 Ge	Lβ ₁	1.2941	13.288	6	29 Cu	Abs. edge	0.932	Abs. edge	0.932
9.585	35 Br	Lβ ₁	1.2935	13.30	1	83 Bi	NiPii.iii	0.9297	NiPii.iii	0.9297
9.59	66 Dy	Mα	1.293	13.335	3	29 Cu	LiiMiv.v	0.9292	LiiMiv.v	0.9292
9.600	62 Sm	Mγ	1.291	13.343	5	59 Pr	Mα	0.9257	Mα	0.9257
9.640	32 Ge	Lβ ₁	1.2801	13.394	5	59 Pr	Abs. edge	0.914	Abs. edge	0.914
9.6709	33 As	Lα _{1,2}	1.2820	13.57	2	04 Gd	Mζ	0.906	Mζ	0.906
9.686	72 Hf	Mζ ₁	1.2800	13.68	2	30 Zn	Lη	0.902	Lη	0.902
9.686	72 Hf	Mζ ₁	1.2800	13.75	4	58 Ce	MivNvi	0.897	MivNvi	0.897
9.702	65 Tb	Mβ	1.2601	13.8	1	90 Th	NiiiOv	0.884	NiiiOv	0.884
9.8900	12 Mg	Kα _{1,2}	1.25300	14.02	2	30 Zn	LiiM _i	0.883	LiiM _i	0.883
9.924	32 Ge	Lii	1.2494	14.04	2	58 Ce	Mα	0.872	Mα	0.872
9.962	34 Se	Lη	1.2446	14.22	2	63 Eu	Mζ	0.8706	Mζ	0.8706
10.00	65 Tb	Mα	1.240	14.242	5	28 Ni	Lii	0.8688	Abs. edge	0.8688
10.09	92 U	Lβ ₁	1.229	14.271	6	28 Ni	Lβ ₁	0.86889	LiiMiv	0.86889
10.175	32 Ge	Lβ ₁	1.2185	14.3018	1	10 Ne	K	0.870	Abs. edge	0.870
10.187	32 Ge	Liii	1.2170	14.31	3	27 Co	Lβ _{1,4}		L _i Mii.iii	

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10.254	64 Gd	Mβ	1.2091	14.39	5	58 Ce	Kβ	MvO _{II,III}	0.862
10.294	34 Se	L _I	1.2044	14.452	5	10 Ne	Mβ	KM	0.8579
10.31	30 Zn	L _I	1.197	14.51	5	57 La	L _{III}	M _{IV} N _{VI}	0.854
10.359	31 Ga	Lβ _{3,4}	1.197	14.525	5	28 Ni	L _{III}	Abs. edge	0.8536
10.40	92 U	Lα _{1,2}	1.192	14.56	3	28 Ni	L _{III} M _{IV}	L _{III} M _{IV}	0.8515
10.4361	32 Ce	Mα	1.18800	14.610	3	10 Ne	Kα _{1,2}	KL _{II,III}	0.8486
10.46	64 Gd	Mξ	1.185	14.88	5	57 La	Mα	MvN _{VI,VII}	0.833
10.48	70 Yb	Mγ	1.183	14.90	2	29 Cu	Lγ	L _{II} M _I	0.831
10.505	60 Nd	Miv	1.180	14.91	4	62 Sm	Mξ	MvN _{III}	0.8111
10.711	63 Eu	Miv	1.1575	15.286	2	29 Cu	L	L _{III} M _I	0.7967
10.734	33 As	Lγ	1.1550	15.56	9	56 Ba	Miv	Abs. edge	0.7938
10.750	63 Eu	Mβ	1.1533	15.618	1	27 Co	L _{II}	Abs. edge	0.792
10.828	31 Ga	L _{II}	1.1450	15.65	5	26 Fe	Lβ _{3,4}	L _{II} M _{III,III}	0.792
10.96	63 Eu	Mα	1.131	15.665	4	27 Co	Lβ ₁	L _{II} M _{IV}	0.7914
10.998	59 Pr	Mγ	1.1273	15.72	8	56 Ba	Mv	M _{IV} O _{II}	0.789
11.013	63 Eu	Mv	1.1258	15.89	9	56 Ba	Mv	Abs. edge	0.7801
11.023	31 Ga	Lβ ₁	1.1248	15.91	1	56 Ba	Mv	Abs. edge	0.779
11.072	33 As	L _I	1.1198	15.915	5	56 Ba	L _{III}	Abs. edge	0.7790
11.07	90 Th	L _{II}	1.120	15.93	5	52 Te	Mγ	M _{III} N _{IV,V}	0.778
11.100	31 Ga	L _{III}	1.1169	15.972	4	27 Co	Lα _{1,2}	L _{III} M _{IV,V}	0.7762
11.200	30 Zn	Lβ _{3,4}	1.1070	15.98	6	27 Co	Lα _{1,2}	M _{III} N _{IV}	0.776
11.27	62 Sm	Mβ	1.0998	16.20	5	51 Sb	Lγ	MvO _{II}	0.765
11.288	62 Sm	Miv	1.0983	16.27	5	56 Ba	Lη	L _{II} M _I	0.762
11.292	31 Ga	Lα _{1,2}	1.09792	16.46	3	28 Ni	Mξ	MvN _{III}	0.753
11.37	68 Er	Mξ	1.0901	16.693	4	60 Nd	L	L _{III} M _I	0.7427
11.47	62 Sm	Mα	1.081	16.7	9	28 Ni	L _I	Abs. edge	0.741
11.53	58 Ce	Mγ	1.0749	16.92	1	24 Cr	Mγ	M _{III} N _{IV,V}	0.733
11.552	62 Sm	Mv	1.0732	16.93	4	51 Sb	Mγ	M _{II} N _{IV}	0.733
11.569	11 Na	K	1.072	17.19	5	50 Sn	Lβ _{3,4}	L _I M _{II,III}	0.721
11.575	11 Na	Kβ	1.0717	17.202	4	26 Fe	L _{II}	Abs. edge	0.7208
11.609	32 Ce	Lγ	1.0711	17.26	5	26 Fe	Lβ ₁	L _{II} M _{IV}	0.7185
11.862	30 Zn	L _{II}	1.0680	17.38	4	59 Pr	Mξ	MvN _{III}	0.714
11.86	67 Ho	L _{II}	1.04523	17.525	5	26 Fe	L _{III}	Abs. edge	0.7074
11.9101	11 Na	Mξ	1.0450	17.59	2	26 Fe	Lα _{1,2}	L _{III} M _{IV}	0.7050
11.965	32 Ge	Kα _{1,2}	1.0362	17.6	2	52 Te	L _{II}	M _{II} N _I	0.703
11.983	30 Zn	L _I	1.0347	17.87	1	27 Co	L _{II}	L _{II} M _I	0.694
12.08	57 La	Mγ	1.027	17.9	3	50 Sn	L _{II}	M _{III} N _{IV,V}	0.691
12.122	29 Cu	Lβ _{3,4}	1.0228	18.282	5	24 Cr	L _I	Abs. edge	0.691
					8	27 Co	L _I	L _{III} M _I	0.6778

TABLE 7f-2. WAVELENGTHS OF X-RAY EMISSION LINES AND ABSORPTION EDGES: IN NUMERICAL ORDER (Continued)

