8b. Properties of Nuclides

DAVID T. GOLDMAN

National Bureau of Standards

Table 8b-1 lists the properties that serve to characterize stable and radioactive nuclides. They are shown in order of ascending atomic number. The stable isotopes which constitute the naturally occurring elements are distinguished by **boldface** type. The literature was reviewed through December, 1968. In the interests of legibility and conciseness, no specific references are given with the table. Detailed information about the nuclides can be found in the list of general references that immediately precedes the table. The numbers cited here have been rounded off to the last significant figure before the uncertainty.

The first three columns of the table give for each element the atomic number, accepted symbol, and name. For the isotopes within each element, columns 4 and 5 give A, mass number, and N, number of neutrons. The atomic number is Z, and $A = Z + N$.

Column 6 lists the mass excess, or the difference between the actual weight of the nuclide and A, in milliatomic mass units (1 amu = 931.481 MeV). The scale is chosen such that the atomic mass of ^{12}C is exactly 12, and, hence, the mass excess of ^{12}C is identically zero. The values are taken mainly from the analysis of Mattauch, Thiele, and Wapstra [1], and from a later revision by Wapstra for $A \geq 212$ [2]. References 1 and 2 also contribute to column 12, the beta-decay Q values, the energy difference between the ground states of parent and daughter nuclei.

Two major sources of radioactive decay data are the products of the Nuclear Data Group at Oak Ridge National Laboratory [3] and the "Table of Isotopes" compiled at Lawrence Radiation Laboratory [4]. Except for more recently available data, these two references form the general source of most of the material given in columns 7, 8, 11, and 13. Other references to limited regions of the periodic table are the series prepared by Ajzenberg-Selove and Lauritsen [7] for $A \leq 20$ and Endt and Vander Leun [8] for $11 \leq Z \leq 21$.

The isotopic abundances of the naturally occurring isotopes are shown in **boldface** in column 8 and are those given by Fuller and Nier [5]. Columns 9 and 10 present the nuclear magnetic moments (in nuclear magnetons) and quadrupole moments (in barns), respectively. They are taken from an evaluation by Fuller and Cohen [6], which also provides data for the spins and parities of the nuclides (column 7).

Column 11 gives the decay particle, the most important decay energies in MeV and, in parentheses, the probability, in percent, of this decay energy in each transition. Column 13 gives similar information for the main gamma radiation.

Column 14 presents the 2,200-m/s (often called "thermal") neutron-absorption cross section. It is taken from the analysis of Goldman, et al. [9].

Much of the work presented here was initiated in the preparation of the "Chart of the Nuclides," the latest of which is the ninth edition [10].

References

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5. Fuller, G. H., and A. O. Nier: Appendix 2, "Relative Isotopic Abundances," *Nucl. Data Sheets*.
6. Fuller, G. H., and V. W. Cohen: *Nucl. Data* **A5**(5), 6 (1968).
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9. Goldman, D. T., P. Aline, R. Sher, and J. R. Stehn: Twenty-two Hundred Meter per Second Neutron Absorption Cross Sections, submitted for publication.
10. Goldman, D. T., and J. R. Roesser: "Chart of the Nuclides," 9th ed., General Electric Co., 1966.

TABLE 8b-1. PROPERTIES OF NUCLIDES

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
0	n	Neutron	1	1	8.6652	$\frac{1}{2}+$	11 m	−1.9131		β^-0.78			
1	H	Hydrogen	1	0	7.8252	$\frac{1}{2}+$	99.985%	+2.79278	.....	....	.....	.....	0.332
			2	1	14.1022	1+	0.015%	+0.85742	+0.0028	.....	.....	.....	0.00052
			3	2	16.0407	$\frac{1}{2}+$	12.3 y	+2.9789	....	β^-0.0186	0.01861		
2	He	Helium	3	1	16.0297	$\frac{1}{2}+$	0.00011%	−2.1276	.....	.....	.....	.....	5327
			4	2	2.603	0+	100%	.....	.....	.....	.....	.....	0
			6	4	18.89	0+	0.802 s	.....	.....	β^-3.51(100)	3.51		
			8	6	34.	0+	0.122 s	.....	.....	β^-10, . . . , n	10.7	0.99(88)	
3	Li	Lithium	6	3	15.123	1+	7.42%	+0.82202	−0.0008	.....	.....	.....	950
			7	4	16.004	$\frac{3}{2}-$	92.58%	+3.2564	−0.04	....	.....	.....	0.037
			8	5	22.487	2+	0.85 s	+1.6532	.....	β^-13, α1.6	16.0		
			9	6	26.80	$(\frac{3}{2})-$	0.172 s	.....	.....	β^-11.0(75), 13.5(2), n0.7, . . .	13.61		
4	Be	Beryllium	7	3	16.929	$\leq\frac{3}{2}-$	53.37 d	.....	.....	ϵ(100)	0.862	0.478(10)	51,000
			9	5	12.183	$\frac{3}{2}-$	100%	−1.1776	+0.05				
			10	6	13.534	0+	2.7×10^6 y	.....	.....	β^-0.555(100)	0.555	.....	≤0.001
			11	7	21.67	$(\frac{1}{2})+$	13.6 s	.....	.....	β^-11.5(61), 9.3(29), 4.7(6), 3.6(4)	11.61	2.12(32), 6.79(4), 5.86(2), 4.64(2), 7.97(2)	
			12	8	27.	0+	0.011 s	.....	.....	β^-, n			
5	B	Boron	8	3	24.609	(2+)	0.774 s	.....	.....	β^+14, α21.6	18.0		
			10	5	12.9385	3+	19.78%	+1.8007	+0.08	....	.....	.....	3836
			11	6	9.305	$\frac{3}{2}-$	80.22%	+2.6885	+0.04	....	.....	.....	0.005
			12	7	14.354	1+	0.0204 s	±1.002	.....	β^-13.37(98), 9.0(1), . . . , α0.195(1.5)	13.370	4.43(1), . . .	
			13	8	17.78	.....	0.019 s	.....	.....	β^-13.4(93), . . . , n	13.437	3.67(7)	
6	C	Carbon	9	3	31.04	.....	0.0127 s	.....	.....	β^+, p8.2(60), 1.1(40), 2α			
			10	4	16.86	0+	19.4 s	.....	.....	β^+1.87(0.98), 0.85(1.6), 1.87	.....	0.717(100) 1.023(1.6)	
			11	5	11.432	$\frac{3}{2}-$	20.4 m	±1.03	±0.031	β^+0.97(99+), ϵ(0.2)	1.98		
			12	6	0.	0+	98.89%	.....	.....	.....	.....	.....	0.0034

			13	7	3.354	$\frac{1}{2}-$	1.11 %	+0.7024	.....	.....	.....	.....	0.0009
			14	8	3.2420	0+	5730 y	.....	.....	β^-0.156	0.1561		
			15	9	10.600	$\frac{1}{2}+$	2.4 s	.....	.....	β^-4.51(68), 9.82(32)	9.77	5.299(68)	
			16	10	14.70	0+	0.74 s	.....	.....	β^-, n	8.0		
7	N	Nitrogen	12	5	18.62	1+	0.0110 s	±0.46	.....	β^+16.38, . . . , (100) 3α0.195(3)	17.36	4.43(2.4)	
			13	6	5.738	$\frac{1}{2}-$	10.0 m	±0.3221	.....	β^+1.19(100)	2.22		
			14	7	3.0744	1+	99.63 %	+0.4036	.....	.....	.....	.....	1.89
			15	8	0.108	$\frac{1}{2}-$	0.37 %	−0.2831	.....	.....	.....	.....	0.000024
			16	9	6.101	2−	7.2 s	.....	.....	β^-4.3(68), 10.4(26), . . . , α1.7(0.001)	10.422	6.13(69), 7.11(5), 2.75(1)	
			17	10	8.45	$(\frac{1}{2})-$	4.16 s	.....	.....	β^-4.1(95), 7.81(3), 8.68(2), n0.40(45), 1.2(45), 1.81(5)	8.68	0.87(3), 2.19(0.5)	
			18	11	14.25	(0,1,2)−	0.63 s	.....	.....	β^-9.4	13.9	1.98(100), 0.82(59), 1.65 (59), 2.47(41)	
			13	5	24.81	$(\frac{3}{2}-)$	0.0087 s	.....	.....	β^+, p6.40(80), 6.97(20)	17.8		
8	O	Oxygen	14	6	8.597	0+	71.0 s	.....	.....	β^+1.81(99.4), 4.12(0.6)	5.1443	2.312(99)	
			15	7	3.070	$\frac{1}{2}-$	124 s	±0.718)	.....	β^+1.74(100)	2.760		
			16	8	−5.0850	0+	99.759 %	.....	.....	.....	.....	.....	0.000178
			17	9	−0.867	$\frac{5}{2}+$	0.037 %	−1.8937	−0.026	.....	.....	.....	0.235
			18	10	−0.8400	0−	0.204 %	.....	.....	.....	.....	.....	0.00021
			19	11	3.578	$\frac{5}{2}+$	27 s	.....	.....	β^-3.25(62), 4.60(38)	4.819	0.197(97), 1.37(59)	
			20	12	4.08	0−	14 s	.....	.....	β^-	3.81	1.06(100)	
9	F	Fluorine	17	8	2.096	$\frac{5}{2}+$	66 s	±4.722	.....	β^+1.74(100)	2.759		
			18	9	0.937	1+	109.7 m	.....	.....	β^+0.635(97), ϵ(3)	0.655		
			19	10	−1.595	$\frac{1}{2}+$	100 %	+2.6288	.....	.....	.....	.....	0.0098
			20	11	−0.017	2+	11.4 s	+2.094	.....	β^-5.42(100)	7.030	1.63(100)	
			21	12	−0.049	$\frac{5}{2}+$	4.4 s	.....	.....	β^-5.4(87), 4.0(13)	5.68	0.350(100), 1.38(13)	
			22	13	3.04	(3+)	4.0 s	.....	.....	β^-11	12	1.28(100), 2.06(67)	
10	Ne	Neon	17	7	17.7	$(\frac{1}{2}-)$	0.10 s	.....	.....	β^+, p1.59, 3.80, 5.08, 6.95, . . .			
			18	8	5.711	0+	1.5 s	.....	.....	β^+3.42(93), . . .	4.45	1.04(7)	
			19	9	1.881	$\frac{1}{2}+$	17.4 s	−1.887	.....	β^+2.22(100)	3.238		
			20	10	−7.560	0+	90.92 %	.....	.....	.....	.....	.....	0.038
			21	11	−6.153	$\frac{3}{2}+$	0.257 %	−0.6618	+0.09				
			22	12	−8.615	0+	8.82 %	.....	.....	.....	.....	.....	0.036
			23	13	−5.529	$(\frac{1}{2}+)$	37.6s	−1.08	.....	β^-4.38(67), 3.95(32), 2.4(1), . . .	4.380	0.439(33), 1.64(1), . . .	
			24	14	−6.39	0+	3.38 m	.....	.....	β^-1.99(92), 1.10(8)	2.47	0.472(100), 0.88(8)	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
11	Na	Sodium	20	9	7.4	.....	0.402 s	.....	.....	β^+11.25, 5.55, . . . , α2.14, . . .	13.91	1.63, . . .	
			21	10	−2.35	$\frac{3}{2}+$	22.8 s	+2.386	.....	β^+2.52(98), 2.17(2)	3.54	0.35(2.2)	
			22	11	−5.563	3+	2.602 y	+1.746	.....	β^+0.544(90), 1.82(0.05), ϵ(9.5)	2.813	1.274(99.5)	40,000
			23	12	−10.229	$\frac{3}{2}+$	100%	+2.2175	+0.14	.....	.....	.....	0.534
			24	13	−9.036	4+	14.98 h	+1.690	.....	β^-1.39(99), . . .	5.515	2.754(99), 1.369(99), . . .	
			25	14	−10.05	5-2+	60 s	.....	.....	β^-3.8(65), 3.3(30), 2.2(5)	3.83	0.98(15), 0.39(14), 0.58(14), 1.61(6)	
			26	15	−8.1	2 or 3+	1.04 s	.....	.....	β^-6.7(100), . . .	8.5	1.81(100)	
12	Mg	Magnesium	20	8	19.	.....	0.6 s	.....	.....	β^+, p3.4, 4.0, 4.3, 4.8, 5.9, 0.45	13.1		
			21	9	11.71	.....	0.12 s	.....	.....	β^+3.16(59), 3.23(36), 1.88(5)	4.80	0.073(59), 0.583(100), 1.28(5)	
			22	10	−0.41	0+	4.00 s	.....	.....	β^+3.04(91), 2.60(9)	4.056	0.439(9)	
			23	11	−5.875	$\frac{3}{2}+$	12.0 s	.....	.....	.....	.....	.....	0.05
			24	12	−14.956	0+	78.70%	—	.....	.....	.....	.....	0.18
			25	13	−14.161	$\frac{5}{2}+$	10.13%	−0.8551	+0.22	.....	.....	.....	0.030
			26	14	−17.407	0+	11.17%	.....	.....	.....	.....	.....	
			27	15	−15.657	$\frac{1}{2}+$	9.49 m	.....	.....	β^-1.75(69), 1.59(31)	2.61	0.84(70), 1.0(30), 0.18(1)	
			28	16	−16.121	0+	21.3 h	.....	.....	β^-0.46(100)	1.835	0.032(96), 1.35(70), 0.40(31), 0.95(29)	
13	Al	Aluminum	24m	...	.....	1+	0.13 s	.....	.....	β^-13.3(4.4), 11.9(1.9), . . .	14.32	IT0.439(93), 1.369(1.9)	
			24	11	0.5	4+	2.09 s	.....	.....	β^+3.40(48), 4.12(41), 8.74(8), 6.8(3)	13.88	1.37(40), 2.73(32), 4.22(15), 7.1(7), 5.4(6)	
			25	12	−9.568	$\frac{5}{2}+$	7.23 s	.....	.....	β^+3.24(100)	4.26		
			26m	13	.....	0+	6.38 s	.....	.....	β^+3.21(100)	4.232		
			26	13	−13.106	5+	7.4×10^5 y	.....	.....	β^+1.16(85), ϵ(15)	4.003	1.81(100), 1.2(2), . . .	

			27	**14**	−18.459	$\frac{5}{2}$+	**100%**	+3.6414	+0.15	.....	.....	.....	0.232
			28	15	−18.088	3+	2.27 m	.....	.....	β^-2.87(100)	4.634	1.779(100)	
			29	16	−19.552	$\frac{5}{2}$+	6.52 m	.....	.....	β^-2.5(93), 1.5(7)	3.68	1.27(93), 2.43(7)	
			30	17	−17.1	(2,3)+	3.3 s	.....	.....	β^-3.8(84), 5.1(16)	8.5	2.23(58), 3.51(42)	
14	Si	Silicon	25	11	4.1	($\frac{5}{2}$+)	0.22 s	.....	.....	β^+, p4.35, 1.95, 3.47, 2.31, 2.18, 0.97, . . .	12.7		
			26	12	−7.66	0+	2.1 s	.....	.....	β^+3.83(60), 3.00(34)	5.07	0.82(34)	
			27	13	−13.297	$\frac{5}{2}$+	4.17 s	.....	.....	β^+3.8(100), . . .	4.81		
			28	**14**	−23.071	0+	**92.11%**	.....	.....	.....	.....	.....	0.16
			29	**15**	−23.504	$\frac{1}{2}$+	**4.70%**	−0.5553	.....	.....	.....	.....	0.28
			30	**16**	−26.228	0+	**3.00%**	.....	.....	.....	.....	.....	0.10
			31	17	−24.636	$\frac{3}{2}$+	2.62 h	.....	.....	β^-1.49(99.9), 0.21(0.1)	1.492	1.266(0.1)	
			32	18	−25.86	0+	650 y	.....	.....	β^-0.21(100)	0.21		
15	P	Phosphorus	28	13	−8.2	(3)+	0.27 s	.....	.....	β^+11.5(52), 6.96(16), 5.25(13), 3.94(13), 8.80(7)	14	1.78(100), 4.50(29), 3.04(8), 7.50(7), 2.84(6), . . .	
			29	14	−18.19	$\frac{1}{2}$+	4.23 s	.....	.....	β^+3.94(98), 2.68(1), . .	4.95	1.27(1)	
			30	15	−21.68	1+	2.50 m	.....	.....	β^+3.24(99.5), 1.01(0.5)	4.24	2.23(0.5)	
			31	**16**	−26.235	$\frac{1}{2}$+	**100%**	+1.1317	.....	.....	.....	.....	0.19
			32	17	−26.091	1+	14.29 d	−0.2523	.....	β^-1.710(100)	1.710		
			33	18	−28.272	($\frac{1}{2}$)+	25.3 d	.....	.....	β^-0.248(100)	0.248		
			34	19	−26.7	1+	12.1 s	.....	.....	β^-5.1(75), 3.2(25)	5.1	2.1(25), 4.0(0.2)	
16	S	Sulfur	29	13	−3.	($\frac{5}{2}$+)	0.19 s	.....	.....	β^+, p3.5, 3.73, 5.0, 5.2, 5.4, . . .	~14		
			30	14	−15.10	0+	1.25 s	.....	.....	β^+4.43(80), 5.10(20), . . .	6.13	0.68(80), . . .	
			31	15	−20.39	$\frac{1}{2}$+	2.61 s	.....	.....	β^+4.39(99), . . .	5.44	1.266(1)	
			32	**16**	−27.926	0+	**95.0%**	.....	.....	.....	.....	.....	0.53
			33	**17**	−28.541	$\frac{3}{2}$+	**0.75%**	+0.6433	−0.055	.....	.....	.....	0.18
			34	**18**	−32.130	0+	**4.21%**	.....	.....	.....	.....	.....	0.02
			35	19	−30.967	$\frac{3}{2}$+	87.0 d	+1.00 or −1.07	+0.04	β^+0.167(100)	0.167		
			36	**20**	−32.91	0+	**0.014%**	.....	.....	.....	.....	.....	0.14
			37	21	−28.88	($\frac{7}{2}$−)	5.05 m	.....	.....	β^-1.6(94), 4.8(6), . . .	4.8	3.11(94), 3.71(0.4)	
			38	22	−28.8	0+	2.87 h	.....	.....	β^-1.1(95), 3.0(5)	3.0	1.88(95)	
17	Cl	Chlorine	32	15	−14.24	2+	0.30 s	.....	.....	β^+9.5(60), 4.7(25), 7.5(14), 6.2(10), 11.6(1)	12.8	2.23(89), 4.77(25), 2.46(5), 1.65(5), 3.31(4), . . .	
			33	16	−22.56	$\frac{3}{2}$+	2.52 s	.....	.....	β^+4.5(997), . . .	5.57	2.9(0.3)	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
17	Cl	Chlorine	34*m*	...	.....	3+	32.2 m	.....	.....	β^+2.5(28), 1.3(27), . . .	5.63	IT0.146(45), 2.13(41), 3.30(14), 4.12(0.4)	
			34	17	−26.250	0+	1.57 s	.....	.....	β^+4.5(100)	5.48		
			35	18	−31.146	$\frac{3}{2}$+	**75.53%**	+0.82133	−0.079	.....	.....	.....	44
			36	19	−31.693	2+	3.07×10^5 y	+1.285	−0.017	β^-0.71(98.3), ϵ(1.7), β^+0.12(0.002)	0.712 1.14		
			37	20	−34.097	$\frac{3}{2}$+	**24.47%**	+0.68411	−0.062	.....	.....	.....	0.43
			38*m*	...	.....	5−	0.74 s	.....	.....	.....	.....	.....	
			38	21	−32.00	2−	37.2 m	.....	.....	β^-4.9(53), 1.1(36), 2.8(11)	4.9	2.17(47), 1.64(36), 3.81(0.02)	
			39	22	−31.90	$\frac{3}{2}$+	55.5 m	.....	.....	β^-1.91(85), 2.18(8), 3.44(7)	3.44	1.27(50), 1.52(43), 0.25(42)	
			40	23	−29.6	(2−)	1.42 m	.....	.....	β^-~7.5, ~3.2	7.5	1.45, 3.1, 0.33, 2.85, . . .	
18	Ar	Argon	33	15	−10.	($\frac{1}{2}$+)	0.18 s	.....	.....	β^+, p3.27, 2.17, 2.54, 3.93, . . .	12		
			34	16	−19.7	0+	0.9 s	.....	.....	β^+5.05	6.06	0.67	
			35	17	−24.75	$\frac{3}{2}$+	1.80 s	+0.63	.....	β^+4.95(93), . . .	5.96	1.19(5), 1.71(2)	
			36	18	−32.453	0+	**0.337%**	.....	.....	.....	.....	.....	6
			37	19	−33.223	$\frac{3}{2}$+	34.8 d	+0.95	.....	ϵ(100)	0.814		
			38	20	−37.267	0+	**0.063%**	.....	.....	.....	.....	.....	0.8
			39	21	−35.683	$\frac{7}{2}$−	269 y	−1.3	.....	β^-0.565(100)	0.565	.....	500
			40	22	−37.615	0+	**99.60%**	.....	.....	.....	.....	.....	0.65
			41	23	−35.500	$\frac{7}{2}$−	1.83 h	.....	.....	β^-1.198(99), 2.489(0.8)	2.49	1.294(99), 1.67(0.05)	0.5
			42	24	−36.95	0+	33 y	.....	.....	β^-	0.60		
			43	25	.....	.....	6 m	.....	.....	β^-	.....	0.976	
			44	26	.....	.....	14 m	.....	.....	β^-	.....	1.887	
19	K	Potassium	36	17	−18.6	.....	0.27 s	.....	.....	β^+9.9(70), 5.3(25)	12.9	1.97(89), 2.43(23), 2.21(19), 4.44(5)	
			37	18	−26.64	$\frac{3}{2}$+	1.23 s	+0.204	.....	β^+5.12(98), . . .	6.15	2.80(2)	
			38*m*	...	.....	0+	0.95 s	.....	.....	β^+5.03(100)	6.05		