Wavelength, Å*	p.e.†	Element	Designation	keV.	Wavelength, Å*	p.e.†	Element	Designation	keV	Designation	keV
18.32	2	9 F	Kα	0.6768	33.1	2	41 Nb	KL	0.375	M _{II} N _V	0.375
18.35	4	58 Ce	M _I ‡	0.676	33.5	3	47 Ag	M _{IV} O _{II,III}	0.370	M _{IV} O _{II,III}	0.370
18.8	1	51 Sb	M _{II} N _I	0.658	33.57	9	90 Th	M _{II} N _{VI}	0.3693	N _{IV} N _{VI}	0.3693
18.8	2	47 Ag	M _{II} N _{II,III}	0.658	34.8	1	92 U	N _V N _{VI,VII}	0.357	N _V N _{VI,VII}	0.357
18.96	4	24 Cr	L _I M _{III,III}	0.654	34.9	2	41 Nb	L _I M _{IV}	0.356	M _{III} N _{IV,V}	0.356
19.11	2	25 Mn	L _{II} M _{IV}	0.6488	35.13	2	21 Sc	M _{III} M _I	0.3529	L _{II} M _I	0.3529
19.1	1	52 Te	M _{III} N _I	0.648	35.13	1	20 Ca	Abs. edge	0.3529	Abs. edge	0.3529
19.40	7	48 Cd	M _{III} N _{IV}	0.639	35.3	3	42 Mo	M _{III} N _I	0.351	M _{III} N _I	0.351
19.44	5	57 La	M _V N _{III}	0.638	35.39	1	20 Ca	Abs. edge	0.34931	Abs. edge	0.34931
19.45	1	25 Mn	L _{III} M _{IV,V}	0.6374	35.59	3	21 Sc	L _{III} M _I	0.3483	L _{III} M _I	0.3483
19.66	5	53 I	Abs. edge	0.631	35.53	1	20 Ca	Abs. edge	0.34793	Abs. edge	0.34793
19.75	4	26 Fe	L _{II} M _I	0.628	35.94	2	20 Ca	L _{II} M _{IV}	0.3449	L _{II} M _{IV}	0.3449
20.0	1	50 Sn	M _{II} N _I	0.619	36.32	9	90 Th	N _V N _{VI,VII}	0.3414	N _V N _{VI,VII}	0.3414
20.1	2	46 Pd	M _I N _{II,III}	0.616	36.33	2	20 Ca	L _{III} M _{IV,V}	0.3413	L _{III} M _{IV,V}	0.3413
20.15	1	26 Fe	L _{III} M _I	0.6152	36.8	1	48 Cd	L _{α_{1,3}}	0.3371	M _{IV} O _{II,III}	0.3371
20.2	1	51 Sb	M _{III} N _I	0.612	37.4	2	46 Pd	M _I ‡	0.332	M _{IV} O _{II,III}	0.332
20.47	7	48 Cd	M _{III} N _{IV,V}	0.606	37.5	2	42 Mo	M _{III} N _I	0.331	M _{III} N _I	0.331
20.64	4	56 Ba	M _V N _{III}	0.601	38.4	3	41 Nb	M _{III} N _I	0.323	M _{III} N _I	0.323
20.66	7	47 Ag	M _{II} N _{IV}	0.600	39.77	7	47 Ag	M _I ‡	0.3117	M _{IV} N _{II,III}	0.3117
20.7	1	24 Cr	Abs. edge	0.598	40.46	2	20 Ca	L _{II} M _I	0.3064	L _{II} M _I	0.3064
21.19	5	23 Va	L _I M _{III,III}	0.585	40.7	2	41 Nb	M _{III} N _I	0.305	M _{III} N _I	0.305
21.27	1	24 Cr	L _{II} M _{IV}	0.5828	40.9	2	45 Rh	M _{IV} O _{II,III}	0.303	M _{IV} O _{II,III}	0.303
21.34	5	52 Te	M _{IV} O _{II,III}	0.581	40.96	2	20 Ca	L _{III} M _I	0.3027	L _{III} M _I	0.3027
21.5	1	50 Sn	M _{III} N _I	0.575	42.1	2	92 U	N _{VI} O _V	0.295	N _{VI} O _V	0.295
21.04	3	24 Cr	L _{III} M _{IV,V}	0.5728	42.1	1	19 K	Abs. edge	0.2946	Abs. edge	0.2946
21.78	5	52 Te	M _V O _{III}	0.569	42.3	2	82 Pb	N _{IV} N _{VI}	0.293	N _{IV} N _{VI}	0.293
21.82	7	47 Ag	M _{III} N _{IV,V}	0.568	43.3	2	92 U	N _{VI} O _{IV}	0.286	N _{VI} O _{IV}	0.286
21.85	2	25 Mn	L _{II} M _I	0.5675	43.6	1	46 Pd	M _{IV} N _{II,III}	0.2844	M _{IV} N _{II,III}	0.2844
22.1	1	46 Pd	M _{II} N _{IV}	0.560	43.68	1	6 C	Abs. edge	0.28384	Abs. edge	0.28384
22.20	1	25 Mn	L _{III} M _I	0.5563	44.7	3	6 C	Kα	0.277	Kα	0.277
22.9	2	48 Cd	M _{II} N _I	0.540	44.8	1	44 Ru	M _{IV} O _{II,III}	0.2768	M _{IV} O _{II,III}	0.2768
23.32	1	80	Abs. edge	0.5317	45.0	1	82 Pb	N _V N _{VI,VII}	0.2756	N _V N _{VI,VII}	0.2756
23.3	1	46 Pd	M _{III} N _{IV,V}	0.531	45.2	3	80 Hg	N _{IV} N _{VI}	0.274	N _{IV} N _{VI}	0.274

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23.62	8 O	K α	KL	0.5249	45.2	1	51 Sb	M _{III} M _{IV}	0.2743
23.88	23 Va	L β_1	L _{III} M _{IV}	0.5192	46.48	9	39 Y	M _{III} N _I	0.267
24.25	23 Va	L $\alpha_{1,2}$	L _{III} M _{IV} ,v	0.5113	46.5	2	81 Tl	N _V N _{VI} ,VII	0.267
24.28	50 Sn	M _{IV} ,v	Abs. edge	0.511	46.8	2	79 Au	N _{IV} N _{VI}	0.265
24.30	24 Cr	L η	L _{III} M _I	0.5102	47.24	2	19 K	L _{III} M _I	0.2625
24.4	47 Ag		M _V N _I	0.509	47.3	1	50 Sn	M _{III} M _{IV}	0.2621
24.5	48 Cd		M _{III} N _I	0.507	47.67	9	45 Rh	M _{IV} ,vN _{II} ,III	0.2601
24.78	24 Cr	L β_1	L _{III} M _I	0.5003	47.74	1	19 K	L _{III} M _I	0.25971
25.01	45 Rh	M γ	M _{III} N _{IV} ,v	0.496	47.9	3	80 Hg	N _V N _{VI} ,VII	0.259
25.3	50 Sn		M _{IV} O _{II} ,III	0.491	48.1	2	78 Pt	N _{IV} N _{VI}	0.258
25.50	44 Ru		M _{III} N _{IV}	0.486	48.2	1	90 Th	N _{VI} O _V	0.2572
25.7	50 Sn		M _V O _{II}	0.483	48.5	2	39 Y	M _{III} N _I	0.256
26.0	47 Ag		M _{III} N _I	0.478	49.4	1	79 Au	N _V N _{VI} ,VII	0.2510
26.2	46 Pd		M _{III} N _I	0.474	49.5	1	90 Th	N _{VI} O _{IV}	0.2505
26.72	52 Te	M ζ	M _{IV} ,vN _{II} ,III	0.464	50.0	1	90 Th	N _{IV} N _{VI}	0.2470
26.9	44 Ru	M γ	M _{III} N _{IV} ,v	0.462	50.2	1	77 Ir	M _{III} M _V	0.2465
27.05	22 Ti	L β_1	L _{III} M _{IV}	0.4584	50.3	1	52 Te	N _V N _{VI} ,VII	0.2436
27.29	22 Ti	L β_2	Abs. edge	0.4544	50.9	1	78 Pt	M _{III} N _I	0.2416
27.34	23 Va	L η	L _{III} M _I	0.4535	51.3	1	38 Sr	N _V N _{VI}	0.2388
27.42	22 Ti	L $\alpha_{1,2}$	L _{III} M _{IV} ,v	0.4522	51.9	1	76 Os	N _{IV} N _{VI}	0.2384
27.77	23 Va	L β_1	L _{III} M _I	0.4465	52.0	2	48 Cd	M _{III} M _{IV}	0.2375
27.9	46 Pd		M _{III} N _I	0.445	52.2	1	51 Sb	M _{III} M _V	0.2369
28.1	45 Rh		M _{III} N _I	0.442	52.34	7	44 Ru	M _{IV} ,vN _{II} ,III	0.2348
28.13	48 Cd	M _{IV} ,v	Abs. edge	0.4408	52.8	1	77 Ir	N _V N _{VI} ,VII	0.2313
28.88	51 Sb	M ζ	M _{IV} ,vN _{II} ,III	0.429	53.6	1	38 Sr	M _{III} N _I	0.2295
29.8	45 Rh		M _{III} N _I	0.417	54.0	2	74 W	N _{II} N _{IV}	0.2295
30.4	48 Cd		M _{IV} O _{II} ,III	0.408	54.0	1	47 Ag	M _{III} M _{IV}	0.2287
30.8	48 Cd		M _V O _{II}	0.403	54.2	1	50 Sn	M _{III} M _V	0.2266
30.82	47 Ag	M _{IV}	Abs. edge	0.4022	54.7	2	76 Os	N _V N _{VI} ,VII	0.2262
30.89	22 Ti	L η	L _{III} M _I	0.4013	54.8	2	42 NiO	M _{IV} ,vO _{II} ,III	0.2221
30.99	7 N	K	Abs. edge	0.4000	55.8	1	74 W	N _{IV} N _{VI}	0.2217
31.02	21 Sc	L β_1	L _{III} M _{IV}	0.3996	55.9	1	18 A	L _{III} M _I	0.2201
31.14	47 Ag	M γ	Abs. edge	0.3981	56.3	1	18 A	L _{III} M _I	0.2201
31.24	50 Sn	M ζ	M _{IV} ,vN _{II} ,III	0.397	56.5	1	46 Pd	M _{III} M _{IV}	0.2194
31.35	21 Sc	L $\alpha_{1,2}$	L _{III} M _{IV} ,v	0.3954	57.0	2	37 Rb	M _{III} N _I	0.2174
31.36	22 Ti	L β_1	L _{III} M _I	0.3953	58.2	1	73 Ta	N _{IV} N _{VI}	0.2130
31.60	7 N	K α	KL	0.3924	58.4	1	74 W	N _V N _{VII}	0.2122
31.8	92 U		N _{IV} N _{VI}	0.390	58.7	2	48 Cd	M _{III} M _V	0.2111
32.3	44 Ru		M _{III} N _I	0.384	59.3	1	45 Rh	M _{III} M _{IV}	0.2090