			38	19	−30.90	3+	7.68 m	+1.374	.....	β^+2.7(99.8), . . .	5.93	2.17(99.8), 3.94(0.2)	
			39	20	−36.290	$\frac{3}{2}$+	93.10%	+0.3914	+0.055	.....	.....	.....	2.2
			40	21	−36.000	4−	1.28×10^9 y	−1.298	−0.07	β^-1.31(89.4),	1.314		
							0.0118%	.....	.....	ϵ(10.6), β^+(0.001)	1.505	1.461(10.6)	70
			41	22	−38.173	$\frac{3}{2}$+	6.88%	+0.2149	+0.067	.....	.....	.....	1.3
			42	23	−37.59	2−	12.35 h	−1.141	.....	β^-3.52(87), 2.00(18), . . .	3.52	1.52(18), . . .	
			43	24	−39.27	$\frac{3}{2}$+	21.8 h	±0.163	.....	β^-0.82(83), 0.46(10), 1.24(3), 1.82(1.3)	1.82	0.372(85), 0.616(60), 0.396(20), 0.593(13), 0.222(3), 1.02(2), . . .	
			44	25	−38.44	(2−)	22.0 m	.....	.....	β^-5.2(35), 2(30), 4(9), . . .	5.2	1.16(65), . . .	
			45	26	−39.3	$\frac{3}{2}$+	20 m	±0.173	.....	β^-2.1(70), 1.1(20), 4(10)	4.19	0.175, 1.71, . . .	
			46	27	−38.0	2(−)	115 s	.....	.....	β^-6.3(50), . . .	7.72	1.347(100), 3.70(31), 3.02(10), 2.27(9), 1.78(9), . . .	
			47	28	−38.3	$\frac{1}{2}$+	17.5 s	.....	.....	β^-4.1(99), 6(1)	6.65	2.0, 2.6	
20	Ca	Calcium	37	17	−14.2	.....	0.175 s	.....	.....	β^+, p3.16, 1.74, 2.77, 1.98, 2.54, . . .	11.56		
			38	18	−23.74	0+	0.5 s	.....	.....	β^+5.59(79), 4.02(21), . . .	6.6	1.57(20), . . .	
			39	19	−29.29	$\frac{3}{2}$+	0.88 s	.....	.....	β^+5.48(100)	6.50		
			40	20	−37.408	0+	96.97%	.....	.....	.....	.....	.....	0.41
			41	21	−37.721	$\frac{7}{2}$−	7.7×10^4 y	−1.595	.....	ϵ(100)	0.41		
			42	22	−41.372	0+	0.64%	.....	.....	.....	.....	.....	0.70
			43	23	−41.223	$\frac{7}{2}$−	0.145%	−1.317	.....	.....	.....	.....	6.2
			44	24	−44.510	0+	2.06%	.....	.....	.....	.....	.....	1.0
			45	25	−43.807	$(\frac{7}{2})$−	162.7 d	.....	.....	β^-0.256(100), . . .	0.256	0.0124(0.002)	
			46	26	−46.31	0+	0.0033%	.....	.....	.....	.....	.....	0.7
			47	27	−45.46	$\frac{7}{2}$−	4.56 d	.....	.....	β^-0.67(83), 1.98(17)	1.98	1.297(75), 0.807(7), 0.489(7), . . .	
			48	28	−47.47	0+	0.18%	.....	.....	.....	.....	.....	1.1
			49	29	−44.33	$\frac{3}{2}$−	8.8 m	.....	.....	β^-2.1(89), 1.0(10), . . .	5.26	3.1(89), 4.06(10), 4.7(0.3), . . .	
			50	30	−42.49	0+	0 s	.....	.....	β^-3.1	4.97	0.257, 0.072, 1.52, 1.59	
21	Sc	Scandium	40	19	−22.03	4−	0.180 s	.....	.....	β^+5.7(51), 9.58(20), 8.8(15), 7.5(15)	14.33	3.74(100), 0.75(46), 1.88(23), 2.05(23), 3.17(13), 1.13(12), . . .	
			41	20	−30.75	$\frac{7}{2}$−	0.60 s	.....	.....	β^+5.5(100)	6.5		

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
21	Sc	Scandium	42*m*	...	.....	7+	61 s	.....	.....	β^+2.9(100)	6.96	0.438(100), 1.23(100), 1.52(100)	
			42	21	−34.47	0+	0.68 s	.....	.....	β^+5.39(100)	6.43		
			43	22	−38.84	$\frac{7}{2}-$	3.94 h	+4.62	−0.26	β^+1.20(78), 0.82(22)	2.22	0.374(22)	
			44*m*	...	.....	6+	59 h	+3.88	−0.19	ϵ(1.3)	.....	IT0.271(99), 1.02(1.3), 1.12(1.3), 1.16(1.3)	
			44	23	−40.594	2+	3.92 h	+2.56	+0.10	β^+1.467(95), ϵ(5)	3.647	1.156(100), 1.5(0.8), 2.7(0.1)	
			45*m*	...	.....	$\frac{3}{2}+$	0.30 s	.....	.....	.....	.....	IT0.0124(100)	
			45	24	−44.083	$\frac{7}{2}-$	100%	+4.7564	−0.22	.....	.....	.....	25
			46*m*	...	.....	7(+)	19 s	.....	.....	.....	.....	IT0.143	
			46	25	−44.829	4+	83.80 d	+3.03	+0.12	β^-0.357(100), 1.48(0.004), β^+(1.6 × 10^{-3})	2.367	0.889(100), 1.220(100)	8
			47	26	−47.589	$\frac{7}{2}-$	3.35 d	+5.34	−0.22	β^-0.44(73), 0.60(27)	1.38		
			48	27	−47.78	6+	1.82 d	.....	.....	β^-3.33(88), 3.51(12)	0.600	0.159(73)	
			49	28	−49.97	$(\frac{7}{2})-$	57.5 m	.....	.....	β^-2.01(100), . . .	3.98	1.311(100), 0.983(100), 1.037(98), 0.175(9), 1.212(3)	
			50*m*	...	.....	(2+)	0.35 s	.....	.....	.....	2.01	1.78(0.03)	
			50	29	−47.82	(5+)	1.73 m	.....	.....	β^-3.6, . . .	.....	IT0.258	
			51	30	−46.40	$(\frac{7}{2}-)$	12 s	.....	.....	β^-5.04(55), 4.32(45)	6.89	1.12(109), 1.56(100), 0.52(90)	
22	Ti	Titanium	41	19	.....	.....	0.088 s	.....	.....	β^-, p4.81, 3.14, 3.80, 1.58, 4.27, 2.32, . . .	6.52	1.45(55), 2.15(45)	
			43	21	−31.48	$\frac{7}{2}-$	0.49 s	.....	.....	β^-5.8(100)	13		
			44	22	−40.43	0+	48 y	.....	.....	ϵ(100)	6.8		
			45	23	−41.87	$\frac{7}{2}-$	3.09 h	±0.095	≈±0.02	β^+1.04(85), . . . , ϵ(15)	0.16	0.0784(100), 0.0678(100)	
			46	24	−47.368	0+	7.93%	.....	.....	.....	2.06	0.719(0.4), . . .	
											.....	.....	0.6

			47	25	−48.232	$\frac{5}{2}-$	**7.28%**	−0.7883	+0.29	....	.....	.....	1.7
			48	26	−52.051	0+	**73.94%**	.....	.....	....	.....	.....	8.3
			49	27	−52.128	$\frac{7}{2}-$	**5.51%**	−1.1039	+0.24	.....	.....	.....	1.9
			50	28	−55.216	0+	**5.34%**	.....	.....	....	.....	.....	0.14
			51	29	−53.40	$\frac{3}{2}-$	5.8 m	.....	.....	β^-2.13(94), 1.50(6)	2.46	0.320(95), 0.928(5), 0.605(1)	
			52	30	53.11	.....	1.7 m	.....	.....	β^-1.8	1.97	0.125, 0.17	
23	V	Vanadium	46	23	−39.79	(0+)	0.426 s	.....	.....	β^+6.0(100)	7.05		
			47	24	−45.10	$\frac{3}{2}-$	33 m	.....	.....	β^+1.90(96), ϵ(4)	2.92	1.5(0.7), 1.8(5), . . .	
			48	25	−47.741	4+	16.0 d	.....	.....	β^+0.694(60), ϵ(40)	4.013	0.983(100), 1.312(98), 2.24(3), . . .	
			49	26	−51.482	$\frac{7}{2}-$	330 d	±4.5	.....	ϵ(100)	0.605		
			50	27	−52.836	6+	6×10^{15} y	+3.3470	±0.06	ϵ(70)	2.22	1.55(70)	100
							0.24%	.....	.....	β^-(30)	1.03	0.783(30)	
			51	28	−56.036	$\frac{7}{2}-$	**99.76%**	+5.149	−0.05	....	.....	.....	4.8
			52	29	−55.22	3+	3.73 m	.....	.....	β^-2.47(99), . . .	3.97	1.43(100) . . .	
			53	30	−55.67	$(\frac{7}{2}-)$	2.0 m	.....	.....	β^-2.5(100)	.....	1.0(100)	
			54	31	−53.6	.....	55 s	.....	.....	β^-3.3(100)	~7	2.21(100) 0.99(100), 0.84(100)	
24	Cr	Chromium	46	22	.....	.....	1.1 s	.....	.....	β^+			
			48	24	−46.0	0+	23 h	.....	.....	ϵ(100)	1.4	0.116(100), 0.31(100)	
			49	25	−48.73	$(\frac{5}{2})-$	41.9 m	±0.48	.....	β^+1.54(65), 1.42(29), . . .	2.56	0.090(30) 0.063(29), 0.153(4) . . .	
			50	26	−53.051	0+	**4.31%**	.....	.....	....	.....	.....	16
			51	27	−55.229	$\frac{7}{2}-$	27.8 d	±0.94	.....	ϵ(100)	0.752	0.320(9)	
			52	28	−59.490	0+	**83.76%**	.....	.....	....	.....	.....	0.76
			53	29	−59.349	$\frac{3}{2}-$	**9.55%**	−0.4743	±0.03	....	.....	.....	18.2
			54	30	−61.12	0+	**2.38%**	.....	.....	....	.....	.....	0.38
			55	31	−59.17	$\frac{3}{2}-$	3.5 m	.....	.....	β^-2.59(99+)	2.59	1.52, 2.24	
			56	32	−59.4	0+	5.9 m	.....	.....	β^-1.5(100)	1.6	0.083(100), 0.026(100)	
25	Mn	Manganese	50(*m*)?	...	.....	.....	2 m	.....	.....	β^+(99), ϵ(1)	.....	0.79, 1.11, . . .	
			50	25	−45.76	(0+)	0.286 s	.....	.....	β^+6.6	7.63		
			51	26	−51.79	$\frac{5}{2}-$	46 m	±3.57	.....	β^+2.17(97), ϵ(3)	3.19		
			52*m*	...	.....	2+	21 m	±0.0076	.....	β^+2.63(92), ϵ(8)	.....	1.435(100), . . .	
			52	27	−54.43	6+	5.7 d	±3.05	.....	ϵ(62), β^+0.58(38)	4.708	1.435(100), 0.938(100), 0.747(99), . . .	
			53	28	−58.71	$\frac{7}{2}-$	2×10^6 y	±5.01	.....	ϵ(100)	0.598	.....	≈170
			54	29	−59.64	3+	313 d	±3.29	.....	ϵ(100)	1.38	0.835(100)	<10
			55	30	−61.954	$\frac{5}{2}-$	100%	+3.444	+0.4	....	.....	.....	13.3

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
25	Mn	Manganese	56	31	−61.093	3+	2.576 h	+3.218	.....	β^- 2.85(53), 1.04(30), 0.75(16), . .	3.70	0.847(100), 1.81(30), 2.12(15), . . .	
			57	32	−61.9	$(\frac{5}{2}-)$	1.7 m	.....	.....	β^- 2.55(82), 1.1(18)	2.7	0.117, 0.134, . . .	
			58	33	−60.2	.....	1.1 m	.....	.....	β^-	~6.1	0.36, 0.41, 0.52, 0.57, 0.82, 1.0, 1.25, 1.4, 1.6, 2.2, 2.8	
26	Fe	Iron	52	26	−51.88	0+	8.2 h	.....	.....	β^+ 0.8(56), ϵ(44)	2.37	0.165(100)	
			53	27	−54.69	$(\frac{7}{2})-$	8.5 m	.....	.....	β^+ 2.8(50), 2.4(38), . . . ϵ(2)	3.98	0.38(39)	
			54	28	−60.38	0+	5.82%	.....	.....	.....	.....	.....	2.8
			55	29	−61.705	$\frac{3}{2}-$	2.6 y	.....	.....	ϵ(100)	0.232	.....	2.6
			56	30	−65.066	0+	91.66%	.....	.....	.....	.....	.....	2.5
			57	31	−64.609	$\frac{1}{2}-$	2.19%	+0.0902	.....	.....	.....	.....	1.23
			58	32	−66.725	0+	0.33%	.....	.....	.....	.....	.....	
			59	33	−65.131	$\frac{3}{2}-$	45.1 d	.....	.....	β^- 0.467(54), 0.273(48), . . .	1.566	1.10(56), 1.29(44), 0.192(3), . . .	
			60	34	−66.95	0+	3×10^5 y	.....	.....	β^- 0.135(100)	0.194	0.059(100)	
			61	35	−63.4	$\frac{3}{2}(-)$	6.07 m	.....	.....	β^- 2.62(39), 2.50(26), 2.78(18), . . .	3.80	1.20(43), 1.025(43), 0.297(21), . . .	
27	Co	Cobalt	54m	...	.....	(6,7+)	1.43 m	.....	.....	β^+ 4.5(100)	.....	0.41(100), 1.14(100), 1.41(100)	
			54	27	−51.53	(0+)	0.194 s	.....	.....	β^+ (100)	8.25		
			55	28	−57.99	$\frac{7}{2}-$	18.2 h	.....	.....	β^- 1.50(50), 1.03(30), 0.3(2), ... ϵ(25) ϵ(80), β^+ 1.46(19), 1.14(1)	3.46	0.93(80), 1.41(13), 0.48(12), . . .	
			56	29	−60.15	4+	77 d	±3.83	.....		4.57	0.845(100), 1.24(70), 2.60(16), 1.77(15), 1.038(14), 2.04(8), . . .	
			57	30	−63.711	$\frac{7}{2}-$	270 d	±4.62	.....	ϵ(100)	0.837	0.122(89), 0.0144(89), 0.136(11), . . .	
			58m	...	.....	5+	9.1 h	.....	.....	.....	.....	IT0.025	140,000

			58	31	−64.248	2+	71.3 d	+4.03	.....	ε(85) β⁺0.48(15), . . .	2.309	0.8105(100), . . .	1700
			59	32	−66.811	$\frac{7}{2}$−	100%	+4.62	+0.4	.....	.....	.....	37.2
			60*m*	...	.....	2+	10.47 m	.....	.....	β⁻1.55(0.2), . . .	.....	IT0.0586(99.8), 1.33(.2), . . .	58
			60	33	−66.189	5+	5.26 y	+3.78	.....	β⁻0.315(99.7), 0.67(0.2), 1.49(0.1)	2.82	1.33(100), 1.17(99.9)	2.0
			61	34	−67.56	$\frac{7}{2}$−	99 m	.....	.....	β⁻1.22(100)	1.29	0.07(100)	
			62	...	.....	(1+, 2+)	1.55 m	.....	.....	β⁻			
			62	35	−66.05	(4+, 5+)	13.9 m	.....	.....	β⁻2.88(75), 0.88(25)	5.22	1.170(100), 1.163(82), 1.47(20), 1.74(20), 2.03(7)	
			63	36	−66.41	($\frac{5}{2}$−, $\frac{7}{2}$−)	52 s	.....	.....	β⁻3.6(100)	3.7	0.088(100)	
			64*m*	...	.....	(4+)	28 s	.....	.....	.....	.....	IT0.095(100)	
			64	37	−64.5	(1+)	<23 s	.....	.....	β⁻	~7.0		
28	Ni	Nickel	56	28	−57.88	0+	6.10 d	.....	.....	ε(100)	2.11	0.163(99), 0.812(84), 0.755(51), 0.276(34), 0.472(34), . . .	
			57	29	−60.23	$\frac{3}{2}$−	36.0 h	.....	.....	ε(53), β⁺0.85(40), 0.72(6), . . .	3.24	1.37(86), 0.127(14), 1.89(14), . . .	
			58	30	−64.664	0+	67.88%	.....	.....	.....	.....	.....	4.7
			59	31	−65.660	$\frac{3}{2}$−	7.5 × 10⁴ y	.....	.....	ε(100)	1.073		
			60	32	−69.220	0+	26.23%	.....	.....	.....	.....	.....	2.8
			61	33	−68.950	$\frac{3}{2}$−	1.19%	−0.7487	+0.16	.....	.....	.....	2.5
			62	34	−71.660	0+	3.66%	.....	.....	.....	.....	.....	15
			63	35	−70.339	$\frac{1}{2}$−	92 y	.....	.....	β⁻0.0659(100)	0.0659		
			64	36	−72.04	0+	1.01%	.....	.....	.....	.....	.....	1.52
			65	37	−69.93	$\frac{5}{2}$−	2.54 h	.....	.....	β⁻2.14(58), 0.65(30), 1.02(10), . . .	2.13	1.482(25), 1.115(16), 0.366(5), . . .	20
			66	38	−70.92	0+	55 h	.....	.....	β⁻0.20	0.20		
			67	39	−67.8	(−)	50 s	.....	.....	β⁻4.1(50), 2(30), 3.2(4), . . .	4.1	0.90(50), 0.89(24), 1.26(22)	
29	Cu	Copper	58	29	−55.46	.....	3.20 s	.....	.....	β⁺	8.57		
			59	30	−60.50	$\frac{3}{2}$−	82 s	.....	.....	β⁺3.75(71), . . . , ε(1)	4.80	1.31(10), 0.88(9), 0.34(4), 0.87(5), . . .	
			60	31	−62.64	2+	23 m	+1.22	.....	β⁺2.00(47), 3.00(14), 3.92(8), . . . , ε(8)	6.13	1.33(87), 1.79(45), 0.83(19), . . .	
			61	32	−66.54	$\frac{3}{2}$−	3.32 h	+2.13	.....	β⁺1.22(52), 0.93(6), 0.56(3), . . . , ε(37)	2.24	0.283(13), 0.656(10), 0.067(5), 1.19(4), . . .	
			62	33	−67.43	1+	9.8 m	−0.38	.....	β⁺2.92(94), 1.75(2), 0.87(2), ε	3.94	1.17(3), 0.875(1), . . .	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu × 10^{-4}	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
29	Cu	Copper	63	34	−70.410	$\frac{3}{2}-$	69.09%	+2.223	−0.180	...	...	...	4.5
			64	35	−70.243	1+	12.82 h	−0.216	...	ϵ(41), β^+0.654(19), β^-0.573(40)	1.677 0.573	1.348(0.6)	<6,000
			65	36	−72.21	$\frac{3}{2}-$	30.91%	+2.382	−0.195	...	...	...	2.3
			66	37	−71.13	1+	5.1 m	±0.283	...	β^-2.53(91), 1.6(9), ...	2.63	1.039(9), ...	130
			67	38	−72.24	$(\frac{3}{2}-)$	62 h	...	...	β^-0.395(51), 0.484(28), 0.577(20)	0.576	0.185(45), 0.0933(35), 0.0913(6), ...	
			68	39	−70.23	(1.)+	31 s	...	...	β^-3.5(75), 2.3(10), 2.7(4), ...	4.58	1.08(97), 1.26(15), ...	
			69	40	−70.8	$(\frac{3}{2})-$	3.0 m	...	...	β^-2.6(79), ...	2.6	1.007(10), 0.834(6), 0.531(3), 0.649(1), ...	
30	Zn	Zinc	60	30	−58.18	0+	2.3 m	...	...	ϵ, β^+			
			61	31	−60.8	$\frac{3}{2}-$	1.48 m	...	...	β^+(99), ϵ(1)	5.91	0.47(11), 1.64(6), 0.97(3), 0.69(2)	
			62	32	−65.62	0+	9.15 h	...	...	ϵ(87), β^+0.66(13)	1.68	0.041(36), 0.597(20), 0.506(13), ...	
			63	33	−66.79	$\frac{3}{2}-$	38.4 m	−0.282	+0.31	β^+2.34(76), 1.69(10), 1.40(7), ..., ϵ(6)	3.36	0.670(11), 0.962(8), ...	
			64	34	−70.860	0+	18.89%	...	...	...	...	...	0.80
			65	35	−70.77	$\frac{5}{2}-$	244 d	+0.769	−0.026	ϵ(98), β^+0.325(2)	1.353	1.115(51), ...	
			66	36	−73.960	0+	27.98%	...	...	...	...	...	0.9
			67	37	−72.868	$\frac{5}{2}-$	4.11%	+0.8754	+0.17	...	...	...	6
			68	38	−75.152	0+	18.57%	...	...	...	...	...	1.08
			69m	...	...	$\frac{9}{2}+$	13.9 h	...	...	...	...	IT0.439(100)	
			69	39	−73.46	$\frac{1}{2}-$	58 m	...	...	β^-0.9(100)	0.92		
			70	40	−74.67	0+	0.62%	...	...	...	...	...	0.099
			71m	...	...	$(\frac{9}{2}+)$	3.92 h	...	...	β^-1.45(98), ...	...	0.387(94), 0.488(70), 0.620(65), ...	

			71	41	−72.28	$(\frac{1}{2}-)$	2.4 m	.....	.....	β^-2.61(80), 2.10(14), . . .	2.61	0.512(13), 0.92(3), . . .	
			72	42	−73.14	0+	46.5 h	.....	.....	β^-0.296(90) 0.25(10)	0.457	0.145(92), 0.193(8), 0.016(8), . . .	
31	Ga	Gallium	63	32	−61.	$(\frac{3}{2}-)$	33 s	.....	.....	β^+	~5.5		
			64	33	−63.26	0+	2.6 m	.....	.....	β^+2.89(33), 6.05(22), . . . , ϵ(2)	7.08	0.992(46), 3.366(17), 0.809(14), 0.919(8), 2.375(8), . . .	
			65	34	−67.27	.....	15.2 m	.....	.....	β^+2.12(53), 2.03(10), 2.24(7), . . . , ϵ(10)	3.26	0.115(55), 0.061(15), 0.153(9), 0.752(7), . . .	
			66	35	−68.39	0(+)	9.4 h	.....	.....	β^+4.153(51), 0.94(3), . . . , ϵ(42)	5.175	1.039(40), 2.748(25), 0.828(6), 2.190(6), . . .	
			67	36	−71.78	$\frac{3}{2}-$	78 h	+1.850	+0.22	ϵ(100)	1.00	0.0933(70), 0.1845(2), 0.300(15), 0.393(4), . . .	
			68	37	−72.01	1+	68.3 m	±0.0117	±0.031	β^+1.90(88), 0.82(1), ϵ(10)	2.92	1.078(3), . . .	
			69	38	−74.420	$\frac{3}{2}-$	**60.4%**	+2.016	+0.19	.....	.....	.....	1.8
			70	39	−73.973	1+	21.1 m	.....	.....	β^-1.65(99.5), . . .	1.66	1.04(0.5), 0.173(0.2)	
			71	40	−75.294	$\frac{3}{2}-$	**39.6%**	+2.562	+0.12	.....	.....	.....	5
			72	41	−73.63	3−	14.1 h	−0.1322	+0.59	β^-0.95(28), 0.66(21), 0.64(15), 3.15(10), 1.47(9), . . .	4.000	0.834(95), 2.201(29), 0.630(23), 2.508(14), . . .	
			73	42	−74.87	$(\frac{3}{2}-)$	4.8 h	.....	.....	β^-1.19(85), 0.40(9), 1.16(5), . . .	1.55	0.296(87), 0.325(13), 0.742(7), . . .	
			74	43	−72.92	(3−)	7.9 m	.....	.....	β^-2.6(52), 1.3, . . .	5.5	0.596(85), 2.35(49), 0.609(13) . . .	
			75	44	−73.6	.....	1.9 m	.....	.....	β^-3.3	3.3	0.58, 0.36	
			76	45	.....	(3−)	32 s	.....	.....	β^-5.8, 5.3, 2.2, . . .	~7	1.12, 0.560, . . .	
			77	46	.....	.....	17 s	.....	.....	β^-			
			78	47	.....	.....	~4 s	.....	.....	β^-			
32	Ge	Germanium	65	33	−60.	.....	1.5 m	.....	.....	β^+5.5, 3.8, . . .	6.5	0.67(3), 1.72(2)	
			66	34	−66.15	0+	2.4 h	.....	.....	β^+1.3, 2.0, . . . , ϵ	3.0	0.044(44), 0.382(29), 0.109(17), 0.273(12), 0.338(10), 0.065(8), . . .	
			67	35	−67.6	.....	19 m	.....	.....	β^+3.24(51), 1.6(12), 2.3(8), . . . , ϵ(6)	4.43	0.167(90), 0.915(10), 1.48(9), . . .	
			68	36	−71.60	0+	275 d	.....	.....	ϵ(100)	~0.7		
			69	37	−72.034	.....	39 h	.....	.....	β^+1.21(32), . . . , ϵ(63)	2.227	1.107(26), 0.574(12), 0.872(9), . . .	
			70	38	−75.749	0+	**20.52%**	.....	.....	.....	.....	.....	0.28
			71	39	−75.044	$\frac{1}{2}-$	11 d	+0.546	.....	ϵ(100)	0.235		

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-4}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
32	Ge	Germanium	**72**	40	−77.918	0+	**27.43%**						0.98
			73*m*	...		($\frac{1}{2}$−)	0.53 s					IT0.0533(99), 0.0670(1), 0.0135(99)	
			73	41	−76.536	$\frac{9}{2}$+	**7.76%**	−0.8792	−0.28				14
			74	42	−78.821	0+	36.54%						0.45
			75*m*	...		($\frac{7}{2}$+)	46 s					IT0.133(100)	
			75	43	−77.12	$\frac{1}{2}$(−)	83 m	±0.51		β^- 1.19(87), 0.919(11), ...	1.189	0.2646(11), 0.199(1), ...	
			76	44	−78.595	0+	**7.76%**						
			77*m*	...		($\frac{1}{2}$)−	53 s			β^- 2.90(52), ...		IT0.159(26), 0.215(22), ...	
			77	45	−76.39	($\frac{7}{2}$+)	11.3 h			β^-	2.76	0.263(50), 0.210(32), 0.215(28), 0.417(25), 0.558(18), ...	
			78	46	−77.0	0+	1.5 h			β^- 0.70(100)	0.98	0.278(100)	
			79	47	74.5	...	50 s			β^-	4.3	...	0.23
33	As	Arsenic	68	35	...	...	~7 m			β^-			
			69	36	−67.77	...	15 m			β^- 2.9, ϵ	3.9	0.23	
			70	37	−69.07	4(+)	52 m			β^- 2.144(74), 1.44(10), 2.89(6), ϵ(10)	6.22	1.040(80), 0.668(26), 0.595(24), 0.760(24), 1.14(24), 1.738(23), ...	
			71	38	−72.89	($\frac{5}{2}$)−	64 h			ϵ(66), β^+ 0.812(33), ...	2.009	0.175(99), 1.10(3), ...	
			72	39	−73.24	2−	26 h			β^- 2.50(60), 3.34(18), 1.87(5) ϵ(.0)	4.357	0.834(78), 2.201(20), 2.508(10), 0.630(8), ...	
			73	40	−76.17	($\frac{3}{2}$−)	76 d			ϵ(.00)	0.341	0.0533(99), 0.0135(99), 0.0670(1)	
			74*m*	...		(5)	8 s					IT0.283(100)	

			74	41	−76.069	2−	17.7 d	.....	.....	ε(33), β^+0.91(28), 1.51(4), β^-1.36(19), 0.72(16)	2.56 1.354	0.596(58), 0.635(16), . . .	
			75	**42**	−78.400	$\frac{3}{2}$(−)	**100%**	+1.439	+0.29	.....	.....	.....	4.3
			76	43	−77.602	2−	26.4 h	−0.905	±7	β^-2.97(52), 2.41(29), 1.76(10), . . .	2.972	0.5593(41), 0.657(6), 1.216(5), . . .	
			77	44	−79.35	$\frac{3}{2}$−	38.8 h	.....	.....	β^-0.686(97), . . .	0.686	0.239(2), . . .	
			78	45	−78.1	(2−)	1.5 h	.....	.....	β^-4.1(25), 1.4(25), . . .	4.1	0.641(56), 0.695(21), 1.310(14), . . .	
			79	46	−79.1	$(\frac{3}{2})$−	9.0 m	.....	.....	β^-2.14(95), 1.70(2), 1.80(1.5), 1.25(1.5), . . .	2.24	0.36(2), 0.43(2), . . .	
			80	47	−77.0	1+	15 s	.....	.....	β^-6.0(56), . . .	6.0	0.666(42), 1.64(2), 1.22(2), . . .	
			81	48	−77.9	$(\frac{3}{2}-)$	32 s	.....	.....	β^-3.8(100)	3.8		
			82	49	.....	.....	15 s	.....	.....	β^-	.....	0.655, 0.817	
			83	50	.....	.....	14 s	.....	.....	β^-			
			84	51	.....	.....	6 s	.....	.....	β^-			
			85	52	.....	.....	2.1 s	.....	.....	β^-, n			
34	Se	Selenium	70	36	.....	0+	39 m	.....	.....	β^+	∼2.5	0.021, 0.032, 0.050, 0.113, 0.203, 0.427, . . .	
			71	37	−68.	$(\frac{7}{2},\frac{5}{2})$−	4.5 m	.....	.....	β^+3.4	4.4	0.15, 0.83, 0.87, 1.10, . . .	
			72	38	−73.	0+	8.5 d	.....	.....	ε	∼0.6	0.046	
			73*m*	...	.....	$(\frac{1}{2}-)$	42 m	.....	.....	β^+1.71, 1.63(85), ε(15)	.....	0.084, 0.254, 0.394, 0.402, 0.578, 1.08, . . .	
			73	39	−73.23	$(\frac{9}{2}+)$	7.1 h	.....	.....	β^+1.32(70), . . . , ε(29	2.74	0.360(99), 0.0669(65), 0.0757(50), . . .	
			74	**40**	−77.524	0+	**0.87%**	.....	.....	.....	.....	.....	53
			75	41	−77.471	$\frac{5}{2}$(+)	120 d	.....	+1.0	ε(100)	0.865	0.264(59), 0.136(57), 0.279(25), 0.121(17), . . .	
			76	**42**	−80.788	0+	**9.02%**	.....	.....	.....	.....	.....	85
			77	**43**	−80.087	$\frac{1}{2}$−	**7.58%**	+0.534	.....	.....	.....	.....	42
			78	**44**	−82.691	0+	**23.52%**	.....	.....	.....	.....	.....	0.4
			79*m*	...	.....	$\frac{1}{2}$−	3.9 m	.....	.....	.....	.....	IT0.096(100)	
			79	45	−81.516	$\frac{7}{2}$+	6.5×10^4 y	−1.02	+0.8	β^-0.15(100)	0.154		
			80	**46**	−83.475	0+	**49.82%**	.....	.....	.....	.....	.....	0.61
			81*m*	...	.....	$(\frac{7}{2}+)$	57 m	.....	.....	β^-1.17(0.13), 1.05(0.05)	.....	IT0.103(99.8)	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu × 10⁻³	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
34	Se	Selenium	81	47	−82.00	$(\frac{1}{2})-$	18 m			β^-1.58(98), 1.03(1), 0.77(1), . . .	1.576	0.276(2), 0.290(1), 0.565(1), . . .	
			82	48	−83.29	0+	9.19%						
			83*m*	...	.....	$(\frac{1}{2})-$	69 s			β^-2.50(50), 2.40(25), 1.50(25)		1.031(22), 0.356(16), 0.989(14), 0.676(13), . . .	0.05
			83	49	−80.99	$(\frac{9}{2})+$	23 m			β^-0.93, 1.51, . . .	3.58	0.356(73), 0.512(45), 0.226(34), 0.720(22), . . .	
			84	50	−81.5	0+	3.2 m			β^-1.4(100)	1.8	0.408(100)	
			85	51	.....	.....	39 s			β^-			
			86	52	.....	0+	16 s			β^-			
			87	53	.....	.....	6 s			β^-, *n*			
35	Br	Bromine	70?	35	.....	.....	23 s			β^+, p2.5	~12		
			74	39	−70.	0+, 1+	36 m			β^+4.7	5.7	0.630, 0.720, . .	
			75	40	−74.26	$(\frac{3}{2}-)$	97 m			β^+1.72(51), 1.1(10), 0.65(3), ϵ(30)	3.02	0.620, 0.285	
			76	41	−75.3	1(+)	16 h	±0.548	±0.25	β^+3.58, 0.93, 1.80, ϵ		0.56, 0.65, . . .	
			77*m*	...	.....	$\frac{9}{2}+$	4.3 m					IT0.1076(100)	
			77	42	−78.62	$\frac{3}{2}-$	56 h			ϵ(99), β^+0.36(1)	1.371	0.239(27), 0.298(8), 0.578(7), . . .	
			78	43	−78.85	1+	6.4 m			β^+2.52(82), ... ϵ(7)	3.57	0.614(13)	
			79*m*	...	.....	$\frac{9}{2}+$	4.9 s					IT0.208(100)	
			79	44	−81.668	$\frac{3}{2}-$	50.54%	+2.106	+0.31				10.5
			80*m*	...	.....	5−	4.42 h	+1.317	+0.71			IT0.048(100), 0.037(100)	
			80	45	−81.464	1−	17.6 m	±0.514	±0.18	β^-2.02(84), 1.38(7), ... ϵ(6), β^+0.866(3)	2.02 1.873	0.616(7), 0.666(1), . . .	
			81	46	−83.708	$\frac{3}{2}-$	49.46%	+2.270	+0.26				3.1
			82*m*	...	.....	2−	6.1 m			β^-1.66, 2.36		IT0.046(99.8),0.777(0.2), . . .	