TABLE 71-2. WAVELENGTHS OF X-RAY EMISSION LINES AND ABSORPTION EDGES: IN NUMERICAL ORDER (Continued)

Wavelength, Å*	p.e.†	Element	Designation	key	Wavelength, Å*	p.e.†	Element	Designation	key
59.5	3	74 W	NvNvI	0.208	117.4	4	62 Sn	NivvOii,iii	0.1056
59.5	2	37 Rb	MiiiNvI	0.2083	117.7	1	81 Tl	NviiOv	0.10530
60.5	1	47 Ag	MiiiMv	0.2048	123.	1	14 Si	Abs. edge	0.1006
61.1	2	73 Th	NvNvi,vii	0.2028	126.8	2	37 Rb	MivNiii	0.0978
61.9	2	41 Nb	MivvOii,iii	0.2002	127.8	2	37 Rb	MivNii	0.0970
62.2	1	44 Ru	MiiMv	0.1992	128.7	2	37 Rb	MvNiii	0.0964
62.9	1	46 Pd	MiiMv	0.1970	128.9	7	60 Nd	NivvOii,iii	0.0962
63.0	5	71 Lu	NivNvi	0.197	135.5	4	14 Si	Lii,iiiM	0.0915
64.38	7	42 Mo	MivvNii,iii	0.1926	136.5	4	59 Ir	NivvOii,iii	0.0908
65.1	7	70 Yb	NivNvi	0.190	137.0	5	30 Zn	Abs. edge	0.0905
65.5	1	45 Rh	MiiiMv	0.1892	142.5	1	13 Al	Abs. edge	0.08701
65.7	2	71 Lu	NvNvi,vii	0.1886	143.9	5	30 Zn	Abs. edge	0.0862
67.33	9	17 Cl	LiiMv	0.1841	144.4	6	58 Ce	NivvOii,iii	0.0859
67.6	3	5 B	KL	0.1833	144.4	3	37 Rb	MiMiii	0.0859
67.90	9	17 Cl	LiiMv	0.1826	152.6	6	57 La	NivvOii,iii	0.0812
68.2	3	90 Th	Oiiiv,v	0.1817	157.	3	30 Zn	Mii,iiiMiv,v	0.079
68.3	1	44 Ru	MiiiMv	0.1814	159.0	2	56 Ba	NivOiii	0.07796
68.9	2	42 Mo	MiiMv	0.1798	159.5	5	29 Cu	Abs. edge	0.0777
69.3	5	70 Yb	NvNvi,vii	0.179	163.3	2	56 Ba	NvOiii	0.07590
70.0	4	40 Zr	MivvOii,iii	0.177	164.6	2	56 Ba	NvOiii	0.07530
72.1	3	41 Nb	MiiMv	0.1718	164.7	3	35 Br	MiMiii	0.0753
72.19	9	41 Nb	MivvNii,iii	0.1717	166.0	5	29 Cu	Abs. edge	0.0747
72.7	9	68 Er	NivNvi	0.171	170.4	1	13 Al	Abs. edge	0.07278
74.9	1	42 Mo	MiiiMv	0.1656	171.4	5	13 Al	Lii,iiiM	0.0724
76.3	7	68 Er	NvNvi,vii	0.163	173.	3	29 Cu	Mii,iiiMiv,v	0.072
76.7	2	40 Zr	MiiMv	0.1617	181.	5	90 Th	Oiv,vQii,iii	0.068
76.9	2	35 Br	MiiNvI	0.1613	183.8	1	55 Cs	NivOiii	0.06746
78.4	2	41 Nb	MiiiMv	0.1582	184.6	3	35 Br	MiMiii	0.0672
79.8	3	35 Br	MiiiNvI	0.1554	188.4	1	28 Ni	Abs. edge	0.06581
80.9	3	40 Zr	MiiiMv	0.1533	188.6	1	55 Cs	NivOiii	0.06574
81.5	2	39 Y	MiiMv	0.1522	189.5	3	35 Br	MivNiii	0.0654
82.1	2	40 Zr	MivvNii,iii	0.1511	190.3	1	55 Cs	NvOiii	0.06515
83.	1	66 Dy	NivvNvi,vii	0.149	190.	2	28 Ni	Mii,iiiMiv,v	0.0651

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83.4	16 S	<i>L_{II,III}M_I</i>	0.1487	191.1	2	35 Br	<i>M_{IV}N_{III}</i>	0.06488
85.7	38 Sr	<i>M_{II}M_{IV}</i>	0.1447	192.6	2	35 Br	<i>M_VN_{III}</i>	0.06437
86.	65 Tb	<i>N_{IV}V_NVI, VII</i>	0.144	197.3	1	12 Mg	Abs. edge	0.06284
86.5	39 Y	<i>M_{III}M_{IV}V</i>	0.1434	202.	5	27 Co	Abs. edge	0.061
91.4	38 Sr	<i>M_{III}M_{IV}V</i>	0.1357	203.	1	16 S	<i>L_IL_{II,III}</i>	0.061
91.5	37 Rb	<i>M_{II}M_{IV}</i>	0.1355	214.	6	27 Co	<i>M_{II,III}M_{IV}V</i>	0.058
91.6	83 Bi	<i>N_{VI}O_{IV}</i>	0.1354	224.	1	3 I	Abs. edge	0.0552
93.2	83 Bi	<i>N_{VII}O_V</i>	0.1330	226.5	1	3 Li	Abs. edge	0.05475
93.4	39 Y	<i>M_{IV}V_NII, III</i>	0.1328	227.8	1	34 Se	Abs. edge	0.05443
94.	15 P	Abs. edge	0.132	228.	1	3 Li	<i>KL</i>	0.0543
96.7	37 Rb	<i>M_{III}M_{IV}V</i>	0.1282	230.	2	34 Se	<i>M_VN_{III}</i>	0.0538
97.2	66 Dy	<i>N_{IV}V_OII, III</i>	0.128	230.	1	26 Fe	Abs. edge	0.0538
98.	62 Sm	<i>N_{IV}V_NVI, VII</i>	0.126	243.	5	26 Fe	<i>M_{II,III}M_{IV}V</i>	0.051
100.2	82 Pb	<i>N_{VI}O_V</i>	0.1237	249.3	1	12 Mg	Abs. edge	0.04973
102.2	65 Tb	<i>N_{IV}V_OII, III</i>	0.1213	250.7	1	12 Mg	Abs. edge	0.04945
102.4	82 Pb	<i>N_{VI}O_{IV}</i>	0.1211	251.5	5	12 Mg	<i>L_{II,III}M</i>	0.04929
103.8	15 P	<i>L_{II,III}M</i>	0.1194	273.	6	25 Ni	<i>M_{II,III}M_{IV}V</i>	0.045
104.3	82 Pb	<i>N_{VII}O_V</i>	0.1189	280.	1	13 Al	<i>L_IL_{II,III}</i>	0.0428
107.	60 Nd	<i>N_{IV}V_NVI, VII</i>	0.116	309.	9	24 Cr	<i>M_{II,III}M_{IV}V</i>	0.040
108.0	38 Sr	<i>M_{IV}N_{III}</i>	0.1148	317.	1	12 Mg	<i>L_IL_{II,III}</i>	0.0392
108.7	38 Sr	<i>M_VN_{III}</i>	0.1140	337.	9	23 V	<i>M_{II,III}M_{IV}V</i>	0.0368
109.4	35 Br	<i>M_{II}M_{IV}</i>	0.1133	376.	1	11 Na	<i>L_IL_{II,III}</i>	0.03299
110.6	29 Cu	Abs. edge	0.1121	399.	5	35 Br	Abs. edge	0.0311
111.	4 Be	Abs. edge	0.111	405.	5	11 Na	Abs. edge	0.0306
112.0	63 Eu	<i>N_{IV}V_OII, III</i>	0.1107	407.1	5	11 Na	<i>L_{II,III}M</i>	0.03045
113.0	81 Tl	<i>N_{VI}O_V</i>	0.10968	417.	5	17 Cl	Abs. edge	0.0297
113.	59 Pr	<i>N_{IV}V_NVI, VII</i>	0.1095	444.	5	53 I	Abs. edge	0.0279
113.8	35 Br	<i>M_{III}M_{IV}V</i>	0.1089	525.	9	20 Ca	<i>M_{II,III}N_I</i>	0.0236
114.	4 Be	<i>KL</i>	0.1085	692.	9	19 K	<i>M_{II,III}N_I</i>	0.0179
115.3	81 Tl	<i>N_{VI}O_{IV}</i>	0.1075					