			82	47	−83.20	5−	35.4 h	±1.626	±0.70	β^-0.44(98), . . .	3.088	0.7768(83), 0.5543(70), 0.6191(43), . . .	
			83	48	−84.83	$(\frac{3}{2})-$	2.40 h	.....	.....	β^-0.925(99), 0.395(1)	0.967	0.032(100), 0.093(100), 0.521(1)	
			84	...	.....	.....	6.0 m	.....	.....	β^-1.9(72), 0.8(20), . . .	.....	0.88(75), 1.46(75), 0.44(68), 1.89(16)	
			84	49	−83.45	.....	31.8 m	.....	.....	β^-4.7(32), 0.8(19), 2.8(15), 3.8(14), . . .	4.7	0.88(48), 1.9(10), 2.47(7), 1.01(6), . . .	
			85	50	−84.5	$(\frac{3}{2}-)$	3.0 m	.....	.....	β^-2.5	2.8		
			86	51	−81.5	.....	54 s	.....	.....	β^-7.4(15), 5.6(15), . . .	7.4	1.56, 1.36, 2.75, 5.44, . . .	
			87	52	−80.	.....	55 s	.....	.....	β^-2.6(70), . . . , n	6.5	1.44, 2.98, 2.56, 4.2, ...	
			88	53	.....	.....	16 s	.....	.....	β^-, n	.....	0.76	
			89	54	.....	.....	4.5 s	.....	.....	β^-, n			
			90	55	.....	.....	1.6 s	.....	.....	β^-, n			
36	Kr	Krypton	74	38	−67.	0+	16 m	.....	.....	β^+3.1	4.1		
			75	39	−69.	.....	5.5 m	.....	.....	β^+, ϵ	~5		
			76	40	−74.	0+	14.8 h	.....	.....	ϵ(100)	~1.0	0.316, 0.267, . . .	
			77	41	−75.5	$\frac{7}{2}+$	1.2 h	.....	.....	β^+1.85(40), 1.70(35), 1.87(3), . . . , ϵ(19)	2.99	0.130(87), 0.146(42), 0.106(10) . . .	
			78	42	−79.599	0+	**0.35%**	.....	.....	.....	.....	.....	4.7
			79*m*	...	.....	$(\frac{7}{2}+)$	55 s	.....	.....	.....	.....	IT0.127(100)	
			79	43	−79.93	$(\frac{1}{2}-)$	34.9 h	.....	.....	ϵ(91), β^+0.604(7), . . .	1.628	0.2613(11) 0.3974(10) 0.6059(10), . . .	
			80	44	−83.62	0+	**2.27%**	.....	.....	.....	.....	.....	14
			81*m*	...	.....	$\frac{1}{2}-$	13 s	.....	.....	.....	.....	IT0.190(100)	
			81	45	−83.4	$\frac{7}{2}+$	2.1×10^5 y	.....	.....	ϵ(100)	0.29		
			82	46	−86.518	0+	**11.56%**	.....	.....	.....	.....	.....	37
			83*m*	...	.....	$\frac{1}{2}(-)$	1.9 h	.....	.....	.....	.....	IT0.032(100), 0.053(100)	
			83	47	−85.869	$\frac{9}{2}+$	**11.55%**	−0.970	+0.26	.....	.....	.....	170
			84	48	−88.495	0+	**56.90%**	.....	.....	.....	.....	.....	0.13
			85*m*	...	.....	$\frac{1}{2}-$	4.4 h	.....	.....	β^-0.82(77)	.....	0.1495(77), IT0.305(23)	
			85	49	−87.463	$\frac{9}{2}+$	10.76 y	±1.005	+0.43	β^-0.66(99.6), . . .	0.67	0.514(0.4)	
			86	50	−89.384	0+	**17.37%**	.....	.....	.....	.....	.....	0.06
			87	51	−86.64	$(\frac{5}{2}+)$	76 m	.....	.....	β^-3.5(55), 1.9(15), 1.3(14), 3.1(8), 1.5(6), . . .	3.89	0.403(58), 2.57(14), 0.845(8), 2.01(3), 0.674(3), . . .	
			88	52	−85.6	0+	2.80 h	.....	.....	β^-0.52(68), 2.8(20), 0.9(12)	2.8	2.40(35), 0.19(35), 0.85(23), . . .	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abuncance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
36	Kr	Krypton	89	53	−82.19	.....	3.2 m	.....	.....	β^-4.9, 4.6, 3.8, . . .	5.2	0.221(25), 0.548(21), 1.533(11), 0.498(11), 1.472(10), 0.904(7), . . .	
			90	54	−80.3	0+	33 s	.....	.....	β^-2.80(47), . . .	4.56	0.120(65), 0.536(48), 1.11(48), . . .	
			91	55	−77.	.....	9 s	.....	.....	β^-~3.6	6.5	0.108(65), 0.509(25)	
			92	56	.....	0+	2.0 s	.....	.....	β^-	.....	0.14(50), . . .	
			93	57	.....	.....	1.2 s	.....	.....	β^-			
			94	58	.....	.....	1.4 s	.....	.....	β^-			
			95	59	.....	.....	Short						
37	Rb	Rubidium	78	41	.....	.....	6.5 m	.....	.....	.....	.....	0.455, 0.664, 1.110, 1.943, 1.148, . . .	
			79	42	−76.1	.....	23 m	.....	.....	β^+	3.5	0.688, 0.183, 0.147, 0.143, 0.130, 0.622, . . .	
			80	43	−77.	1+	34 s	.....	.....	β^+4.1(60), . . .	5.8	0.616(40)	
			81*m*	...	.....	$\frac{9}{2}$+	32 m	.....	.....	β^+1.4(50)	.....	IT0.085(50)	
			81	44	−91.0	$\frac{3}{2}$−	4.7 h	+2.05	.....	ϵ(68), β^+1.05(30), 0.475(2)	2.26	0.190(65), 0.446(22) 0.457(3), 0.538(2), . . .	
			82*m*	...	.....	5−	6.4 h	+1.643	.....	β^+0.8(100)	.....	0.7768(83), 0.5543(70), 0.619(41), 0.698(35), 1.044(31), 1.317(25), . . .	
			82	45	−81.8	1+	1.3 m	.....	.....	β^+3.15(83), . . . , ϵ(5)	4.17	0.7769(13), 1.384(1), . . .	
			83	46	−85.	$\frac{5}{2}$−	83 d	+1.4	.....	ϵ(100)	1.0	0.521(46), 0.530(30), . . .	
			84*m*	...	.....	6+	20 m	.....	.....	ϵ?	.....	IT0.464(52), 0.216(48), 0.250(48)	
			84	47	−85.619	2−	33.0 d	−1.32	.....	ϵ(76), β^+0.80(11), 1.67(10)	2.680	0.883(73), . . .	
										β^-0.39(3)	0.886		

			85	48	−88.200	$\frac{5}{2}-$	**72.15%**	+1.3524	+0.26	.....	.....	.....	0.45
			86m	...	.....	.....	1.02 m	.....	.....	.....	.....	IT0.56(100)	
			86	49	−88.822	2−	18.66 d	−1.691	.....	β^-1.78(91), 0.70(9) ϵ(0.005)	1.78 0.52	1.078(9)	
			87	50	−90.814	$\frac{3}{2}-$	5×10^{10} y **27.85%**	+2.7500	+0.12	β^-0.274(100)	0.274	.....	1.0
			88	51	−88.7	2−	17.8 m	±0.51	.....	β^-5.2(76), 2.5(14), 3.4(4), . . .	5.2	1.863(21), 0.898(13), 2.68(2), . . .	
			89	52	−87.72	.....	15.4 m	.....	.....	β^-1.26(38), 2.21(32), 4.49(18), 1.92(4), . . .	4.49	1.03(60), 1.25(47), 2.19(17), 2.57(12), 0.659(10) 0.949(10), . . .	
			90	...	.....	.....	4.3 m						
			90	53	−85.2	(2−)	2.6 m	.....	.....	β^-6.6, 5.8, 4.4, 2.2, . . .	6.6	0.83(61), 4.34(18), 3.34(15), . . .	
			91	54	−84.	.....	57 s	.....	.....	β^-4.6	5.7		
			92	55	−81.	.....	4.4 s	.....	.....	β^-	~7.9		
			93	56	−78.	.....	5.9 s	.....	.....	β^-, n	~7		
			94	57	.....	.....	2.7 s	.....	.....	β^-, n			
			95	58	.....	.....	0.36 s	.....	.....	β^-, n			
			96	59	.....	.....	0.23 s	.....	.....	β^-, n			
			97	60	.....	.....	0.14 s	.....	.....	β^-, n			
38	Sr	Strontium	**80**	42	.....	0+	1.7 h	.....	.....	ϵ(100)	.....	0.58	
			81	43	−77.	.....	29 m	.....	.....	β^+	~4		
			82	44	−81.	0+	25 d	.....	.....	ϵ(100)	~0.6		
			83	45	−82.3	$\frac{7}{2}+$	33 h	.....	.....	ϵ(80), β^+1.15(11), 0.81(7), . . .	2.21	0.763(43), 0.385(35), 0.040(23), . . .	
			84	46	−86.570	0+	**0.56%**	.....	.....	.....	.....	.....	0.88
			85m	...	.....	$(\frac{1}{2}-)$	70 m	.....	.....	ϵ(14)	.....	IT0.007(85), 0.231(85), 0.150(14), 0.237(1)	
			85	47	−87.06	$(\frac{9}{2}+)$	64 d	.....	.....	ϵ(100)	1.11	0.514(100)	
			86	48	−90.724	0+	**9.86%**	.....	.....	.....	.....	.....	0.8
			87m	...	.....	$\frac{1}{2}-$	2.83 h	.....	.....	ϵ(1)	.....	IT0.388(99)	
			87	49	−91.108	$\frac{9}{2}+$	**7.02%**	−1.093	+0.3				
			88	50	−94.372	0+	**82.56%**	.....	.....	.....	.....	.....	0.005
			89	51	−92.53	$\frac{5}{2}+$	52 d	.....	.....	β^-1.46(99.9), . . .	1.463	0.91(0.01)	0.5
			90	52	−92.25	0+	28.1 y	.....	.....	β^-0.546(100)	0.546	.....	0.9
			91	53	−89.34	$\frac{5}{2}+$	9.67 h	.....	.....	β^-1.09(33), 1.36(29), 2.67(26), 0.62(7), 2.04(4)	2.67	1.025(30), 0.748(27), 0.645(15), 1.413(5), 0.93(3)	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-4}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
38	Sr	Strontium	92	54	−89.0	0+	2.71 h	.....	.....	β^-0.55(90), 1.5(10)	1.9	1.37(90), 0.44(4), 0.23(3)	
			93	55	−85.8	.....	8 m	.....	.....	β^-2.9(65), 2.6(25), 3.9(14), . . .	4.3	0.60, 0.8, 1.2, . . .	
			94	56	−84.6	0+	1.3 m	.....	.....	β^-2.1	3.5	1.42(100)	
			95	57	−81.	.. ..	26 s	.....	.....	β^-	~5.7		
			96	58	.....	.....	4.0 s	.....	.....	β^-			
			97	59	.....	.....	~0.4 s	.....	.....	β^-			
39	Y	Yttrium	82	43	.....	.....	Short						
			83	44	−78.	.....	7.5 m						
			84	45	−79.11	.....	41 m	.....	.....	ϵ, β^+3.5, 2.9	5.3	0.795(100), 0.992(100), 1.041(50), . . .	
			85*m*	...	.....	($\frac{1}{2}$−)	2.8 h	.....	.....	β^+1.54(50), 1.1, . . . , ϵ(45)	.....	0.92(9), 0.503, 0.70, 0.77	
			85	46	−83.56	($\frac{9}{2}$+)	4.9 h	.....	.....	β^+2.24(55), 2.1(10), 1.1(4), . . . , ϵ(30)	3.26	0.231(13), 2.16(9), 0.77(8), . . .	
			86*m*	...	.....	5−	48 m	.....	.....	.....	.....	IT0.102(100), 0.208(100)	
			86	47	−85.05	4−	14.6 h	.....	.....	ϵ(73), β^+1.2(11) . . .	5.27	1.077(82), 0.63(37), 1.16(35), 0.778(21), . . .	
			87*m*	. .	.....	($\frac{9}{2}$+)	14 h	.....	.....	β^+(5)	.....	IT0.381(99)	
			87	48	−89.09	($\frac{1}{2}$−)	80 h	.....	.....	ϵ(99.7), β^+0.7(0.3)	1.9	0.483, 0.388	
			88	49	−90.49	(4−)	108 d	.....	.....	ϵ(99.8), β^+0.76(0.2)	3.621	1.836(100), 0.898(91)	
			89*m*	...	.....	$\frac{9}{2}$+	16 s	.....	.....	.....	.....	IT0.91(100)	
			89	50	−94.133	$\frac{1}{2}$−	100%	−0.1373	.....	.....	.....	.....	0.001
			90*m*	...	.....	(7+)	3.1 h	.....	.....	β^-(0.4)	.....	IT0.202(99.6), 0.483 (99.6)	
			90	51	−92.84	2−	64.2 h	−1.63	−0.15	β^-2.27(99.8), . . .	2.27	1.75(0.2)	
			91*m*	...	.....	$\frac{9}{2}$+	50 m	.....	.....	.....	.....	IT0.551(100)	1.4
			91	52	−92.71	$\frac{1}{2}$−	58.8 d	±0.164	.....	β^-1.545(99.7), . . .	1.545	1.21(0.3)	
			92	53	−91.07	2−	3.53 h	.....	.....	β^-3.53(86), . . .	3.63	0.934(14), 1.40(5), . . .	
			93	54	−90.45	($\frac{1}{2}$−)	10.2 h	.....	.....	β^-2.39(90), . . .	2.89	0.267(6), 0.94(2), 1.90(2), . . .	
			94	55	−88.3	.....	20.3 m	.....	.....	β^-5.0(50), . . .	5.0	0.92(43), 0.56(6), . . .	

			95	56	−87.2	(½−)	10.7 m			β⁻4.43(82), 1.31(5), 0.86(4), . . .	4.43	0.953, 2.175, 1.323, 2.631, 3.576, . . .	
			96	57	−84.		2.3 m			β⁻3.5	~7	0.7, 1.0, 1.5, . . .	
			97	58	−82.		1.11 s			β⁻	~6		
			99	60			~0.8 s			β⁻			
40	Zr	Zirconium	81	41			~10 m						
			82	42		0+	9.5 m						
			83	43			5-10 m						
			84	44		0+	16 m						
			85	45			15 m			ε, β⁺		0.04	
			85	45	−78.		1.4 h			ε, β⁺	~5		
			86	46	−84.	0+	16.5 h			ε(100)	~1	0.243(96), 0.028(20), 0.612(5)	
			87	47	−85.33		1.6 h			β⁺2.10(83), ε(17)	3.50		
			88	48	−90.8	0+	85 d			ε(100)	~0.7	0.394(97)	
			89m	...		(½−)	4.18 m			ε(5), β⁺0.89(1), . . .		IT0.588(94), 1.51(6)	
			89	49	−91.091	(9/2+)	78.4 h			ε(78), β⁺0.90(22)	2.834	0.909(99), 1.713(1), . . .	
			90m	...		5−	0.81 s					IT2.32(94), 0.133(6), 2.18(6)	
			90	50	−95.300	0+	**51.46%**						0.05
			91	51	−94.358	5/2+	**11.23%**	−1.303					1.0
			92	52	−94.961	0+	**17.11%**						0.15
			93	53	−93.552	5/2+	1.5 × 10^6 y			β⁻0.060(95), . . .	0.063		<4
			94	54	−93.680	0+	**17.40%**						0.075
			95	55	−91.965	5/2+	65 d			β⁻0.362(55), 0.399(43), 0.88(1), . . .	1.121	0.756(55), 0.723(43), 0.235(1)	
			96	56	−91.718	0+	**2.80%**						0.05
			97	57	−89.03		17.0 h			β⁻1.93(86), 0.56(5), 1.42(3), . . .	2.67	0.743(95), 0.508(5)	
			98	58	−87.25	0+	31 s			β⁻2.1	2.2		
			99	59	−84.		2.4 s			β⁻	~4.5		
			100	60	−83.		~1 s			β⁻	~3		
			101	61	−78.		~3.3 s			β⁻	~6.5		
41	Nb	Niobium	88	47	−82.		14 m			β⁺3.2, . . . , ε	~7.2	1.08, 1.06, 0.67, 0.40, 0.27, 0.075, 1.083	
			89m	...		(½−)	42 m			β⁺3.1, ε		0.588	
			89	48	−86.9	(9/2+)	1.9 h			β⁺2.9, ε	3.9	1.626, 3.577, 3.838, . . .	
			90m	...		(4)−	20 s					IT<0.003, 0.122	
			90	49	−88.74	(8+)	14.6 h			β⁺1.5(55), ε(45)	6.11	1.14(97), 2.32(82), 0.142(75), 2.18(14)	
			91m	...		(½−)	62 d			ε(3)		IT0.1045(97), 1.21(3)	
			91	50	−93.00	(9/2+)	Long			ε(100)	1.26		
			92m	...		2+	10.16 d			ε(99.9), β⁺		0.934(99), 0.9(2), 1.8(1)	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-1}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
41	Nb	Niobium	92	51	−92.79	(7+)	>350 y						
			93*m*	...	.....	$\frac{1}{2}-$	13.6 y	.....	.....	.....	.....	IT0.0304(100)	
			93	52	−93.620	$\frac{9}{2}+$	100%	+6.167	−0.22	.....	.....	.....	1.0
			94*m*	...	.....	3+	6.3 m	.....	.....	β^-1.2(0.2), . . .	.....	IT0.0407(99+), 0.871(0.2)	11
			94	53	−92.70	6+	2.0×10^4 y	.....	.....	β^-0.5(100)	2.06	0.702(100), 0.871(100)	
			95*m*	...	.....	$(\frac{1}{2}-)$	90 h	.....	.....	.....	.....	IT0.253(100)	<7
			95	54	−93.170	$(\frac{5}{2}+)$	35.1 d	.....	.....	β^-0.160(99), . . .	0.925	0.765(99)	
			96	55	−91.90	.....	23.4 h	.....	.....	β^-0.748(95), 0.50(5)	3.19	0.778(97), 0.569(59), 1.092(49), 0.459(28), 0.851(22), 1.200(21), . . .	
			97*m*	...	.....	$(\frac{1}{2}-)$	1.0 m	.....	.....	.....	.....	IT0.747(100)	
			97	56	−91.90	$(\frac{9}{2}+)$	72 m	.....	.....	β^-1.27(98), . . .	1.93	0.658(98), 1.0(2)	
			98*m*	...	.....	.....	2.8 s	.....	.....	β^-1.3	.....	0.780, 1.020, . . .	
			98	52	−89.6	(4,5+)	51 m	.....	.....	β^-2.32(38), 1.94(29), 1.42(25), 3.1(8)	4.6	0.780(100), 0.720(75), 1.44(10), 1.68(10), 1.93(8), 0.330(8)	
			99*m*	...	.....	.....	10 s	.....	.....	β^-	.....	IT	
			99	53	−89.	.....	2.4 m	.....	.....	β^-3.2, . . .	~3	0.100(1), 0.260(1)	
			100	...	.....	.....	3.0 m	.....	.....	β^-	.....	0.53(100), 0.36(55), 0.45(40), 0.14(10), . . .	
			100	54	−86.	.....	11 m	.....	.....	β^-3.5(45), 3.1(45), 4.2(10)	~5	0.53(100), 0.62(60), 1.04(10), 1.15(10), 1.47(5)	
			101	...	−85.	.....	1.0 m	.....	.....	β^-	~1		
42	Mo	Molybdenum	88	46	−77.	0+	27 m	.....	.....	β^+2.5	~5	2.69	
			89	47	−81.	.....	7 m	.....	.....	β^+4.9, 4.0	~6		
			90	48	−86.1	0+	5.7 h	.....	.....	ϵ(75), β^+1.09(25)	2.49	0.257(85), 0.123(71), 0.942(10), 0.445(9), 1.273(8), . . .	

			91m	...	.....	$(\frac{1}{2}-)$	66 s	.....	.....	β^+2.78(30), 3.09(5), ...	.....	IT0.658(60), 1.21(20), 1.53(15)	
			91	49	−88.23	$(\frac{9}{2}+)$	15.49 m	.....	.....	β^+3.44(94), ϵ(6)	4.46		
			92	50	−93.192	0+	15.84%	.....	.....	.....	.....	.....	<0.3
			93m	...	.....	$(\frac{21}{2}+)$	6.9 h	.....	.....	.....	.....	IT0.685, 1.479, 0.264	
			93	51	−93.19	$\frac{5}{2}+$	3000 y	.....	.....	ϵ(100)	0.40		
			94	52	−94.910	0+	9.04%						
			95	53	−94.163	$\frac{5}{2}+$	15.72%	−0.9133	±0.12	.....	.....	.....	14.4
			96	54	−95.326	0+	16.53%	.....	.....	.....	.....	.....	1.0
			97	55	−93.977	$\frac{5}{2}+$	9.46%	−0.9325	±1.1	.....	.....	.....	1.9
			98	56	−94.591	0+	23.78%	.....	.....	.....	.....	.....	0.14
			99	57	−92.28	$\frac{1}{2}+$	66.7 h	.....	.....	β^-1.23(82), 0.45(17), 0.86(1), ...	1.37	0.141(99), 0.740(14), 0.181(7), 0.778(4), 0.041(2), ...	
			100	58	−92.522	0+	9.61%	.....	.....	.....	.....	.....	0.20
			101	59	−89.65	$(\frac{1}{2}+)$	14.6 m	.....	.....	β^-0.74(38), 1.61(25), 0.84(13), 1.23(11), 2.23(10), ...	2.82	0.191(25), 1.02(25), 0.59(21), 2.08(16), 0.89(15), ...	
			102	60	−90.	0+	11 m	.....	.....	β^-1.2	1.2		
			103	...	.....	.....	5 h	.....	.....	β^-	.....	0.54, 1.3 1.7, 1.1, 1.5	
			103	61	−86.	.....	62 s	.....	.....	β^-	~4		
			104	62	.....	0+	1.3 m	.....	.....	β^-4.8, 2.2	.....	0.070	
			105	63	.....	.....	40 s	.....	.....	β^-			
			106	64	.....	0+	9.5 s	.....	.....	β^-			
43	Tc	Technetium	92	49	−84.7	(8,9+)	4.4 m	.....	.....	β^+4.1(92), ϵ(8)	7.9	1.54(100), 0.79(95), 0.33(90), 0.14(67), 0.24(30), 0.090(20)	
			93m	...	.....	$(\frac{1}{2}-)$	43 m	.....	.....	ϵ(18)	.....	IT0.390(82), 2.66(18)	
			93	50	−89.77	$(\frac{9}{2}+)$	2.7 h	.....	.....	ϵ(87), β^+0.82(11), 0.68(2)	3.19	1.35(65), 1.49(33)	
			94m	...	.....	2+	53 m	.....	.....	β^+2.47(63), ... , ϵ(34)	.....	0.871(91), 1.53(6), 1.87(6), 2.74(4), 0.993(2), ...	
			94	51	−90.337	6, 7+	293 m	.....	.....	ϵ(89), β^+0.816(11)	4.26	0.849(100), 0.702(100), 0.871(100), ...	
			95m	...	.....	$(\frac{1}{2}-)$	61 d	.....	.....	ϵ(95), β^+0.71(0.3), 0.49(0.1)	.....	IT0.0389(4), 0.204(70), 0.584(36), 0.838(27), ...	
			95	52	−92.34	$(\frac{9}{2}+)$	20.0 h	.....	.....	ϵ(100)	1.70	0.768(82), 0.84(11), 1.06(4)	
			96m	...	.....	....	52 m	.....	.....	β^+2.0, 0.4(0.01)	.....	IT0.0344(99+)	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu × 10⁻³	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
43	Tc	Technetium	96	53	−92.17	.....	4.3 d	.....	.....	ε(100)	2.9	0.778(100), 0.851(100), 0.81(84), 1.12(16), 0.32(5)	
			97m	...	.....	($\frac{1}{2}$−)	90 d	.....	.....	.....	.....	IT0.0965(100)	
			97	54	−93.61	($\frac{9}{2}$+)	2.6×10^6 y	.....	.....	ε(100)	~0.3		
			98	55	−92.9	(7,6+)	1.5×10^6 y	.....	.....	β⁻0.30(100)	1.7	0.76(100), 0.66(100)	
			99m	...	.....	$\frac{1}{2}$−	6.0 h	.....	.....	.....	.....	IT0.002, 0.141	
			99	56	−93.751	$\frac{9}{2}$+	2.14×10^5 y	+5.68	+0.3	β⁻0.292(100)	0.292	.....	22
			100	57	−92.16	1+	17 s	.....	.....	β⁻3.38, 2.88, 2.2	3.4	0.540, 0.60, 0.71, 0.81, ...	
			101	58	−92.67	($\frac{5}{2}$+)	14.0 m	.....	.....	β⁻1.32(90), 1.07(10)	1.63	0.307(91), 0.545(8), ...	
			102	...	.....	(1)+	5 s	.....	.....	β⁻1.4			
			102	59	−91.	.....	4.5 m	.....	.....	β⁻2.2	~4.5	0.47, 0.63, 1.1, 2.19, 1.60, ...	
			103	60	−91.2	.....	50 s	.....	.....	β⁻2.2, 2.0	2.4	0.135, 0.21, 0.35	
			104	61	−89.	.....	18 m	.....	.....	β⁻4.6, 3.3, 2.4, 1.8, ...	~5.3	0.36, 0.53, 0.89, 1.6, 2.5, ...	
			105	62	−88.7	.....	7.7 m	.....	.....	β⁻3.4	3.4	0.159, 0.143, 0.108, 0.321, ...	
			106	63	−86.	.....	37 s	.....	.....	β⁻	~5.5		
			107	64	.....	.....	29 s	.....	.....	β⁻			
44	Ru	Ruthenium	93	49	−83.	.....	50 s	.....	.....	β⁺	~4		
			94	50	−88.64	.....	52 m	.....	.....	ε	1.58	0.37, 0.89	
			95	51	−89.59	($\frac{7}{2}$+)	1.65 h	.....	.....	ε(85), β⁺1.1(10), 1.33(3), 0.7(1)	2.35	0.340(70), 1.09(21), 0.625(13), 1.45(5)	
			96	52	−92.402	0+	5.51%	.....	.....	.....	.....	.....	0.21
			97	53	−92.4	($\frac{5}{2}$+)	2.9 d	.....	.....	ε(100)	1.2	0.215(91), 0.324(8)	
			98	54	−94.711	0+	1.87%	.....	.....	.....	.....	.....	<8
			99	55	−94.063	$\frac{5}{2}$+	12.72%	−0.63	.....	.....	.....	.....	9.9
			100	56	−95.782	0+	12.62%	.....	.....	.....	.....	.....	9.7
			101	57	−94.423	$\frac{5}{2}$+	17.07%	−0.69	.....	.....	.....	.....	2.9

			102	58	−95.652	0+	**31.51%**	.....	.....	.....	.....	.....	**1.44**
			103	59	−93.67	$(\frac{5}{2}+)$	39.6 d	.....	.....	β^-0.21(89), 0.1(7), 0.70(3), . . .	0.74	0.040(100), 0.497(88), 0.610(6), . . .	
			104	60	−94.572	0+	**18.58%**	.....	.....	.....	.....	.....	**0.47**
			105	61	−92.25	$(\frac{5}{2}+)$	4.44 h	.....	.....	β^-1.14, 1.08, 0.91, 1.9, 0.52	1.92	0.726(48), 0.470(18), 0.678(7), 0.317(11), 0.970(2), . . .	0.20
			106	62	−92.68	0+	367 d	.....	.....	β^-0.0394(100)	0.0394	.....	0.146
			107	63	−89.9	.....	4.2 m	.....	.....	β^-3.2, 2.1, 2.3, . . .	3.2	0.195(14), 0.86(7), 0.93(4), 1.03(4), 1.29(4), . . .	
			108	64	−90.0	0+	4.5 m	.....	.....	β^-1.3(72), 1.1(28)	1.3	0.165(28)	
			109	65	.....	.....	35 s	.....	.....	β^-			
45	Rh	Rhodium	95	50	−84.	.....	5 m	.....	.....	ϵ, β^+	∼5	0.942, 1.36	
			96 m	...	.....	.....	1.5 m	.....	.....	ϵ, β^+	.....	IT?	
			96	51	−85.49	.....	9 m	.....	.....	ϵ, β^+	6.44	0.83, 0.53, 0.69	
			97	52	−88.6	.....	32 m	.....	.....	β^+2.47, 2.06, 1.8	3.49	0.08, 0.19, 0.43, 0.26, 0.86, 1.57, 2.54, . . .	
			98*m*	...	.....	.....	3 n	.....	.....	.....	.....	IT	
			98	53	−89.28	.....	8.7 m	.....	.....	β^+2.5, 3.3	5.1	0.65(100)	
			99*m*	...	.....	.....	4.7 h	.....	.....	ϵ(90), β^+0.74(10)	.....	0.34(70), 0.62(20), . . .	
			99	54	−91.86	.....	16 d	.....	.....	ϵ, β^+1.03, 0.71, 0.59, 0.44	2.05	0.528, 0.089, 0.353, 0.322, 0.618, . . .	
			100	55	−91.89	1, 2−	20 h	.....	.....	ϵ(93), β^+2.62(3), 2.07(3), . . .	3.64	0.540(88), 2.37(39), 0.820(25), 1.55(23), 1.35(20), . . .	
			101*m*	...	.....	$(\frac{9}{2}-)$	4.5 d	.....	.....	ϵ(90)	.....	IT0.157(10), 0.307(83), 0.545(6), . . .	
			101	56	−93.82	$(\frac{1}{2}-)$	3 y	.....	.....	ϵ(100)	0.56	0.127(84), 0.198(75), 0.325(11)	
			102	...	.....	.....	2.9 y	.....	.....	ϵ(100)	.....	0.475(93), 0.63(54), 0.698(41), 1.05(41), 0.768(30), . . .	
			102	57	−93.16	.....	206 d	.....	.....	ϵ(72), β^+1.30(9), 0.83(3)	2.32	0.475(57), 0.628(4),	
										β^-1.15	1.15	1.103(3), . . .	
			103	58	−94.489	$\frac{1}{2}-$	**100%**	−0.0883	.....	.....	.....	.....	150
			104*m*	...	.....	5+	4.30 m	.....	.....	β^-(0.18)	.....	IT0.039(99+), 0.0457(97), 0.051(47), . . .	800
			104	59	−93.337	1+	43 s	.....	.....	β^-2.5(98), 1.9(1.9), . . . ϵ(0.5)	2.47 1.15	0.56(1.9), 1.24(0.1)	40

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
45	Rh	Rhodium	105*m*	...	.....	$(\frac{1}{2}-)$	45 s	.....	.....	.....	.....	IT0.129(100)	
			105	60	−94.31	$(\frac{7}{2}+)$	35.6 h	.....	.....	β^-0.565(75), 0.246(20), ...	0.565	0.319(19), 0.306(5)	18,700
			106*m*	...	.....	.....	130 m	.....	.....	β^-0.92(66), 0.70(22), 1.31(3), ...	.....	0.512(88), 0.735(41), 0.451(35), 0.82(35), 1.04(34), ...	
			106	61	−92.72	1+	30.4 s	.....	.....	β^-3.54(79), 2.4(11), 3.1(8), ...	3.54	0.512(21), 0.623(11), ...	
			107	62	−93.25	$(\frac{5}{2})+$	22 m	.....	.....	β^-1.20(71), 1.12(8), 0.84(7), ...	1.51	0.305(73), 0.390(11), 0.68(3), ...	
			108	63	−91.3	1+	17 s	.....	.....	β^-4.5(50), ...	~4.5	0.434(43), 0.62(22), 0.51(10), ...	
			109*m*	...	.....	.....	50 s	.....	.....	.....	.....	IT0.11	
			109	64	−91.	.....	30 s	.....	.....	β^-	~2.5	0.49, 0.31	
			110	65	−89.0	1+	5 s	.....	.....	β^-5.5, ...	5.5	0.374	
46	Pd	Palladium	98	52	−87.	0+	17 m	.....	.....	ϵ	~2	0.132?	
			99	53	−88.2	.....	22 m	.....	.....	β^+2.0	3.4	0.140, 0.275, 0.420, 0.67	
			100	54	−91.	0+	4.0 d	.....	.....	ϵ(100)	~0.4	0.084(49), 0.074(34), 0.126(16), 0.159(4)	
			101	55	−91.69	$(\frac{5}{2}+)$	8.4 h	.....	.....	ϵ(97.5), β^+0.73(2), 0.49(0.5)	1.99	0.290(30), 0.590(24), 0.566(7), 0.723(5), ...	
			102	56	−94.39	0+	0.96%	.....	.....	.....	.....	.....	
			103	57	−93.89	$(\frac{5}{2}+)$	17 d	.....	.....	ϵ(100)	0.56	0.040(100). ...	4.8
			104	58	−95.99	0+	10.97%						
			105	59	−94.91	$\frac{5}{2}+$	22.23%	−0.642	+0.8				
			106	60	−96.51	0+	27.33%	.....	.....	.....	.....	.....	
			107	61	−94.871	$\frac{5}{2}+$	~7 × 10⁶ y	.....	.....	β^-0.035(100)	0.035	.....	0.28
			108	62	−96.109	0+	26.71%						
			109*m*	...	.....	$(\frac{1}{2}+)$	4.7 m	.....	.....	.....	.....	IT0.188(60), 0.08(40), 0.11(40)	