TABLE 7f-3. RECOMMENDED VALUES OF THE ATOMIC ENERGY LEVELS, AND PROBABLE ERRORS IN EV*

Level	1 H	2 He	3 Li	4 Be	5 B	6 C	7 N	8 O
K.....	13.59811 [*]	24.58678 [*]	54.75 ± 0.02 (54.75)	111.0 ± 1.0 (111.0)	188.0 ± 0.4 [188.0] ^f	283.8 ± 0.4 [283.8] ^f (283.8)	401.6 ± 0.4 [401.6] ^f	532.0 ± 0.4 [532.0] ^f
L _I.....	.....	.....	.....	.....	.....	.....	.....	23.7 ± 0.4 [23.7] ^d
L _{II,III}...	.....	.....	.....	.....	4.7 ± 0.9	6.4 ± 1.9	9.2 ± 0.6	7.1 ± 0.8
Level	9 F	10 Ne	11 Na	12 Mg	13 Al	14 Si	15 P	16 S
K.....	685.4 ± 0.4 [685.4] ^f	866.9 ± 0.3 (866.9)	1072.1 ± 0.4 [1072.1] ^f (1072.)	1305.0 ± 0.4 [1305.0] ^f (1303.)	1559.6 ± 0.4 [1559.6] ^f (1559.8)	1838.9 ± 0.4 [1838.9] ^f	2145.5 ± 0.4 [2145.5] ^f	2472.0 ± 0.4 [2472.0] ^f (2470.)
L _I	(31.)	(45.)	63.3 ± 0.4 [63.3] ^d	89.4 ± 0.4 [89.4] ^d (83.)	117.7 ± 0.4 [117.7] ^d (87.)	148.7 ± 0.4 [148.7] ^d	189.3 ± 0.4 [189.3] ^f	229.2 ± 0.4 [229.2] ^d
L _{II,III} ...	8.6 ± 0.8	18.3 ± 0.4	31.1 ± 0.4 (31.)	51.4 ± 0.5 (50.)	73.1 ± 0.5 (72.8)	99.2 ± 0.5 (100.6)	132.2 ± 0.5 (132.)	164.8 ± 0.7

* Where applicable, photoelectron direct measurements are listed in square brackets [] immediately under the recommended values. The measured values of the X-ray absorption energies are shown in parentheses (). Interpolated values are enclosed in angular brackets ().

TABLE 7f-3. RECOMMENDED VALUES OF THE ATOMIC ENERGY LEVELS, AND PROBABLE ERRORS IN EV* (Continued)

Level	17 Cl	18 Ar	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr
K.....	2822.4 ± 0.3 [2822.4] ^c (2020.)	3202.9 ± 0.3 (3202.9)	3607.4 ± 0.4 [3607.4] ^c (3607.8)	4038.1 ± 0.4 [4038.1] ^c (4038.1)	4492.8 ± 0.4 [4492.8] ^c	4966.4 ± 0.4 [4966.4] ^c (4964.5)	5465.1 ± 0.3 [5465.1] ^c (5464.)	5980.2 ± 0.3 [5989.2] ^c (5989.)
L _I	270.2 ± 0.4 (320.) ^d	320. ^d	377.1 ± 0.4 [377.1] ^d	437.8 ± 0.4 [437.8] ^d	500.4 ± 0.4 [500.4] ^c	563.7 ± 0.4 [563.7] ^c	628.2 ± 0.4 [628.2] ^d	694.6 ± 0.4 [694.6] ^d
L _{II}	201.6 ± 0.3	247.3 ± 0.3	296.3 ± 0.4	350.0 ± 0.4	406.7 ± 0.4	451.5 ± 0.4	520.5 ± 0.3	583.7 ± 0.3
L _{III}	200.0 ± 0.3	245.2 ± 0.3	293.6 ± 0.4	346.4 ± 0.4	402.2 ± 0.4	455.5 ± 0.4	512.9 ± 0.3	574.5 ± 0.3
M _I	17.5 ± 0.4	25.3 ± 0.4	33.9 ± 0.4	43.7 ± 0.4	53.8 ± 0.4	60.3 ± 0.4	66.5 ± 0.4	74.1 ± 0.4
M _{II}	6.8 ± 0.4	12.4 ± 0.3	17.8 ± 0.4	25.4 ± 0.4	32.3 ± 0.5	34.6 ± 0.4	37.8 ± 0.3	42.5 ± 0.3
M _{IV}.....	.....	.....	.....	.....	6.6 ± 0.5	3.7	2.2 ± 0.3	2.3 ± 0.4
Level	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge
K.....	6539.0 ± 0.4 [6539.0] ^c (6538.)	7112.0 ± 0.9 [7111.3] ^d (7111.2)	7708.9 ± 0.3 [7708.9] ^c (7709.5)	8332.8 ± 0.4 [8332.8] ^c (8331.6)	8978.0 ± 0.4 [8978.9] ^{c,d} (8980.3)	9658.6 ± 0.6 [9658.6] ^c (9660.7)	10367.1 ± 0.5 [10367.1] ^c (10368.2)	11103.1 ± 0.7 [11103.8] ^c (11103.6)
L _I	769.0 ± 0.4 [769.0] ^d	846.1 ± 0.4 [846.1] ^d	925.6 ± 0.4 [925.6] ^d	1008.1 ± 0.4 [1008.1] ^d	1096.1 ± 0.4 [1096.0] ^d	1193.6 ± 0.9	1297.7 ± 1.1	1414.3 ± 0.7 [1413.6] ^c
L _{II}	651.4 ± 0.4	721.1 ± 0.9	793.6 ± 0.3	871.9 ± 0.4	951.0 ± 0.4	1042.8 ± 0.6	1142.3 ± 0.5	1247.8 ± 0.7
L _{III}	640.3 ± 0.4 (707.4)	708.1 ± 0.9	778.6 ± 0.3	854.7 ± 0.4	931.1 ± 0.4	1019.7 ± 0.6	1115.4 ± 0.5	1216.7 ± 0.7
M _I	83.9 ± 0.5	92.9 ± 0.9	100.7 ± 0.4	111.8 ± 0.6	119.8 ± 0.6	135.9 ± 1.1	158.1 ± 0.5	180.0 ± 0.8
M _{II}	48.6 ± 0.4	54.0 ± 0.9	59.5 ± 0.3	68.1 ± 0.4	73.6 ± 0.4	80.6 ± 0.6	106.8 ± 0.7	127.9 ± 0.9
M _{III}.....	.....	(54.)	(61.)	(66.)	(75.)	(86.)	102.9 ± 0.5	120.8 ± 0.7
M _{IV}	3.3 ± 0.5	3.6 ± 0.9	2.9 ± 0.3	3.6 ± 0.4	1.6 ± 0.4	8.1 ± 0.6	17.4 ± 0.5	28.7 ± 0.7

TABLE 7f-3. RECOMMENDED VALUES OF THE ATOMIC ENERGY LEVELS, AND PROBABLE ERRORS IN eV* (Continued)