			109	63	−94.046	$\frac{5}{2}$+	13.47 h	.....	.....	β^-1.03(99+), . . .	1.115	0.088(89), . . .	
			110	64	−94.84	0+	11.81%	.....	.....	.....	.....	.....	0.4
			111*m*	...	.....	.....	5.5 h	.....	.....	β^-(25)	.....	IT0.17(75), 0.07	
			111	65	−92.33	.....	22 m	.....	.....	β^-2.2(100)	2.2	0.38, 0.58, . . .	
			112	66	−92.61	0+	21 h	.....	.....	β^-0.28(100)	0.30	0.0185(20)	
			113	67	.....	.....	1.4 m	.....	.....	β^-			
			114	68	.....	0+	2.4 m	.....	.....	β^-			
			115	69	.....	.....	40 s	.....	.....	β^- ~4.5(73), ~4.4(27)			
			117	71	.....	.....	5 s	.....	.....	β^-			
			118	72	.....	0+	3.1 s	.....	.....	β^-			
47	Ag	Silver	99	52	−81.7	.....	2.8 m	.....	.....	β^+3.32(53), 1.7(24), 2.45(23)	6.0	1.04(45), 1.70(40), 1.53(32), . . .	
			100	53	−84.	.....	9 m	.....	.....	β^+ 5.8	.....	0.728	
			101	54	−87.0	.....	11 m	.....	.....	β^+2.73(44), 2.18(23), 1.56(17), . . . , ϵ	4.4	0.26, 1.16, 0.65, 0.67, 0.58, . . .	
			102*m*	...	.....	2	7.7 m	+4	.....	β^+3.4, 4.06, 3.07, ϵ(13)	.....	0.86, 0.73, 1.60, 0.558, . . .	
			102	...	.....	.....	4 m	.....	.....	β^+2.4(40), 2.9, 3.3, 3.6	.....	0.55, 0.78, 1.27, 2.06	
			102	55	−88.4	5	13 m	.....	.....	β^+2.20(37), 1.90(13), 1.50(3), . . . , ϵ(45)	5.56	0.558(85), 0.727(65), 1.80(42), 2.07(20), . . .	
			103*m*	...	.....	($\frac{1}{2}$−)	5.7 s	.....	.....	.....	.....	IT0.138	
			103	56	−91.0	$\frac{7}{2}$+	66 m	+4.4	.....	ϵ(50), β^+1.7, 1.3	2.7	0.27(34), 0.12(26), 0.15(23), 0.24(10), 1.16(9), . . .	
			104*m*	. .	.....	2+	30 m	+3.7	.....	β^+2.7(60), ϵ(10)	.....	IT0.02(30), 0.556(70)	
			104	57	−91.58	5+	67 m	+4.0	.....	ϵ, β^+0.99	4.10	0.556(84), 0.764(48), 0.854(30), 1.34(8), 1.62(8), . . .	
			105	58	−93.48	$\frac{1}{2}$−	40 d	±0.101	.....	ϵ(100), β^+	1.34	0.344(42), 0.280(32), 0.064(10), 0.443(10), 0.644(10), 1.088(4), . . .	
			106*m*	...	.....	6+	8.4 d	.....	.....	ϵ(100)	.....	0.115(55), 0.061(15), 0.153(9), 0.752(7), . . .	
			106	29	−93.32	1+	24.7 m	+2.9	.....	β^+1.96(50), . . . , ϵ(30)	2.97	0.512(20)	
			107*m*	...	.....	$\frac{7}{2}$+	44.3 s	.....	.....	.....	.....	IT0.093(100)	
			107	60	−94.909	$\frac{1}{2}$−	51.82%	−0.1135	.....	.....	.....	.....	35
			108*m*	...	.....	(6+)	>5 y	.....	.....	ϵ(90)	.....	IT0.03(9), 0.08(9), 0.722(90), 0.614(90)	
			108	61	−94.047	1+	2.42 m	+2.80	.....	β^-1.6(96), . . .	1.64	0.632(2)	
										ϵ(2), β^+0.88(0.28)	1.92	0.434(0.45)	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
47	Ag	Silver	109*m*	...	.....	$\frac{7}{2}+$	39.8 s	±4.3	.....	.....	.....	IT0.088(100)	
			109	62	−95.244	$\frac{1}{2}-$	48.18%	−0.1305	.....	.....	.....	.....	93
			110*m*	...	.....	6+	253 d	+3.601	.....	β^-0.087(67), 0.53(31), ...	.....	0.658(96), 0.885(71), 0.937(32), 0.764(213), 1.384(21), . . . , IT0.116(1)	82
			110	63	−93.886	1+	24.4 s	+2.85	.....	β^-2.88(96), 2.2(4), . . . ϵ(0.3)	2.88 0.87	0.658(4), . . .	
			111*m*	...	.....	$(\frac{7}{2}+)$	74 s	.....	.....	.....	.....	IT0.065(100)	
			111	64	−94.70	$\frac{1}{2}-$	7.5 d	−0.145	.....	β^-1.05(93), 0.71(6), 0.80(1), . . .	1.05	0.34(6), 0.25(1)	
			112	65	−92.94	2−	3.2 h	±0.054	.....	β^-3.96(54), 3.35(22), 1.96(10), . . .	3.96	0.617(41), 1.40(5), 1.63(3), 2.11(3), 2.55(2), . . .	
			113*m*	...	.....	.....	1.2 m	.....	.....	.....	.....	0.14, 0.30, 0.39, 0.56, 0.70	
			113	66	−93.44	$\frac{1}{2}-$	5.3 h	±0.159	.....	β^-	2.00	0.30(100), 0.67(17)	
			114	67	−91.	.....	5 s	.....	.....	β^-4.6	4.6	3.12(10), 0.58(5), . . .	
			115*m*	...	.....	.....	49 s	.....	.....	β^-~3.2		0.57	
			115	68	−91.1	$(\frac{1}{2}-)$	21 m	.....	.....	β^-3.2, 3.0, 2.7, 2.5, 2.1, 1.0, . . .	3.2	0.22(46), 0.28(13), 2.12(13), 0.14(12), 1.48(11), 0.36(11), . . .	
			116	69	−89.	.....	2.5 m	.....	.....	β^-5.0, . . .	~5.3	0.52(10), 0.70(2)	
			117	70	.....	.....	1.1 m	.....	.....	β^-			
48	Cd	Cadmium	118	71	.....	.....	5.3 s	.....	.....	β^-			
			101	53	−81.0	.....	1.2 m			β^+	5.5		
			102	54	−85.	0+	5.5 m			β^+	~3	0.118, 0.481, . . .	
			103	55	−86.	.....	10 m	.....	.....	β^+	~4.4	0.22, 0.63, 0.85	
			104	56	−90.	0+	57 m	.....	.....	ϵ(100)	~1.2	0.084	

			105	57	−91.	$\frac{5}{2}$	55 m	−0.74	+0.5	β^+1.69, . . .	~2.8	0.31, 0.34 0.35, 0.43, 0.61, 1.9, 2.0, 2.3	
			106	58	−93.537	0+	**1.22%**						1.0
			107	59	−93.388	$\frac{5}{2}$+	6.5 h	−0 6144	+0.8	ϵ(99.7), β^+0.302(0.3)	1.417	0.093(100). . .	
			108	60	−95 811	0+	**0.88%**						1.5
			109	61	−95.050	$\frac{5}{2}$+	453 d	−0.8270	+0.8	ϵ(100)	0.182	0.088(100)	700
			110	62	−96.990	0+	**12.39%**						0.1
			111*m*	..	.....	$\frac{11}{2}$−	48.6 m	−1.11	−1.0	.....	.....	IT0.150, 0.247	
			111	63	−95 814	$\frac{1}{2}$+	**12.75%**	−0.5943					
			112	64	−97.238	0+	**24.07%**						0.06
			113*m*	...	.....	$\frac{11}{2}$−	14 y	−1.087	−0.8	β^-0.58(100)	.....	IT?	
			113	65	−95.592	$\frac{1}{2}$+	**12.26%**	−0.6217		.....	.....	.....	20,000
			114	66	−96.637	0+	**28.86%**			.....	.....	.....	0.34
			115*m*	..	.....	$\frac{11}{2}$−	43 d	−1.040	−0.6	β^-1.62(97), 0.68(1.6), . .	.....	0.935(2), 1.29(1), . . .	
			115	67	−94 57	$\frac{1}{2}$+	53.5 h	−0 6477	.....	β 1.11(60), 0.58(31), . . .	1.45	0.336(95), 0.526(26), 0.492(10), . . .	
			116	68	−95.238	0+	**7.58%**						0.077
			117*m*	...	.....	$\frac{11}{2}$−	3.4 h	.....	.....	β^-0.67, 0.41	.....	0.273(18), 1.998(15), 1.21(11), 0.880(10), 1.433(10) 1.408(8), . . .	
			117	39	−92.78	$\frac{1}{2}$+	2.4 h	.....	.....	β^-0.65, 0.7), 2.23, . . .	2.52	0.273(31), 1.303(19), 0.345(18) 1.577(17), 0.314(16), 0.897(7), . . .	
			118	70	−93.08	0+	50 m	.....	.....	β^-	~0.8		
			119*m*	..	.....	.....	2.7 m	.....	.....	β^-3.5	.....	0.8?	
			119	71	−90.4	.....	10 m	.....	.....	β^-3.5	3.5		
			121	73	.....	.....	13 s	.....	.....	β^-			
49	In	Indium	106	57	−86.30	.....	5.3 m	.....	.....	β^+4.89, 2.7	6.7	0.53, 0.63, 0.86, 1.66, 0.99, . . .	
			107	58	−89.6	.....	32 m	.....	.....	β^+2.2, . . . , ϵ	3.5	0.22(46), 0.32, 0.73, 0.84, 0.94, 1.05, 1.25, . . .	
			108*m*	...	.....	2, 3+	39 m	.....	.....	β^+3.50, 2.66, 2.28, ϵ	5.15	0.383, 0.633, 0.842	
			108	59	−90.3	(6,7+)	56 m	.....	.....	β^+1.29, ϵ	5.11	0.633, 0.842, 0.872, 0.243, 0.150, . . .	
			109*m*$_2$	...	.....	($\frac{19}{2}$+)	0.21 s	.....	.....	.....	.....	IT0.68(100), 1.44(80)	
			109*m*$_1$	...	.....	($\frac{1}{2}$−)	1.3 m	.....	.....	.....	.....	IT0.658(100)	
			109	60	−92.88	$\frac{9}{2}$+	4.3 h	+5.53	+0.86	ϵ(94), β^+0.7)(6)	2.02	0.205, 0.28, 0.35, 0.65, 0.91	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
49	In	Indium	110*m*	...	.....	7(+)	4.9 h	+10.4 or −10.7	−0.21 or +0.22	ϵ, β^+?	.....	0.66, 0.91	
			110	...	−92.77	2+	67 m	+4.36	+0.36	β^+2.20(71), . . . , (29)	3.93	0.658(99), . . .	
			111*m*	...	.....	.....	7.3 m	.....	.....	.....	.....	IT0.539	
			111	...	−94.93	$\frac{9}{2}+$	2.81 d	+5.53	+0.85	ϵ(100)	0.83	0.247(94), 0.173(89), . . .	
			112*m*	...	.....	4+	20.7 m	.....	.....	.....	.....	IT0.156(100)	
			112	63	−94.46	1+	14 m	+2.81	+0.089	β^-0.66(44)	0.66		
			113*m*	...	.....	$\frac{1}{2}-$	100 m	−0.210	.....	ϵ(34), β^+1.56(21)	2.59	0.617(6)	
			113	64	−95.91	$\frac{9}{2}+$	4.28%	+5.523	+0.82	.....	.....	IT0.393(100)	
			114*m*	...	.....	5+	50.0 d	+4.7	.....	ϵ(<0.02)	.....	.....	10.7
			114	65	−95.10	1+	72 s	.....	.....	β^-1.986(98), . . .	.....	IT0.1916(96.5), 0.724(3.5), 0.556(3.5)	
			115*m*	...	.....	$\frac{1}{2}-$	4.50 h	−0.244	.....	ϵ(2), β^+0.4(0.004)	1.986	1.30(0.2)	
			115	66	−96.13	$\frac{9}{2}+$	6×10^{14} y 95.72%	5.534	+0.83	β^-0.83(5)	1.44		
			116m_2	...	.....	.....	2.16 s	.....	.....	β^-0.49(100)	.....	IT0.335(95)	
			116m_1	...	.....	5+	54.0 m	+4.3	.....	.....	0.49	.....	198
			116	67	−94.74	1+	14 s	.....	.....	β^-1.00(49), 0.87(40), 0.60(11), . . .	.....	IT0.164(100)	
			117*m*	...	.....	$\frac{1}{2}-$	1.93 h	−0.2515	.....	β^-3.3(99), . .	.....	1.293(80), 1.09(53), 0.417(36), 2.111(20), 0.819(17), 1.508(11), . . .	
			117	68	−95.47	$\frac{9}{2}+$	44 m	.....	.....	β^-1.77(37), 1.62(16)	3.27	1.293(1), . . .	
			118m_2	...	.....	.....	8.5 s	.....	.....	β^-0.74(100)	.....	IT0.314(47), 0.158(16)	
			118*m*	...	.....	(4,5+)	4.4 m	.....	.....	β^-1.8(1)	1.47	0.56(100), 0.158(100)	
			118	69	−93.9	1+	5 s	.....	.....	β^-1.3(53), 2.0(32), . . .	.....	IT0.138(99)	
			119*m*	...	.....	($\frac{1}{2}-$)	18 m	.....	.....	β^-4.2(80), 3.0(16), . . .	4.2	1.23(97), 1.05(80), 0.69(41), . . .	
										β^-2.7, . . . , (95)	.....	1.23(15)	
												0.023, 0.91, IT0.30(5)	

			119	70	−94.2	$(\frac{9}{2}+)$	2.4 m	.....	.....	β^- 1.6(100)	2.35	0.82(95), 0.73(5)	
			120m?	...	.....	(1)+	3.2 s	.....	.....	β^- ~5.6(~85)	.....	1.17(~15)	
			120	71	−92.	(4,5+)	46 s	.....	.....	β^- 2.2(41), 3.1(27), . . .	5.6	1.171(100), 1.02(61) 1.28(14), 0.090(12), 0.71(12), 0.94(12), . . .	
			121	...	.....	.....	3.1 m	.....	.....	β^- 3.7			
			121	72	−92.1	.....	30 s	.....	.....	β^-	3.4	0.94	
			122	73	−89.	.....	8 s	.....	.....	β^- 5	~7	0.99, 1.14	
			123	74	−89.	.....	36 s	.....	.....	β^- 4.4	4.4		
			124	75	−86.8	.....	4 s	.....	.....	β^- 5	7.4	1.13, 0.99, 3.21	
50	Sn	Tin	108	58	−88.	0+	9 m	.....	.....	ϵ	~2	0.28, 0.42	
			109m	...	.....	.....	1.5 m	.....	.....	β^+		IT	
			109	59	−8.9	.....	18.1 m	.....	.....	ϵ(80), β^+ 1.52(20)	~4	1.12(50), 0.65(44), 0.33(26), 1.55(18), . . .	
			110	60	−92.13	0+	4.0 h	.....	.....	ϵ	0.59	0.283(95)	
			111	61	−92.24	.....	35 m	.....	.....	ϵ(70), β^+ 1.51(30)	2.52	1.14(2), 0.75(1), 1.89(1), . . .	
			112	62	−95.17	0+	**0.96%**	.....	.....	.....	.....	.....	1.15
			113m	...	.....	$(\frac{7}{2}+)$	20 m	.....	.....	ϵ(9)	.....	IT0.079(91)	
			113	63	−94.81	$\frac{1}{2}+$	115 d	±0.88	.....	ϵ(100)	0.76	0.393(100), 0.255(1)	
			114	64	−97.24	0+	**0.66%**						
			115	65	−96.55	$\frac{1}{2}+$	**0.35%**	−0.918					
			116	66	−98.252	0+	**14.30%**	.....	.....	.....	.....	.....	0.006
			117m	...	.....	$\frac{11}{2}-$	14.0 d	.....	.....	.....	.....	IT0.158(100)	
			117	67	−97.039	$\frac{1}{2}+$	**7.61%**	−1.000					
			118	68	−98.387	0+	**24.01%**	.....	.....	.....	.....	.....	0.01
			119m	..	.....	$\frac{11}{2}-$	~250 d	.....	.....	.....	.....	IT0.065(100), 0.02 4	
			119	..	−96 684	$\frac{1}{2}+$	**8.58%**	+1.046					
			120	..	−97.793	0+	**32.85%**	.....	.....	.....	.....	.....	0.14
			121m	..	.....	$(\frac{11}{2}-)$	76 y	.....	.....	β^- 0.35(100)	.....	0.037(100)	
			121	71	−95.762	$\frac{3}{2}+$	27 h	±0.70	±0.08	β^- 0.383(100)	0.383		
			122	72	−96.549	0+	**4.72%**	.....	.....	.....	.....	.....	0.15
			123m	..	.....	$(\frac{3}{2}+)$	40 m	.....	.....	β^- 1.26(100)	.....	0.16(100)	
			123	73	−94.26	$\frac{11}{2}-$	129 d	.....	.....	β^- 1.42(99), . . .	1.42	1.09(1), . . .	
			124	74	−94.717	0+	**5.94%**	.....	.....	.....	.....	.....	0.14
			125m	...	.....	$(\frac{3}{2}+)$	9.7 m	.....	.....	β^- 2.04(97), . . .	.....	0.325(97), . . .	
			125	75	−92.21	$\frac{11}{2}-$	9 6 d	.....	.....	β^- 2.34(95), . . .	2.34	1.067(4), 0.822(1.5), 0.915(1.4), . . .	
			126	76	−92.34	0+	~10^5 y	.....	.....	β^-	~0.3	0.060, 0.067, 0.092	
			127	..	.....	.....	4 m	.....	.....	β 2.7	.....	0.495	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu × 10^{-3}	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
50	Sn	Tin	127	77	−90.	.....	2.1 h	.....	.....	β^- 1.5	.....	0.44, 0.49, 0.82, 1.10, 2.00, 2.32, . . .	
			128	78	−89.5	0+	59 m	.....	.....	β^- 0.08, 0.7	1.3	0.50(61), 0.57(22), 0.072(19), 0.044(7)	
			129*m*	..	.....	.....	2 m	.....	.....	β^-	.....	1.15, . . :	
			129	79	.....	.....	9 m	.....	.....	β^-			
			130	78	.....	0+	2.6 m	.....	.....	β^-			
			131	79	.....	.....	1.3 m	.....	.....	β^-			
			132	80	.....	.....	2.2 m	.....	.....	β^-			
51	Sb	Antimony	112	61	−87.87	.....	0.9 m	.....	.....	β^+, ϵ	6.8	1.27	
			113	62	−90.63	.....	6.7 m	.....	.....	ϵ, β^+2.43, 1.85	3.90	0.32, 0.6–0.9, 1.03, 1.2	
			114	63	−91.12	.....	3.3 m	.....	.....	β^+2.7, ϵ	5.7	0.9, 1.30	
			115	64	−93.40	$\frac{5}{2}$(+)	32 m	+3.46	−0.27	ϵ(67), β^+1.51(33)	3.03	0.499(100), 0.98(5), 1.24(5), 2.22(1)	
			116*m*	...	.....	(8−)	60 m	.....	.....	ϵ(81), β^+1.16(19)	.....	1.293(100), 0.96(75), 0.545(68), 0.406(36), 0.099(30), 0.140(30)	
			116	65	−93.42	3(+)	16 m	.....	.....	ϵ(72), β^+2.3, 1.5	4.5	1.293(85), 0.93(26), 2.23(14)	
			117	66	−95 16	$\frac{5}{2}$+	2.7 h	+2.67	−0.4	ϵ(98), β^+0.57(2)	1.75	0.158(87)	
			118*m*	...	.....	(8)−	5.0 h	.....	.....	ϵ(99+)	.....	1.049(100), 1.230(100), 0.254(93), 0.041(29)	
			118	67	−94.43	1+	3.5 m	±2.5	.....	β^+2.7(75), . . . , ϵ(25)	3.7	1.23(3), . . .	
			119	68	−96.07	($\frac{5}{2}$+)	38.3 h	+3.45	−0.30	ϵ(100)	0.58	0.024	
			120	...	.....	(8−)	5.8 d	.....	.....	ϵ(100)	.....	1.171(100), 1.03(99), 0.200(88), 0.090(81)	
			120	69	−94.92	1+	16.5 m	±2.3	.....	ϵ(56), β^+1.7(44)	2.68	1.17(1)	
			121	70	−96.188	$\frac{5}{2}$+	57.25%	+3.359	−0.29	.....	.....	.....	6.2
			122*m*	...	.....	(8−)	4.2 m	.....	.....	.....	.....	IT(100), 0.061, 0.075, . . .	

			122	71	−94.820	2−	2.8 d	−1.90	+0.69	β^-1.41(63), 1.97(30), 0.72(4)	1.972	0.564(66), 0.686(3), 1.26(1), 1.14(1)	
										ϵ(3)	1.61		
			123	72	−95.780	$\frac{7}{2}$+	**42.75%**	+2.547	−0.37				3.4
			124m_2	..			21 m					IT0.025(100)	
			124m_1	..			93 s			β^-1.19(20)		IT0.01(80), 0.505(20) 0.644(20), 0.603(20)	
			124	73	−94.067	3−	60.2 d			β^-.62(50), 2.31(22), 0.24(11), 1.60(5), . . .	2.916	0.603(97), 1.691(50), 0.722(14), 2.091(7), 0.644(7), . . .	6.5
			125	74	−94.75	$\frac{7}{2}$+	2.75 y	±2.6		β^-0.299(43), 0.126(28), 0.615(13), . . .	0.76	0.427(31), 0.60(24), 0.634(11), 0.463(10), 0.176(6), . . .	
			126m	...			19.1 m			β^-1.9		0.41, 0.67, . . .	
			126	75	−92.7		12.5 d			β^-1.9	3.7	0.29, 0.41, 0.58, 0.69, 0.85, 0.99, . . .	
			127	76	−93.07	($\frac{7}{2}$+)	92 h			β^-0.90(35), 1.12(24), 0.81(17), . . .	1.60	0.685(35), 0.473(22), 0.784(13), 0.253(9), 0.604(5), 0.543(3), . . .	
			128	...			9 h			β^-1		0.314, 0.53, 0.64, 0.75	
			128	77	−90.9		10 m			β^-2.6	4.3	0.75(200), 0.32(83), 1.07(4)	
			129	78	−90.81		4.3 h			β^-0.58(32), 1.55(22), 1.82(12), 1.06(9), . . .	2.4	0.916, 1.03, 0.683, 1.73, . . .	
			130	...			7 m			β^-		0.20, 0.82, 1.03, 1.16	
			130	79	−88.		36 m			β^-	~5	0.19, 0.33, 0.82, 0.94	
			131	80	−88.		23 m			β^-	~3	0.95(48), 0.64(37)	
			132	81	−85.		2.1 m			β^-	~6		
			133	82	−85.		4.2 m			β^-	~4		
			134	83			11 s			β^-, n			
			135	84			2 s			β^-			
52	Te	Tellurium	107	55	−64.		2.2 s			α3.28	~10		
			108	56	−70.	0+	5.3 s			α3.1, β^+, p2.6, 3.4, 3.7	~7		
			109	57	−72.		4.2 s			β^+, p	~9		
			110 or 111	58 or 59			19 s			β^+, p2.46, 2.67, 2.82			
			114	62	−88.		17 m			β^+	~3		
			115m	...			0.1 s					IT0.275	
			115	63	−88.5		6.0 m			β^+2.8, . . . , ϵ(20)	4.5	0.72(34), 1.28(32), 1.38(32), 1.08(24), 0.96(6), 1.58(6)	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-4}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
52	Te	Tellurium	116	64	−91.7	0+	2.50 h	.....	.....	ϵ, β^+0.44?	1.6	0.094(100)	
			117	...	.....	.....	1.9 h	.....	.....	β^+(1.7)			
			117m	..	.....	.....	0.1 s	.....	.....	.....	.....	IT0.03, 0.27	
			117	65	−91.40	$\frac{1}{2}$+	61 m	.....	.....	ϵ(70), β^+1.8(30)	3.50	0.72(65), 1.78(9), 0.93(6)	
			118	66	−94.	0+	6.0 d	.....	.....	ϵ(100)	~0.3		
			119m	...	.....	J_2^1−	4.7 d	.....	.....	ϵ(100)	.....	1.212(67), 0.153(62), 0.270(25), 1.137(7), 2.09(4), ...	
			119	67	−93.60	$\frac{1}{2}$+	15.9 h	±0.25	.....	ϵ(98), β^+0.627(2), 0.57(0.3)	2.294	0.644(85), 0.70(11), 1.75(4), ...	
			120	68	−95.98	0+	0.089%	.....	.....	.....	.....	.....	2, 3
			121m	...	.....	J_2^1−	154 d	.....	.....	ϵ(10)	.....	IT0.0818(90), 0.2122(90), 1.10(3)	
			121	69	−95.	$\frac{1}{2}$+	17 d	.....	.....	ϵ(100)	~1.	0.573(80), 0.508(18), ...	
			122	70	−96.944	0+	2.46%	.....	.....	.....	.....	.....	3.1
			123m	...	.....	J_2^1−	117 d	.....	.....	.....	.....	IT0.088(100), 0.159(100)	
			123	71	−95.718	$\frac{1}{2}$+	~1.2 × 10^{13} y	−0.7359	.....	ϵ(100)	0.06	.....	140
			124	72	−97.170	0+	0.87%	.....	.....	.....	.....	.....	
			125m	...	.....	J_2^1−	4.61%	.....	.....	.....	.....	.....	6 8
			125	73	−95.574	$\frac{1}{2}$+	58 d	.....	.....	.....	.....	IT0.1094(100), 0.0355(100)	
			126	74	−96.688	0+	6.99%	−0.8871	.....	.....	.....	.....	1 56
			127m	...	.....	(J_2^1−)	18.71%	.....	.....	.....	.....	.....	1.02
			127	75	−94.79	($\frac{5}{2}$+)	109 d	.....	.....	β^-(1)	.....	.....	
			128	76	−95.532	0+	9.3 h	.....	.....	β^-0.69(99.7), ...	0.69	IT0.0887(100) 0.417(0.3), ...	
			129m	...	.....	J_2^1−	31.79%	.....	.....	.....	.....	.....	0.22
			129	77	−93.40	$\frac{3}{2}$+	34 d	.....	.....	β^-1.60(30), 0.91(6), ...	.....	IT0.1056(04), 0.696(6), 0.730, ...	
			130	78	−93.768	0+	69 m	.....	.....	β^-1.45(89), 1.00(9), 0.37(1), ...	1.48	0.927(19), 0.460(15), 1.08(2), ...	
							34.48%	.....	.....	.....	.....	.....	0.22

			131*m*	...	.....	J_2^1-	30 h	.....	.....	β^-0.42(43), 0.57(31), 0.22(4), 2.46(4), . . .	.....	IT0.182(18), 0.78(60), 0.85(31), 1.127(13), 1.206(11), 0.336(9), . . .	
			131	79	−91.45	$\frac{3}{2}+$	25 m	.....	.....	β^-2.14(62), 1.68(26), 1.35(15), . . .	2.28	0.150(68), 0.453(16), 1.147(6), 0.493(5), 0.603(4), . . .	
			132	80	−91.46	0+	78 h	.....	.....	β^-0.22(100)	0.50	0.228(100), 0.050(16), 0.116(2), 0.112(2)	
			133*m*	...	.....	(J_2^1-)	54 m	.....	.....	β^-1.3, 2.4(87)	.....	IT0.334(13), 0.913(98), 0.647(33), 0.864(78), 0.915(18), . . .	
			133	81	−89.0	$(\frac{3}{2}+)$	12.5 m	.....	.....	β^-2.24(35), 2.65(26), 1.63(14), 1.24(9), 1.40(6), . . .	3.0	0.312(70), 0.407(31), 1.333(11), 0.720(8), 0.787(7), 0.931(5), . . .	
			134	82	−89.	0+	42 m	.....	.....	β^-	∼1.4	0.204(21), 0.262(19), 0.17(16), 0.08(13)	
			135	83	−83.	.....	29 s	.....	.....	β^-	∼6		
			136	84	.....	0+	∼33 s	.....	.....	β^-			
53	I	Iodine	115	62	−83.	.....	1.3 m	.....	.....	β^+	∼5.5		
			116	63	−81.	.....	<0.5 m	.....	.....	β^+	∼7	0.101	
			117	64	−86.8	.....	2.7 m	.....	.....	β^+, ϵ	4.3	0.274, 0.325, 0.599, . . .	
			118*m*	...	.....	.....	8 m	.....	.....	β^+4.9(57), 4.3(43)	.....	0.605(100), 0.600(44), 0.612(19), IT0.104	
			118	65	−88.	.....	13 m	.....	.....	β^+5.5(51), . . . , ϵ(46)	.....	0.605(100), 1.15(13), . . .	
										ϵ(46)		0.258, 0.644, . .	
			119	66	−90.2	.....	19.3 m	.....	.....	β^+2.22(57), 2.16(3), 1.84(2), ϵ(38)	3.2	0.26, 0.78	
			120*m*	...	.....	.....	50 m	.....	.....	ϵ(95), β^+3.8, 3.1	.....	0.56(100), 0.60(100), 0.61(31), . . .	
			120	67	−90.	.....	1.3 h	.....	.....	ϵ(54), β^+4.0, 2.1(46)	5.4	0.56, 1.53, 2.46, 2.57, 0.64, 0.60, . . .	
			121	68	−93.	$(\frac{5}{2}+)$	2.1 h	.....	.....	ϵ(91), β^+1.2(9)	2.36	0.212(90), 0.32(6), 0.27(3)	
			122	69	−92.49	1+	3.5 m	.....	.....	β^+3.12(90), 2.6(10), . . .	4.14	0.564(10), 0.69(1), 0.78(1)	
			123	70	−94.4	$\frac{5}{2}+$	13.3 h	.....	.....	ϵ(100)	1.2	0.159(97), 0.53(2), . . .	
			124	71	−93.78	2−	4.2 d	.....	.....	ϵ(75), β^+1.53(14), 2.14(11)	3.17	0.605(67), 0.73(14), 1.69(14), 0.644(12), 1.51(4), . . .	
			125	72	−95.415	$\frac{5}{2}+$	59.9 d	+3.0	−0.89	ϵ(100)	0.149	0.0355(7)	900
			126	73	−94.38	2−	13 d	.....	.....	ϵ(55), β^+1.13(1), 0.46(0.3)	2.159	3.667(33), 0.75(3), . . .	
										β^-0.865(30), 1.25(9), 0.385(5)	1.251	0.386(34), 0.49(4), . . .	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu × 10^{-3}	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
53	I	Iodine	127	...	−95.526	$\frac{5}{2}$+	100%	+2.808	−0.79	.....	.....	.....	6.2
			128	...	−94.19	1+	25.0 m	.....	.....	β^- 2.12(79), 1.67(13), 1.13(2)	2.12	0.44(14), 0.528(1.4), . . .	
			129	76	−95.013	$\frac{7}{2}$+	1.7×10^7 y	+2.617	−0.55	ε(6), β^+	1.27		
			130m	...	.....	.....	9.0 m			β^- 0.150(100)	0.190	0.040(9)	28
			130	77	−93.28	5(−)	12.3 h	.....	.....	β^- 2.5(13), 1.9(2)	.....	IT(85)	
			131	78	−93.873	$\frac{7}{2}$+	8.07 d	+2.74	−0.40	β^- 1.04(52), 0.62(48), 1.7(0.4)	2.99	0.669(100), 0.536(99), 0.743(87), 0.479(35), 1.15(12)	18
			132	79	−92.00	4+	2.3 h	±3.08	±0.08	β^- 0.606(90), 0.33(7), 0.25(2), . . .	0.970	0.364(82), 0.637(7), 0.284(5), 0.080(3), 0.723(2)	~0.7
			133	80	−92.17	$\frac{7}{2}$+	20.9 h	+2.84	−0.26	β^- 1.20(20), 2.16(18), 1.00(18), 0.80(15), 2.16(9), . . .	3.56	0.67(144), 0.773(89), 0.955(22), 0.52(20), 1.40(14), 1.14(6), . . .	
			134	81	−90.15	(4,5+)	52 m	.....	.....	β^- 1.37(85), 0.89(3), . . .	1.80	0.529(90), 0.875(8), 1.30, . . .	
			135	82	−89.94	$\frac{7}{2}$+	6.7 h	.....	.....	β^- 2.43(25), 1.2(23), 1.4(15), 2.2(12), . . .	4.2	0.85(95), 0.89(65), 0.61(18), 0.55(8), 0.41(8), 1.79(5), . . .	
			136	83	−85.3	(2−)	83 s	.....	.....	β^- 1.0, 0.5, 1.4	2.73	1.14(37), 1.28(34), 1.72(19), 1.46(12), 0.80(11), 1.80(11), . . .	
			137	84	−82.	.....	21 s	.....	.....	β^- 4.3(23), 5.6(15), 2.7(8), 7.0(5), . . .	7.0	1.32(95), 2.3(19), 0.39(19), 0.27(18), 0.20(12), 2.63(10), . . .	
			138	85	.....	.....	5.9 s	.....	.....	β^-, n0.5	~5		
			139	86	.....	.....	2 s	.....	.....	β^-, n			
			140	87	.....	.....	1.5 s	.....	.....	β^-			
54	Xe	Xenon	115	61	−75.	.....	19 s	.....	.....	ε	~7.5		
			116	62	−79.	0+	55 s	.....	.....	ε, β^+	~4.5	0.104	

			117	63	−80.	.....	1.1 m	.....	.....	ε, β^+	~4.0	0.117, 0.222, 0.295, . . .	
			118	64	−84.	0+	6 m	.....	.....	β^+	~3	0.05, . . .	
			119	65	−84.8	.....	6 m	.....	.....	β^+	5.0	0.10, . . .	
			120	66	−88.	0+	41 m	.....	.....	ε	~2	0.055, 0.073, 0.176, 0.76	
			121	67	−88.5	.....	39 m	.....	.....	β^+2.8	3.3		
			122	68	−91.	0+	20 h	.....	.....	ε(100)	~1	0.060, 0.090, 0.110, 0.158, 0.180, 0.345	
			123	69	−91.6	.....	2.1 h	.....	.....	ε, β^+1.51	2.7	0.149, 0.090, 0.110, 0.178, 0.329, 0.68, 1.10, . . .	
			124	70	−93.9	0+	**0.096%**	.....	.....	.....	.....	.....	100
			125*m*	...	.....	($\frac{1}{2}$−)	55 s	.....	.....	.....	.....	IT(?)0.075, 0.111	
			125	71	−93.5	($\frac{1}{2}$+)	17 h	.....	.....	ε(99), β^+(1)	1.7	0.188, 0.243, 0.355, 0.454, . . .	
			126	72	−95.71	0+	**0.090%**	.....	.....	β^+	.....	.....	3
			127*m*	...	.....	($\frac{11}{2}$−)	70 s	.....	.....	.....	.....	IT0.175, 0.125	
			127	73	−94.8	($\frac{5}{2}$+)	36.4 d	.....	.....	ε(100)	0.66	0.203(65), 0.172(22), 0.375(20), 0.115(4), . . .	
			128	74	−96.468	0+	**1.92%**	.....	.....	.....	.....	.....	<8
			129*m*	...	.....	$\frac{11}{2}$−	8.0 d	.....	.....	.....	.....	IT0.197, 0.040	
			129	75	−95.216	$\frac{1}{2}$+	**26.44%**	−0.7768	.....	.....	.....	.....	21
			130	76	−96.491	0+	**4.08%**	.....	.....	.....	.....	.....	<26
			131*m*	..	.....	$\frac{11}{2}$−	11.8 d	.....	.....	.....	.....	IT0.164, . . .	
			131	77	−94.915	$\frac{3}{2}$+	**21.18%**	+0.6908	−0.12	.....	.....	.....	90
			132	78	−95.843	0+	**26.89%**	.....	.....	.....	.....	.....	0.4
			133*m*	...	.....	($\frac{11}{2}$−)	2.26 d	.....	.....	.....	.....	IT0.232	
			133	79	−94.19	($\frac{3}{2}$+)	5.27 d	.....	.....	β^-0.346(99), . . .	0.428	0.0810(37), . . .	190
			134	80	−94.602	0+	**10.44%**	.....	.....	.....	.....	.....	0.25
			135*m*	...	.....	($\frac{11}{2}$−)	15.6m	.....	.....	.....	.....	IT0.527	
			135	81	−92.86	($\frac{3}{2}$+)	9.2 h	.....	.....	β^-0.91(97), 0.55(3), . . .	1.16	0.250(97), 0.603(3), . . .	2.64×10^6
			136	82	−92.779	0+	**8.87%**	.....	.....	.....	.....	.....	0.17
			137	83	−88.26	.....	3.9 m	.....	.....	β^-4.1(67), 3.6(33)	4.1	0.455(33)	
			138	84	−86.	0+	14 m	.....	.....	β^-2.4	2.8	0.26, 1.76, 2.02, 0.42, 0.16, 0.51	
			139	85	−81.6	.....	40 s	.....	.....	β^-4.6(31), 4.5(28), 4.8(20), . . .	4.8	0.219(77), 0.175(29), 0.297(24), 0.200(10), 0.394(8), . . .	
			140	86	−79.	0+	14 s	.....	.....	β^-4.7	.....	0.805, 1.413, 0.522, 1.315, 1.309, . . .	
			141	87	.....	.....	1.7 s	.....	.....	β^-			
			142	88	.....	.....	1.15 s	.....	.....	β^-	.....	1.325, 0.572, 0.557, 0.204, 0.645, 0.416, . . .	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu × 10⁻³	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
54	Xe	Xenon	143	89	.....	.....	0.96 s	.....	.....	β^-			
55	Cs	Cesium	144	90	.....	.....	8.8 s	.....	.....	β^-			
			119	64	.....	.....	33 s						
			120	65	.....	.....	61 s						
			121	66	.....	.....	2 m						
			122?	67	.....	.....	0.5 s						
			123	68	−87.	.....	5.6 m	.....	.....	.....	.....	0.1	
			125	70	−90.3	$\frac{1}{2}$	45 m	.....	.....	β^+2.6(50), 2.5(20), ε(30)	~4	0.098	
			126	71	−90.4	1+	1.6 m	+1.41	.....	ε(51), β^+2.05(49)	3.07	0.112	
			127	72	−92.5	$\frac{1}{2}$+	6.2 h	.....	.....	β^+3.8(54), . . . , ε(15)	4.8	0.385(38)	
			128	73	−92.27	1+	3.8 m	+1.46	.....	ε(97), β^+1.07(1), 0.677(1), . . .	2.1	0.406(72), 0.125(10), 0.462, . . .	
			129	74	−94.	$\frac{1}{2}$+	32.4 h	.....	.....	β^+2.9(37), 2.5(14), 1.9(4), ε(45)	3.91	0.441(27), 0.97(1), 1.12(1), 0.528, 0.576	
			130	75	−93.24	1+	29.1 m	(+)1.479	.....	ε(100)	~1.1	0.371(48), 0.410(30), 0.550(5), 0.320(4), 0.280(3), 0.040(2)	
			131	76	−94.53	$\frac{5}{2}$+	9.70 d	+1.37 or −1.45	.....	ε(53), β^+1.97(46), . . . β^-0.442(2)	2.99	0.536(5), 0.586(1), 0.894(1), . . .	
			132	77	−93.59	2(−)	6.5 d	+3.54	−0.57	ε(100)	0.442		
								+2.22	+0.46	ε(97), β^+0.40(0.6)	0.35		
			133	78	−94.56	$\frac{7}{2}$+	100%				2.10	0.668(99), 1.32(0.6), 1.14(0.5), 0.48(4)	
			134m	...	.....	8−	2.90 h	+2.578	−0.003	β^-(2)			
			134	79	−93.30	4+	2.05 y	+1.096		.....	1.3	.....	29.0
								+2.990	+0.36	β^-0.658(71), 0.089(27), 0.415(2)	2.06	IT0.128, . . . 0.605(98), 0.796(88), 0.569(16), 1.365(3), 1.168(2), 1.038(1), . . .	134
			135m	...	.....	($\frac{11}{2}$−)	53 m					IT0.840(100), 0.78(100)	
			135	80	−94.10	$\frac{7}{2}$+	3×10^6 y	+2.729	+0.044	β^-0.21(100)	0.210	.....	8.7
			136	81	−92.71	5	13 d	+3.70	.....	β^-0.34(91), 0.68(7), 0.56(2)	2.54	0.818(100), 1.05(82), 0.340(53), 0.16(36), 1.25(20), 0.273(18), . . .	
			137	82	−92.93	$\frac{7}{2}$+	30.0 y	+2.838	+0.045	β^-0.514(93), 1.176(7)	1.176	0.662(93)	0.11