Level	33 As	34 Se	35 Br	36 Kr	37 Rb	38 Sr	39 Y	40 Zr
K	11866.7 ± 0.7 (11866.7) ^f (11865.)	12657.8 ± 0.7 (12657.8) ^f (12654.5)	13473.7 ± 0.4 (13470.)	14325.6 ± 0.8 (14324.4)	15199.7 ± 0.3 (15202.)	16104.6 ± 0.3 (16107.)	17038.4 ± 0.3 (17038.)	17997.6 ± 0.4 (17999.)
L _I	1526.5 ± 0.8 (1529.)	1653.9 ± 3.5 (1652.5)	1782.0 ± 0.4 (1782.0) ^f	1921.0 ± 0.6 (1921.2) ^g	2065.1 ± 0.3 (2065.4) ^f	2216.3 ± 0.3 (2216.2) ^f	2372.5 ± 0.3 (2372.7) ^f	2531.6 ± 0.3 (2531.6) ^f
L _{II}	1358.6 ± 0.7	1476.2 ± 0.7	1596.0 ± 0.4 (1596.2) ^f	1727.2 ± 0.5 (1727.2) ^g	1863.9 ± 0.3 (1863.4) ^f	2006.8 ± 0.3 (2006.6) ^f	2155.5 ± 0.3 (2155.0) ^f	2306.7 ± 0.3 (2306.5) ^f
L _{III}	1323.1 ± 0.7	1435.8 ± 0.7	1549.9 ± 0.4 (1549.7) ^f	1674.9 ± 0.5 (1674.8) ^g	1804.4 ± 0.3 (1804.6) ^f	1939.6 ± 0.3 (1939.9) ^f	2080.0 ± 0.3 (2080.2) ^f	2222.3 ± 0.3 (2222.5) ^f
M _I	(1323.5)	(1434.0)	256.5 ± 0.4	.....	322.1 ± 0.3	357.5 ± 0.3	393.6 ± 0.3	430.3 ± 0.3
M _{II}	203.5 ± 0.7	231.5 ± 0.7	189.3 ± 0.4	222.7 ± 1.1	247.4 ± 0.3	279.8 ± 0.3	312.4 ± 0.4	344.2 ± 0.4
M _{III}	146.4 ± 1.2	168.2 ± 1.3	181.5 ± 0.4	213.8 ± 1.1	238.5 ± 0.3	269.1 ± 0.3	300.3 ± 0.4	330.5 ± 0.4
M _{IV}	140.5 ± 0.8	161.9 ± 1.0	{ 70.1 ± 0.4 }	88.9 ± 0.8	{ 111.8 ± 0.3 }	135.0 ± 0.3	159.6 ± 0.3	182.4 ± 0.3
M _V	41.2 ± 0.7	56.7 ± 0.8	{ 69.0 ± 0.4 }	24.0 ± 0.8	{ 110.3 ± 0.3 }	133.1 ± 0.3	157.4 ± 0.3	180.0 ± 0.3
N _I	.....	.....	27.3 ± 0.5	.....	29.3 ± 0.3	37.7 ± 0.3	45.4 ± 0.3	51.3 ± 0.3
N _{II}	2.5 ± 1.0	5.6 ± 1.3	{ 5.2 ± 0.4 }	10.6 ± 1.9	{ 14.8 ± 0.4 }	19.9 ± 0.3	25.6 ± 0.4	28.7 ± 0.4
N _{III}	.....	.....	{ 4.6 ± 0.4 }	.....	{ 14.0 ± 0.3 }	.....	.....	.....
Level	41 Nb	42 Mo	43 Tc	44 Ru	45 Rn	46 Pd	47 Ag	48 Cd
K	18985.6 ± 0.4 (18987.)	19999.5 ± 0.3 (20004.)	21044.0 ± 0.7	22117.2 ± 0.3 (22119.)	23210.9 ± 0.3 (23219.8)	24350.3 ± 0.3 (24348.)	25514.0 ± 0.3 (25516.)	26711.2 ± 0.3 (26716.)
L _I	2697.7 ± 0.3 (2697.7) ^f	2865.5 ± 0.3 (2866.0) ^f	3042.5 ± 0.4 (3042.5) ^f	3224.0 ± 0.3 (3224.3) ^f	3411.9 ± 0.3 (3412.0) ^f	3604.3 ± 0.3 (3604.6) ^f	3805.8 ± 0.3 (3806.2) ^m	4018.0 ± 0.3 (4018.1) ^m
L _{II}	2464.7 ± 0.3 (2464.7) ^f	2625.1 ± 0.3 (2624.5) ^f	2793.2 ± 0.4 (2793.2) ^f	2966.9 ± 0.3 (2966.8) ^f	3146.1 ± 0.3 (3146.3) ^f	3330.3 ± 0.3 (3330.3) ^f	3523.7 ± 0.3 (3523.6) ^m	3727.0 ± 0.3 (3727.1) ^m
L _{III}	2370.5 ± 0.3 (2370.8) ^f	2520.2 ± 0.3 (2520.2) ^f	2676.9 ± 0.4 (2676.9) ^f	2837.9 ± 0.3 (2837.7) ^f	3003.8 ± 0.3 (3003.5) ^e	3173.3 ± 0.3 (3173.0) ^e	3351.1 ± 0.3 (3350.8) ^f	3537.5 ± 0.3 (3537.3) ^f

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Level	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe	55 Cs	56 Ba
<i>M</i> _I	468.4 ± 0.3	504.6 ± 0.3	585.0 ± 0.3	627.1 ± 0.3	669.9 ± 0.3	717.5 ± 0.3	770.2 ± 0.3
<i>M</i> _{II}	378.4 ± 0.4	409.7 ± 0.4	444.9 ± 1.5	482.8 ± 0.3	521.0 ± 0.3	559.1 ± 0.3	602.4 ± 0.3	650.7 ± 0.3
<i>M</i> _{III}	363.0 ± 0.4	392.3 ± 0.3	425.0 ± 1.5	460.6 ± 0.3	496.2 ± 0.3	531.5 ± 0.3	571.4 ± 0.3	616.5 ± 0.3
<i>M</i> _{IV}	207.4 ± 0.3	230.3 ± 0.3	256.4 ± 0.5	283.6 ± 0.3	311.7 ± 0.3	340.0 ± 0.3	372.8 ± 0.3	410.5 ± 0.3
<i>M</i> _V	204.6 ± 0.3	227.0 ± 0.3	252.9 ± 0.4	279.4 ± 0.3	307.0 ± 0.3	334.7 ± 0.3	366.7 ± 0.3	403.7 ± 0.3
<i>N</i> _I	58.1 ± 0.3	61.8 ± 0.3	.....	74.9 ± 0.3	81.0 ± 0.3	86.4 ± 0.3	95.2 ± 0.3	107.6 ± 0.3
<i>N</i> _{II}	33.9 ± 0.4	34.8 ± 0.4	38.9 ± 1.9	43.1 ± 0.4	47.9 ± 0.4	51.1 ± 0.4	{ 62.6 ± 0.3 }	66.9 ± 0.4
<i>N</i> _{III}	3.2 ± 0.3	1.8 ± 0.3	.....	2.0 ± 0.3	2.5 ± 0.4	1.5 ± 0.3	{ 55.9 ± 0.3 }	9.3 ± 0.3
<i>N</i> _{IV}.....	.....	.....	.....	.....	.....	.....	.....	.....
<i>N</i> _V.....	.....	.....	.....	.....	.....	.....	.....	.....
<i>O</i> _I.....	.....	.....	.....	.....	.....	.....	.....	.....
<i>O</i> _{II}.....	.....	.....	.....	.....	.....	.....	.....	.....
<i>O</i> _{III}.....	.....	.....	.....	.....	.....	.....	.....	.....
<i>K</i>	27939.9 ± 0.3	29200.1 ± 0.4	30491.2 ± 0.3	31813.8 ± 0.3	33169.4 ± 0.4	34561.4 ± 1.1	35984.6 ± 0.4	37440.6 ± 0.4
<i>L</i> _I	4237.5 ± 0.3	4464.7 ± 0.3	4698.3 ± 0.3	4939.2 ± 0.3	5188.1 ± 0.3	(31590.)	(35987.)	(37452.)
<i>L</i> _{II}	(4237.7) ^m	(4464.5) ^p	(4698.3) ^m	(4939.3) ^m	(5188.1) ^p	5452.8 ± 0.4	5714.3 ± 0.4	5988.8 ± 0.4
<i>L</i> _{III}	(4237.3)	(4464.8)	(4698.4)	(4939.7)	(5188.1) ^p	(5452.8)	(5712.7) ^p	(5986.8) ^p
<i>L</i> _{IV}	3938.0 ± 0.3	4156.1 ± 0.3	4380.4 ± 0.3	4612.0 ± 0.3	4852.1 ± 0.3	5103.7 ± 0.4	5359.4 ± 0.3	5623.6 ± 0.3
<i>L</i> _V	(3937.8) ^m	(4156.2) ^p	(4380.6) ^m	(4612.0) ^m	(4852.0) ^p	(5103.7)	(5359.5) ^p	(5623.6) ^p
<i>L</i> _{VI}	(3939.3)	(4157.)	(4382.)	(4612.6)	(4852.0) ^p	(5103.7)	(5358.)	(5623.3)
<i>M</i> _I	3730.1 ± 0.3	3928.8 ± 0.3	4132.2 ± 0.3	4341.4 ± 0.3	4557.1 ± 0.3	4782.2 ± 0.4	5011.9 ± 0.3	5247.0 ± 0.3
<i>M</i> _{II}	(3730.0) ^p	(3928.8)	(4132.2) ^p	(4341.2) ^p	(4557.1) ^p	(4782.2)	(5011.3)	(5247.3) ^p
<i>M</i> _{III}	(3730.2)	(3928.8)	(4132.3)	(4341.8)	(4557.1) ^p	(4782.2)	(5011.3)	(5247.0)
<i>M</i> _{IV}	825.6 ± 0.3	863.8 ± 0.3	943.7 ± 0.3	1006.0 ± 0.3	1072.1 ± 0.3	.....	1217.1 ± 0.4	1292.8 ± 0.4
<i>M</i> _V	702.2 ± 0.3	756.4 ± 0.4	811.9 ± 0.3	869.7 ± 0.3	930.5 ± 0.3	.....	1065.0 ± 0.5	1136.7 ± 0.5
<i>M</i> _{VI}	664.3 ± 0.3	714.4 ± 0.3	765.6 ± 0.3	818.7 ± 0.3	874.6 ± 0.3	999.0 ± 2.1	997.6 ± 0.5	1062.2 ± 0.5
<i>M</i> _{VII}	450.8 ± 0.3	493.3 ± 0.3	536.9 ± 0.3	582.5 ± 0.3	631.3 ± 0.3	.....	739.5 ± 0.4	796.1 ± 0.3
<i>N</i> _I	443.1 ± 0.3	484.8 ± 0.3	527.5 ± 0.3	572.1 ± 0.3	619.4 ± 0.3	.....	725.5 ± 0.5	780.7 ± 0.3
<i>N</i> _{II}	121.9 ± 0.3	136.5 ± 0.4	152.0 ± 0.3	168.3 ± 0.3	186.4 ± 0.3	.....	230.8 ± 0.4	253.0 ± 0.5
<i>N</i> _{III}	77.4 ± 0.4	88.6 ± 0.4	98.4 ± 0.5	110.2 ± 0.5	122.7 ± 0.5	.....	{ 172.3 ± 0.6 }	191.8 ± 0.7
<i>N</i> _{IV}.....	.....	.....	.....	.....	.....	.....	{ 161.6 ± 0.6 }	179.7 ± 0.6
<i>N</i> _V	16.2 ± 0.3	23.9 ± 0.3	31.4 ± 0.3	39.8 ± 0.3	49.6 ± 0.3	.....	{ 78.8 ± 0.5 }	92.5 ± 0.5
<i>O</i> _I	0.1 ± 4.5	0.9 ± 0.5	6.7 ± 0.5	11.6 ± 0.6	13.6 ± 0.6	{ 22.7 ± 0.5 }	39.9 ± 0.5
<i>O</i> _{II}	0.8 ± 0.4	1.1 ± 0.5	2.1 ± 0.4	2.3 ± 0.5	3.3 ± 0.5	{ 13.1 ± 0.5 }	16.6 ± 0.5
<i>O</i> _{III}	{ 11.4 ± 0.5 }	14.6 ± 0.5

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Level	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg
LIII.....	7514.0 ± 0.4 {7514.2}p (7515.)	7790.1 ± 0.4 {7789.6}p (7789.7)	8071.1 ± 0.4 {8070.0}p (8068.)	8357.0 ± 0.4 {8357.6}p (8357.5)	8618.0 ± 0.4 {8617.8}p (8619.6)	8943.6 ± 0.4 {8942.0}p (8944.1)	9244.1 ± 0.4 {9243.8}p	9560.7 ± 0.4 {9560.4}p (9558.)
MI.....	1967.5 ± 0.6	2046.8 ± 0.4	2128.3 ± 0.6	2206.5 ± 0.6	2306.8 ± 0.7	2398.1 ± 0.4	2491.2 ± 0.5	2600.9 ± 0.4
MII.....	1767.7 ± 0.9	1841.8 ± 0.5	1922.8 ± 1.0	2005.8 ± 0.6	2039.8 ± 1.1	2173.0 ± 0.4	2263.5 ± 0.4	2365.4 ± 0.4
MIH.....	1611.3 ± 0.8	1675.6 ± 0.9	1741.2 ± 0.9	1811.8 ± 0.6	1834.5 ± 1.1	1949.8 ± 0.5	2023.6 ± 0.5	2107.6 ± 0.4
MIV.....	1275.0 ± 0.6	1332.5 ± 0.4	1391.5 ± 0.7	1453.3 ± 0.5	1514.6 ± 0.7	1576.3 ± 0.4	1639.4 ± 0.4	1716.4 ± 0.4
MV.....	1241.2 ± 0.7	1294.9 ± 0.4	1351.4 ± 0.8	1409.3 ± 0.5	1497.7 ± 0.9	1527.8 ± 0.4	1588.5 ± 0.4	1661.7 ± 0.4
MVI.....	397.9 ± 0.8	416.3 ± 0.5	435.7 ± 0.8	449.1 ± 1.0	471.7 ± 0.9	487.2 ± 0.6	506.2 ± 0.6	538.1 ± 0.4
MVII.....	310.2 ± 1.2	331.8 ± 0.6	343.5 ± 1.4	366.2 ± 1.5	385.9 ± 1.6	396.7 ± 0.7	410.1 ± 1.8	437.0 ± 0.5
NI.....	385.0 ± 1.0	292.9 ± 0.6	306.6 ± 0.9	320.0 ± 0.7	336.6 ± 1.6	343.5 ± 0.5	359.3 ± 0.5	380.4 ± 0.5
NIH.....	147.0 ± 0.8	154.2 ± 0.5	161.0 ± 1.0	{176.7 ± 1.2}	179.6 ± 1.2	{198.1 ± 0.5}	{195.0 ± 0.4}	213.7 ± 0.5
NIH.....	2.6 ± 1.5	4.2 ± 1.6	3.7 ± 3.0	4.3 ± 1.4	5.3 ± 1.9	6.3 ± 1.0	6.9 ± 0.5	17.1 ± 0.5
OI.....	39.0 ± 0.8	62.9 ± 0.5	51.2 ± 1.3	59.8 ± 1.7	53.2 ± 3.0	54.1 ± 0.5	56.8 ± 0.5	64.9 ± 0.4
OII.....	25.4 ± 0.8	26.3 ± 0.6	20.3 ± 1.5	29.4 ± 1.6	32.3 ± 1.6	23.4 ± 0.6	28.0 ± 0.6	{38.1 ± 0.6}
OIII.....								{30.6 ± 0.6}
K.....	67416.4 ± 0.6 (67403.)	69525.0 ± 0.3 (69508.)	71676.4 ± 0.4 (71658.)	73870.8 ± 0.5 (73857.)	76111.0 ± 0.5 (76094.)	78394.8 ± 0.7 (78381.)	80724.9 ± 0.5 (80720.)	83102.3 ± 0.8 (83085.)
LI.....	11680.2p (11682.)	12098.2p (12099.6)	12526.7 ± 0.4 (12510.)	12938.0 ± 0.4 (12922.)	13418.5 ± 0.3 (13423.)	13879.9 ± 0.4 (13883.)	14352.8 ± 0.4 (14353.7)	14839.3 ± 1.0 (14842.)
LII.....	11136.1 ± 0.3 (11136.1)p (11132.)	11544.0 ± 0.3 (11541.4)p (11538.)	11958.7 ± 0.3 (11956.9)p (11954.)	12335.0 ± 0.4 (12331.)	12824.1 ± 0.3 (12824.0)p (12820.)	13272.6 ± 0.3 (13272.6)p (13272.3)	13733.6 ± 0.3 (13733.5)p (13736.)	14208.7 ± 0.7 (14215.)
LIII.....	9881.1 ± 0.3 (9880.3)p (9877.7)	10206.8 ± 0.3 (10204.2)p (10200.)	10635.3 ± 0.3 (10531.2)p (10531.)	10870.9 ± 0.3 (10870.7)p (10868.)	11252.2 ± 0.3 (11215.1)p (1122.)	11533.7 ± 0.3 (11533.7)p (11532.)	11918.7 ± 0.3 (11918.2)p (11921.)	12283.9 ± 0.4 (12284.0)p (12286.)
MII.....	2708.0 ± 0.4	2819.6 ± 0.4	2931.7 ± 0.4	3018.5 ± 0.4	3173.7 ± 1.7	3296.0 ± 0.9	3424.9 ± 0.3 (3424.8)p	3561.6 ± 1.1
MIII.....	2468.7 ± 0.3 (2468.6)p	2574.9 ± 0.3 (2575.0)p	2681.6 ± 0.4	2792.2 ± 0.3 (2731.9)p	2908.7 ± 0.3 (2909.1)p	3026.5 ± 0.4 (3026.5)p (3029.)	3147.8 ± 0.4 (3149.5)p	3278.5 ± 1.3
MIV.....	2104.0 ± 0.3 (2104.1)p	2281.0 ± 0.3 (2281.0)p	2367.3 ± 0.3 (2367.3)p	2457.2 ± 0.4 (2457.4)p	2550.7 ± 0.3 (2550.5)p (2550.5)	2645.4 ± 0.4 (2645.5)p (2645.9)	2743.0 ± 0.3 (2743.1)p (2744.0)	2847.1 ± 0.4 (2847.1)p

TABLE 7f-3. RECOMMENDED VALUES OF THE ATOMIC ENERGY LEVELS, AND PROBABLE ERRORS IN EV* (Continued)

Level	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg
<i>M</i> _{IV}	1793.2 ± 0.3 [1793.1] ^p	1871.6 ± 0.3 [1871.4] ^p	1948.9 ± 0.3 [1948.9] ^p	2030.8 ± 0.3 [2031.0] ^p	216.1 ± 0.3 [2110.1] ^p	2291.9 ± 0.3 [2291.9] ^p	2291.1 ± 0.3 [2291.2] ^p (2307.)	2384.9 ± 0.3 [2384.9] ^p
<i>M</i> _V	1735.1 ± 0.3 [1735.2] ^p	1809.2 ± 0.3 [1809.3] ^p	1882.9 ± 0.3 [1882.9] ^p	1940.1 ± 0.3 [1940.2] ^p	2040.4 ± 0.3 [2040.5] ^p	2121.6 ± 0.3 [2121.6] ^p	2205.7 ± 0.3 [2206.1] ^p (2220.)	2294.9 ± 0.3 [2294.9] ^p
<i>N</i> _I	565.5 ± 0.5	595.0 ± 0.4	625.0 ± 0.4	634.3 ± 0.5	690.1 ± 0.4	722.0 ± 0.6	758.8 ± 0.4	800.3 ± 1.0
<i>N</i> _{II}	464.8 ± 0.5	491.6 ± 0.4	517.9 ± 0.5	546.5 ± 0.5	577.1 ± 0.4	609.2 ± 0.6	643.7 ± 0.5	676.9 ± 2.4
<i>N</i> _{III}	404.5 ± 0.4	425.3 ± 0.5	444.4 ± 0.5	488.2 ± 0.6	494.3 ± 0.5	519.0 ± 0.6	545.4 ± 0.5	571.0 ± 1.4
<i>N</i> _{IV}	241.3 ± 0.4	258.8 ± 0.4	273.7 ± 0.5	289.4 ± 0.5	311.4 ± 0.4	300.8 ± 0.5	352.0 ± 0.4	378.3 ± 1.0
<i>N</i> _V	229.3 ± 0.3	245.4 ± 0.4	260.2 ± 0.4	272.8 ± 0.6	294.9 ± 0.4	313.3 ± 0.4	333.9 ± 0.4	359.8 ± 1.2
<i>N</i> _{VI}	25.0 ± 0.4	{ 36.5 ± 0.4 }	40.6 ± 0.4	46.3 ± 0.6	{ 53.4 ± 0.4 }	74.3 ± 0.4	86.4 ± 0.4	102.2 ± 0.5
<i>N</i> _{VII}		{ 33.6 ± 0.4 }			{ 50.5 ± 0.4 }	71.1 ± 0.5	82.8 ± 0.5	98.5 ± 0.5
<i>O</i> _I	71.1 ± 0.5	77.1 ± 0.4	82.8 ± 0.5	83.7 ± 0.6	95.2 ± 0.4	101.7 ± 0.4	107.8 ± 0.7	120.3 ± 1.3
<i>O</i> _{II}	44.9 ± 0.4	46.8 ± 0.5	45.6 ± 0.7	58.0 ± 1.1	53.0 ± 0.6	55.3 ± 0.7	71.7 ± 0.7	80.5 ± 1.3
<i>O</i> _{III}	36.4 ± 0.4	35.6 ± 0.5	34.6 ± 0.6	15.4 ± 1.0	50.5 ± 0.6	51.7 ± 0.7	53.7 ± 0.7	57.6 ± 1.3
<i>O</i> _{IV}	5.7 ± 0.4	6.1 ± 0.4	3.5 ± 0.5	.....	3.8 ± 0.4	2.2 ± 1.3	2.5 ± 0.5	6.4 ± 1.4
Level	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn	87 Fr	88 Ra
<i>K</i>	85530.4 ± 0.6	88004.5 ± 0.7 (88005.)	90525.9 ± 0.7 (90534.)	93105.0 ± 3.8	95729.9 ± 7.7	98404. ± 12.	101137. ± 13.	103921.0 ± 7.2
<i>L</i> _I	15346.7 ± 0.4 (15343.)	15860.8 ± 0.5 (15855.)	16387.5 ± 0.4 (16376.)	16639.3 ± 9.8	17493. ± 29.	18049. ± 38.	18639. ± 40.	19236.7 ± 1.5 (19236.0)
<i>L</i> _{II}	14697.9 ± 0.3 [14697.3] ^p	15200.0 ± 0.4 (15205.)	15711.1 ± 0.3 [15708.4] ^p	16244.3 ± 2.4	16784.7 ± 2.5	17337.1 ± 3.4	17906.5 ± 3.5	18484.3 ± 1.5 (18486.0)
<i>L</i> _{III}	12657.5 ± 0.3 [12656.3] ^p	13036.2 ± 0.3 [13034.9] ^p	13418.6 ± 0.3 [13418.3] ^p	13813.8 ± 1.0 (13813.8)	14213.5 ± 2.0 (14213.5)	14619.4 ± 3.0 (14619.4)	15031.2 ± 3.0 (15031.2)	15444.4 ± 1.5 (15444.0)
<i>M</i> _I	3704.1 ± 0.4	3850.7 ± 0.5	3999.1 ± 0.3 [3999.1] ^p	4149.4 ± 3.9	(4317.)	(4482.)	(4652.)	4822.0 ± 1.5
<i>M</i> _{II}	3415.7 ± 0.3 [3415.7] ^p	3554.2 ± 0.3 [3554.2] ^p	3696.3 ± 0.3 [3696.4] ^p	3854.1 ± 9.8	4008. ± 28.	4159. ± 38	4327. ± 40.	4489.5 ± 1.8

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Level	89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm
<i>M</i> III.....	2956.6 ± 0.3 [2956.5]p	3066.4 ± 0.4 [3066.3]p	3176.9 ± 0.3 [3176.8]p	3301.9 ± 0.9	3426. ± 29.	3538. ± 38.	3663. ± 40.	3791.8 ± 1.7
<i>M</i> IV.....	2485.1 ± 0.3 [2485.2]p	2585.6 ± 0.3 [2585.5]p (2606.)	2687.6 ± 0.3 [2687.4]p	2738.0 ± 1.2	2908.7 ± 2.1	3021.5 ± 3.1	3136.2 ± 3.1	3248.4 ± 1.6
<i>M</i> V.....	2389.3 ± 0.3 [2389.4]p	2484.0 ± 0.3 [2484.2]p (2502.)	2579.6 ± 0.3 [2579.5]p	2633.0 ± 1.1	2786.7 ± 2.1	2892.4 ± 3.1	2999.9 ± 3.1	3104.9 ± 1.6
<i>N</i> I.....	845.5 ± 0.5	893.6 ± 0.7	938.2 ± 0.3 [938.7]p	995.3 ± 2.9	(1042.)	(1097.)	(1153.)	1208.4 ± 1.6
<i>N</i> II.....	721.3 ± 0.8	763.9 ± 0.8	805.3 ± 0.3 [805.3]p	851. ± 12.	886. ± 30.	929. ± 40.	980. ± 42.	1057.6 ± 1.8
<i>N</i> III.....	609.0 ± 0.5	644.5 ± 0.5	678.9 ± 0.3 [678.9]p	705. ± 14.	740. ± 30.	738. ± 40.	810. ± 43.	879.1 ± 1.8
<i>N</i> IV.....	406.6 ± 0.4	435.2 ± 0.5	463.6 ± 0.3 [463.6]p	500.2 ± 2.4	553.2 ± 3.2	536.6 ± 4.0	603.3 ± 4.1	635.9 ± 1.6
<i>N</i> V.....	386.2 ± 0.5	412.9 ± 0.6	440.0 ± 0.3 [440.1]p	473.4 ± 1.3	.....	.....	577. ± 34.	602.7 ± 1.7
<i>N</i> VI.....	122.8 ± 0.4	142.9 ± 0.4	161.9 ± 0.5	.....	.....	.....	.....	298.9 ± 2.4
<i>N</i> VII.....	118.5 ± 0.4	138.1 ± 0.4	157.4 ± 0.6	.....	.....	.....	.....	254.4 ± 2.1
<i>O</i> I.....	136.3 ± 0.7	147.3 ± 0.8	159.3 ± 0.7	.....	.....	.....	.....	200.4 ± 2.0
<i>O</i> II.....	99.6 ± 0.6	104.8 ± 1.0	116.8 ± 0.7	.....	.....	.....	.....	152.8 ± 2.0
<i>O</i> III.....	75.4 ± 0.6	86.0 ± 1.0	92.8 ± 0.6	.....	.....	.....	.....	67.2 ± 1.7
<i>O</i> IV.....	15.3 ± 0.4	21.8 ± 0.4	26.5 ± 0.5	31.4 ± 3.2	.....	.....	.....	43.5 ± 2.2
<i>P</i> I.....	13.1 ± 0.4	19.2 ± 0.4	24.4 ± 0.6	.....	.....	.....	.....	18.8 ± 1.8
<i>P</i> II.....	.....	3.1 ± 1.0	.....	.....	.....	.....	.....	.....
<i>P</i> III.....	.....	0.7 ± 1.0	.....	.....	.....	.....	.....	.....
Level	89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm
<i>K</i>	106755.3 ± 5.3	109650.9 ± 0.9	112601.4 ± 2.4	115606.1 ± 1.6	118678. ± 33.	121818. ± 44.	125027. ± 55.	128220
<i>L</i> I.....	19840. ± 18.	20472.1 ± 0.5	21104.6 ± 1.8	21757.4 ± 0.3	22426.8 ± 0.9	23097.2 ± 1.6	23772.9 ± 2.0 (23772.9)	24460
<i>L</i> II.....	19083.2 ± 2.8	(20464.)	(21128.)	(21771.)	21606.5 ± 0.4	(23109.)	22944.0 ± 1.0	23779
<i>L</i> III.....	15871.0 ± 2.0 (15871.0)	16300.3 ± 0.3 [16299.6]e	16733.1 ± 1.4 (16733.)	17166.3 ± 0.3 (17166.5)r	17610.0 ± 0.4 (17606.2)	18056.8 ± 0.6 (18053.1)	18504.1 ± 0.9 (18504.1)	18930
<i>M</i> I.....	(5002.)	5182.3 ± 0.3 [5182.3]v	5360.9 ± 1.6	5546.0 ± 0.4	5723.2 ± 3.6	5932.9 ± 1.4	6120.5 ± 7.5	6288
<i>M</i> II.....	4056. ± 18.	4830.4 ± 0.4 [4830.6]v	5000.9 ± 2.3	5182.2 ± 0.4 [5180.9]r	5366.2 ± 0.7 [5306.4]r	5541.2 ± 1.7	5710.2 ± 2.1	5895

TABLE 7f-3. RECOMMENDED VALUES OF THE ATOMIC ENERGY LEVELS, AND PROBABLE ERRORS IN eV* (Continued)

Level	89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm
M _{III}	3009. ± 18.	4046.1 ± 0.4 [4046.1] ^e (4041.)	4173.8 ± 1.8	4303.4 ± 0.3 [4303.6] ^f (4299.)	4434.7 ± 0.5 [4434.6] ^f	4550.6 ± 1.5	4007.0 ± 2.1	4707
M _{IV}	3370.2 ± 2.1	3490.8 ± 0.3 [3490.7] ^f (3485.)	3611.2 ± 1.4 (3608.)	3727.6 ± 0.3 [3728.1] ^f (3720.)	3850.3 ± 0.4 [3849.8] ^f	3972.6 ± 0.6 [3972.7] ^f	4092.1 ± 1.0	4227
M _V	3219.0 ± 2.1	3332.0 ± 0.3 [3332.1] ^f (3325.)	3441.8 ± 1.4 (3436.)	3551.7 ± 0.3 [3551.7] ^f (3545.)	3605.8 ± 0.4 [3604.2] ^f	3778.1 ± 0.6 [3778.0] ^f	3880.9 ± 1.0	3971
N _I	(1269.)	1329.5 ± 0.4 [1329.8] ^e	1387.1 ± 1.9	1408.8 ± 0.4 [1441.3] ^f	1500.7 ± 0.8 [1500.7] ^f	1558.6 ± 0.8	1617.1 ± 1.1	1643
N _{II}	1080. ± 19.	1168.2 ± 0.4 [1168.3] ^f	1224.3 ± 1.6	1272.6 ± 0.3 [1272.5] ^f	1327.7 ± 0.8 [1327.7] ^f	1372.1 ± 1.8	1411.8 ± 6.3	1440
N _{III}	800. ± 19.	967.3 ± 0.4 [967.6] ^e	1006.7 ± 1.7	1044.9 ± 0.3 [1044.9] ^f	1086.8 ± 0.7 [1086.8] ^f	1114.8 ± 1.6	(1135.7)	1154
N _{IV}	674.9 ± 3.7	714.1 ± 0.4 [714.4] ^e	743.4 ± 2.1	780.4 ± 0.3 [779.7] ^f	815.9 ± 0.5 [817.1] ^f	848.9 ± 0.6 [848.9] ^f	878.7 ± 1.0	
N _V.....	.....	676.4 ± 0.4 [676.4] ^e	708.2 ± 1.8	737.7 ± 0.3 [737.6] ^f	770.3 ± 0.4 [773.2] ^f	801.4 ± 0.6 [801.4] ^f	827.6 ± 1.0	
N _{VI}.....	.....	344.4 ± 0.3 [344.2] ^e	371.2 ± 1.6	391.3 ± 0.6 [391.3 ± 0.6]	415.0 ± 0.8 [415.0] ^f	445.8 ± 1.7		
N _{VII}.....	.....	335.2 ± 0.4 [335.0] ^e	359.5 ± 1.6	380.9 ± 0.9	404.4 ± 0.5 [404.4] ^f	432.4 ± 2.1		
O _I.....	.....	290.2 ± 0.8 [290.2 ± 0.8]	309.6 ± 4.3	323.7 ± 1.1 [323.7 ± 1.1]	283.4 ± 0.8 [283.4] ^f	351.9 ± 2.4	.....	385
O _{II}.....	.....	229.4 ± 1.1	222.9 ± 3.9	259.3 ± 0.5 [259.3 ± 0.5]	206.1 ± 0.7 [206.1] ^f	274.1 ± 4.7	.....
O _{III}.....	.....	181.8 ± 0.4 [181.8] ^e	.....	195.1 ± 1.3	206.1 ± 0.7	206.5 ± 4.7	115.8 ± 1.3	
O _{IV}.....	.....	94.3 ± 0.4 [94.4] ^e	.....	105.0 ± 0.5 [105.0 ± 0.5]	109.3 ± 0.7 [108.8] ^f	116.0 ± 1.2	.....
O _V.....	.....	87.9 ± 0.3 [88.1] ^f	94.1 ± 2.8	96.3 ± 1.4	101.3 ± 0.5 [101.4] ^f	105.4 ± 1.0	103.3 ± 1.1	
P _I.....	.....	59.5 ± 1.1	.....	70.7 ± 1.2	.....	.....	.....
P _{II}.....	.....	49.0 ± 2.5	.....	42.3 ± 9.0	.....	.....	.....
P _{III}.....	.....	43.0 ± 2.5	.....	32.3 ± 9.0	.....	.....	.....

TABLE 7I-3. RECOMMENDED VALUES OF THE ATOMIC ENERGY LEVELS, AND PROBABLE ERRORS IN EV* (Continued)

Level	97 Bk	98 Cl	99 Fa	100 Fm	101 Md	102 No	103 Lw
K	[131500 ± 40] ^a	135960	139490	143080	146760	150540	154380
L _I	[25275 ± 17] ^a	20110	20300	27760	28570	29380	30240
L _{II}	[24385 ± 17] ^a	25250	26020	26810	27610	28440	29280
L _{III}	[19452 ± 20] ^a	19930	20410	20900	21350	21880	22360
M _I	[6556 ± 21] ^a	6754	6977	7265	7411	7675	7900
M _{II}	[6147 ± 31] ^a	6359	6574	6783	7019	7255	7460
M _{III}	[4977 ± 31] ^a	5109	5252	5397	5546	5688	5710
M _{IV}	4366	4497	4630	4766	4903	5037	5150
M _V	4132	4253	4374	4498	4622	4741	4860
N _I	[1755 ± 22] ^a	1799	1868	1937	2010	2078	2140
N _{II}	1554	1616	1680	1747	1814	1876	1930
N _{III}	1235	1279	1321	1366	1410	1448	1480
O _I	[398 ± 22] ^a	419	435	454	472	484	490

^a J. E. Mack, 1949, as given in C. E. Moore "Atomic Energy Levels" (U.S. National Bureau of Standards, Washington, D.C., 1949), vol. 1, p. 1.
^b G. Herzberg, 1957, as given in C. E. Moore, "Atomic Energy Levels" (U.S. National Bureau of Standards, Washington, D.C., 1958), vol. 3, p. 238.
^c S. Hagström and S. E. Karlsson, *Arkiv Fysik* **26**, 451 (1964); and S. Hagström, *Z. Physik* **178**, 82 (1964).
^d A. Fahlman, D. Hamrin, R. Nordberg, C. Nordling, and K. Siegbahn, *Phys. Rev. Letters* **14**, 127 (1965); R. Nordberg, K. Hamrin, A. Fahlman, C. Nordling, and K. Siegbahn, *Z. Physik* **192**, 402 (1966).
^e E. Sokolowski, *Arkiv Fysik* **15**, 1 (1959).
^f S. Hagström, C. Nordling, and K. Siegbahn, *Alpha-, Beta-, and Gamma-Ray Spectroscopy*, K. Siegbahn, Ed. (North-Holland Publ. Co. Amsterdam, 1965) Vol. 1, p. 845.
^g C. Nordling, *Arkiv Fysik* **15**, 397 (1959).
^h E. Sokolowski, C. Nordling, and K. Siegbahn, *Arkiv Fysik* **12**, 301 (1957).
ⁱ C. Nordling and S. Hagström, *Arkiv Fysik* **16**, 515 (1960).
^j I. Andersson and S. Hagström, *Arkiv Fysik* **27**, 161 (1964).

^{*} M. O. Krause, *Phys. Rev.* **140**, A1845 (1965).
[†] A. Fahlman, O. Hornfeldt, and C. Nordling, *Arkiv Fysik* **23**, 75 (1962).
[‡] P. Bergvall, O. Hornfeldt, and C. Nordling, *Arkiv Fysik* **17**, 113 (1960).
[§] P. Bergvall and S. Hagström, *Arkiv Fysik* **17**, 61 (1960).
^{||} S. Hagström, *Z. Physik* **178**, 82 (1964).
[¶] A. Fahlman and S. Hagström, *Arkiv Fysik* **27**, 69 (1964).
^{‡‡} C. Nordling and S. Hagström, *Z. Physik* **178**, 418 (1964).
^{††} C. Nordling and S. Hagström, *Arkiv Fysik* **15**, 431 (1959).
^{‡‡‡} S. Hagström, *Bull. Am. Phys. Soc.* **11**, 389 (1960).
^{†††} A. Fahlman, K. Hamrin, E. Nordberg, C. Nordling, K. Siegbahn, and L. W. Holm, *Phys. Letters* **19**, 643 (1966).
^{††††} J. M. Hollander, M. D. Holtz, T. Nvakov, and R. L. Graham, *Arkiv Fysik* **28**, 375 (1965).
^{†††††} J. A. Bearden, *Rev. Mod. Phys.* **39**, 73 (1967). J. A. Bearden, X-Ray Wavelengths, NYO 10586 (National Technical Information Service, U.S. Dept. of Commerce, Springfield, Va. 22151).