			138	82	- 89.	3	32.2 m	±0.5	.....	β^-3.40, 2.68, . . .	5.4	1.426(73), 1.01(25), 0.463(23), 2.21(18), 2.63(9), 0.55(8)	
			139	83	−86.7	.....	9.1 m	.....	.....	β^-4.0(90), 2.3, . . .	4.0	1.28, 0.63, 1.65, 0.05, 0.80, . . .	
			140	84	−83.2	.....	65 s	.....	.....	β^-5.1, 2.3	5.7	0.60, 0.91, 1.13, 1.63, 1.83, 2.10, 2.33, 2.72, 3.15, . . .	
			141	85	−80.	.....	24 s	.....	.....	β^-	~5		
			142	87	−76.	.....	2.3 s	.....	.....	β^-7.6, n	~7		
			143	88	.....	.....	1.6 s	.....	.....	β^-			
			144	89	.....	.....	1.06 s	.....	.....	β^-			
56	Ba	Barium	123	67	.....	.....	2 m	.....	.....	β^+, e			
			124	68	.....	.....	2.5 m						
			125m	...	.....	.....	8 m	.....	.....	β^+			
			125	69	−86.	.....	3 m	.....	.....	β^+3.4	4.5	0.076, 0.083, 0.141, 0.056, . . .	
			126	70	−88.	0+	97 m	.....	.....	ε(100)	~1.8	0.23(100), 0.70(33), . . .	
			127m	...	.....	.....	10 m	.....	.....	β^+			
			127	71	−89.	.....	18 m	.....	.....	β^+3.14	4.3	0.11, 0.07, 0.18, 0.20, 0.09	
			128	72	−92.	0+	2.4 d	.....	.....	ε(100)	~0.7	0.134, 0.278, . . .	
			129m	...	.....	.....	2.1 h	.....	.....	ε	.....	0.182, . . .	
			129	73	−91.	.....	2.5 h	.....	.....	β^+1.43, 1.24, 1.0, . . .	2.45	0.21, 0.22, . . .	
			130	74	−93.72	0+	**0.101%**	.....	.....	.....	.....	.....	11
			131m	...	.....	.....	15 m	.....	.....	.....	.....	IT0.078, 0.11, . . .	
			131	75	−93.10	$(\frac{1}{2}+)$	12 d	.....	.....	ε(100)	1.34	0.496(48), 0.124(28), 0.216(19), 0.373(13), 0.25(5), 0.60(3), . . .	
			132	76	−94.95	0+	**0.097%**	.....	.....	.....	.....	.....	8.5
			133m	...	.....	$\frac{11}{2}-$	38.9 h	.....	.....	.....	.....	IT0.276(100), 0.0123	
			133	77	−94.01	$\frac{1}{2}+$	7.8 y	.....	.....	ε(100)	0.515	0.356(52), 0.080(31), 0.303(15), 0.384(7), 0.276(6), . . .	
			134	78	−95.51	0+	**2.42%**	.....	.....	.....	.....	.....	2
			135m	...	.....	$\frac{11}{2}-$	28.7 h	.....	.....	.....	.....	IT0.268(100)	
			135	79	−94.33	$\frac{3}{2}+$	**6.59%**	+0.8365	+0.18	.....	.....	.....	5.8
			136m	...	.....	7−	0.32 s	.....	.....	.....	.....	IT0.164, 1.05, 0.82	
			136	80	−95.44	0+	**7.81%**	.....	.....	.....	.....	.....	0.4
			137m	...	.....	$\frac{11}{2}-$	2.558 m	.....	.....	.....	.....	IT0.6616(100)	
			137	81	−94.18	$\frac{3}{2}+$	**11.32%**	+0.9357	+0.28	.....	.....	.....	5.1

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
56	Ba	Barium	138	82	−94.76	0+	71.66%						0.35
			139	83	−91.17	$(\frac{7}{2}-)$	82.9 m						4
			140	84	−89.36	0+	12.8 d			β^-2.3(72), 2.2(23), . . .	2.3	0.166(23), 1.43(0.5), . . .	1.6
										β^-1.02(52), 0.47(34), 0.59(11), . . .	1.05	0.537(34), 0.030(11), 0.163(6), 0.305(6), 0.438(5), . . .	
			141	85	−85.8	.....	18 m			β^-3.0, 2.8, 2.6, 2.4, 2.0, . . .	3.0	0.191, 0.305, 0.277, 0.460, 0.344, 0.648, . . .	
			142	86	−83.5	0+	11 m			β^-1.0, 1.7	2.2	0.255, 1.180, 0.227, 0.060, 0.905, 0.425, . . .	
			143	87	−79.	.....	12 s						
			144	88	−77.	.....	11.4 s			β^-	~4		
57	La	Lanthanum	124	67	.....	.....	7 m			β^-	~3		
			125	68	.....	.....	<1 m						
			126	69	.....	.....	1.0 m						
			127	70	−83.	.....	3.5 m			β^+, ϵ	.....	0.26	
			128m	...	.....	.....	0.6 s			β^+, ϵ	~5		
			128	71	−84.	.....	4.7 m			.....	.....	0.75, 0.115	
			129	72	−87.	.....	10 m			β^+4.2, ϵ	~7	0.283, 0.479, 0.614, 0.602, . . .	
			130	73	−88.	.....	8.7 m			β^+, ϵ	~4		
										β^+, ϵ	~6	0.36, 0.45, 0.55, 0.72, 0.81, 0.91, 1.01, 1.19, 1.45, . . .	
			131	74	−89.9	$(\frac{1}{2}+)$	59 m			ϵ(72), β^+1.41(7), 1.57(6), 1.94(4), 1.83(3), . . .	2.96	0.108(44), 0.417(19), 0.365(18), 0.285(15), 0.453(7), . . .	
			132	75	−89.9	2−	4.5 h			ϵ(64), β^+3.20(13), 2.62(13), 3.66(10), 2.5(1)	4.7	0.464(74), 0.567(15), 0.663(9), 1.031(8), 0.540(7), 0.515(5), . . .	
			133	76	−92.	.....	4.0 h			ϵ, β^+~1.2	~2	0.29, 0.62, 0.86, 1.08, . . .	

			134	77	−91.52	1+	6.7 m	.....	.....	β^+2.67(62), 2.07(2), ϵ(36)	3.7	0.605(6), . . .	
			135	78	−93.2	$(\frac{5}{2}+)$	19.5 h	.....	.....	ϵ(100)	1.0	0.481(2), 0.87(0.2), 0.59(0.1)	
			136	79	−92.4	1+	9.9 m	.....	.....	ϵ(61), β^+1.85(39), . . .	2.9	0.82(2.5), . . .	
			137	80	−94.	$\frac{7}{2}+$	6×10^{1} y	.....	.....	ϵ(100)	~0.5		
			138	81	−92.84	5−	1.05×10^{11} y	+3.707	±0.8	ϵ(70)	1.78	1.426(70)	
							0.089%	.....	.....	β^-0.21(30)	1.01	0.80(30)	
			139	82	−93.60	$\frac{7}{2}+$	99.911%	+2.778	+0.22	.....	.....	.....	8.8
			140	83	−90.47	3−	40.22 h	.....	.....	β^-1.34(35), 1.24(19), 1.67(17), 2.17(8), . . .	3.767	1.596(96), 0.487(40), 0.329(20), 0.815(19), 0.923(10), 2.53(3), . . .	2.8
			141	84	−89.07	.....	3.9 h	.....	.....	β^-2.43(98), 0.9(2)	2.43	1.37(2)	
			142	85	−85.85	2−	92 m	.....	.....	β^-2.11(23), 1.98(19), 4.517(13), 1.79(11), 0.87(11), . . .	4.517	0.645(48), 2.41(15), 2.55(11), 0.898(9), 1.91(8), 2.99(5), . . .	
			143	86	−84.0	$(\frac{7}{2}+)$	14 m	.....	.....	β^-3.30(75), . . .	3.30	0.625, 1.17, 1.98, 1.58, 2.56, 1.07	
			144	87	−80.		41 s	.....	.....	β^-	~5.5		
58	Ce	Cerium	129	71	.....	.....	~13 m	.....	.....	β^+, ϵ	.....	0.080, 0.32, 0.75	
			130	72	.....	0+	30 m	.....	.....	ϵ, β^+	.....	0.13	
			131m	...	.....	.....	5 m	.....	.....	.....	.....	IT0.231	
			131	73	−85.	.....	10 m	.....	.....	ϵ(89), β^+~2.8	~5	0.170(20), 1.44(9), 0.396(9), 0.119(6), . . .	
			132	74	−88.	0+	4.2 h	.....	.....	ϵ	~1.4	0.182(82), 0.155(12), . . .	
			133m				97 m					IT0.097, 0.077, 0.088, . . .	
			133	75	−89.	.....	5.4 h	.....	.....	ϵ(90), β^+1.3(10)	~3.3	0.477, 0.131, 0.510, 0.278, 0.784, 0.618, . . .	
			134	76	−91.	0+	72 h	.....	.....	ϵ(100)	~0.5		
			135	77	−91.	.....	17.2 h	.....	.....	ϵ(99), β^+0.8(1)	~2.3	0.265(100), 0.606(98), 0.300(56), 0.517(46), 0.783(22), 0.828(22), . . .	
			136	78	−92.82	0+	0.193%	.....	.....	.....	.....	.....	7.3
			137m	...	.....	$\frac{11}{2}-$	34.4 h	.....	.....	ϵ(0.6)	.....	IT0.255(99.4), 0.825(0.5), . . .	
			137	79	−92.	$\frac{3}{2}+$	9.0 h	.....	.....	ϵ(100)	1.2	0.446(2), . . .	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu × 10⁻³	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
58	Ce	Cerium	138	80	−93.97	0+	0.250%	.....	.....	.....	.....	.....	1.1
			139m	...	.....	($\frac{9}{2}$−)	56 s	.....	.....	.....	.....	IT0.746(100)	
			139	81	−93.30	$\frac{3}{2}$+	140 d	.....	.....	ε(100)	0.27	0.1658(100)	
			140	82	−94.52	0+	88.48%	.....	.....	.....	.....	.....	0.58
			141	83	−91.68	$\frac{7}{2}$−	32.4 d	±0.9	.....	β⁻0.437(70), 0.581(30)	0.581	0.1454(70)	29
			142	84	−90.70	0+	11.07%	.....	.....	.....	.....	.....	0.95
			143	85	−87.59	$\frac{3}{2}$−	33.7 h	.....	.....	β⁻1.093(53), 1.387(29), 0.71(16), 0.50(2), 28(1)	1.445	0.293(49), 0.057(11), 0.722(7), 0.664(7), 0.491(2), . . .	6.0
			144	86	−86.31	0+	284 d	.....	.....	β⁻0.32(76), 0.18(19), 0.24(4), . . .	0.32	0.134(17), 0.080(6), 0.041(1), 0.059(1), 0.034(1), . . .	1.0
			145	87	−82.8	.....	3.0 m	.....	.....	β⁻1.7(70), 2.1(4), . . .	2.5	0.725(69), 0.063(19), 0.285(10), 0.435(6), . . .	
			146	88	−81.3	0+	14.2 m	.....	.....	β⁻0.75(95), . . .	1.08	0.317(53), 0.1335(16), 0.264(11), 0.1415(7), 0.210(6), 0.100(3), . . .	
			147	89	−78.	.....	70 s	.....	.....	β⁻	~3		
59	Pr	Praseodymium	148	90	−76.	0+	43 s	.....	.....	β⁻	~2		
			134	75	−84.	.....	17 m	.....	.....	β⁺	~6		
			135	76	−87.	.....	22 m	.....	.....	β⁺2.5	3.6	0.22, 0.30, 0.41, 0.64, 0.96	
			136	77	−87.	.....	1.1 h	.....	.....	ε(67), β⁺2.0(33)	~5	0.080, 0.22, 0.30	
			137	78	−89.	.....	1.3 h	.....	.....	ε(73), β⁺1.7(27), . . .	2.7	0.17, . . .	
			138m	...	.....	(6,7,8−)	2.1 h	.....	.....	ε(77), β⁺1.65(21), . . .	.....	0.837(8), 0.434(5), 0.161(4), 1.087(2), . . .	
			138	79	−89.21	(1+)	1.5 m	.....	.....	β⁺3.43(73), ε(27)	4.44	1.64(100), 0.79(100), 0.298(77), 0.40(9)	
			139	80	−91.03	($\frac{5}{2}$+)	4.5 h	.....	.....	ε(91), β⁺1.09(9)	2.11	0.79, 0.69, . . .	
			140	81	−90.88	(1+)	3.39 m	.....	.....	β⁺2.32(50), ε(50)	3.34	1.35(0.5), . . .	
			141	82	−92.30	$\frac{5}{2}$+	100%	+4.3	−0.07	.....	.....	1.596(0.3), . . .	11.5

			142	83	−89.91	2−	19.2 h	±0.25	±0.03	β⁻2.16(96), 0.59(4), ε(0.01)	2.16	1.57(4)	18
			143	84	−89.14	$\frac{7}{2}$+	13.6 d	.....	.....	β⁻0.931	0.931	.....	89
			144	*85	−86.65	0−	17.3 m	.....	.....	β⁻2.996(98), 2.296(1), 0.806(1) . . .	2.996	0.696(1),2.186(0.7), . . .	
			145	86	−85.45	($\frac{7}{2}$+)	5.98 h	.....	.....	β⁻1.805(98), . . .	1.805	0.674(0.5), 0.749(0.4), . . .	
			146	87	−82.5	(3)−	24.2 m	.....	.....	β⁻1.1(40), 2.1(29), 3.6(11), . . .	4.08	0.454(49), 1.526(18), 0.736(8), 0.790(8), 1.378(6), . . .	
			147	88	−81.0	.....	12 m	.....	.....	β⁻2.10(45), 1.45(35), . . .	2.7	0.565(29), 0.645(16), 1.26(11), 0.61, 1.18, 0.078, . . .	
			148	89	−78.	.....	2.0 n	.....	.....	β⁻4.2	~5	0.31	
			149	90	−76.6	.....	2.3 n	.....	.....	β⁻3.0	3.0	0.11, 0.14, 0.17, 0.30, 0.74	
60	Nd	Neodymium	135	75	.....	.....	12 m	.....	.....	β⁺	.....	0.21, 0.44	
			136	76	.....	0+	55 m	.....	.....	β⁺1.32, 2.97, 6	.....	0.109, 0.453, 0.540, 0.576	
			138	78	−88.	0+	5.2 h	.....	.....	ε, β⁺1.0			
			139m	...	.....	.....	5 h	.....	.....	ε, β⁺3.1	.....	0.73, 0.114, 0.983, 0.327, 1.03, 0.90, . . . , IT0.23	
			139	79	−88.	.....	30 m	.....	.....	β⁺, ε	.....	0.41	
			140	80	−90.1	0+	3.3 d	.....	.....	ε(100)	0.47		
			141m	...	.....	.....	63 s	.....	.....	.....	.....	IT0.755(100)	
			141	81	−90.36	$\frac{5}{2}$+	2.5 h	.....	.....	ε(97), β⁺0.79(3)	1.80	1.14(2), 1.30(1), . . .	
			142	82	−92.23	0+	27.11%	.....	.....	.....	.....	.....	18.8
			143	83	−90.14	$\frac{7}{2}$−	12.17%	−1.08	−0.48	.....	.....	.....	32.0
			144	84	−89.87	0+	2.1 × 10¹⁵ y 23.85%	.....	.....	α1.83	.....	.....	4.0
			145	85	−87.39	$\frac{7}{2}$−	8.30%	−0.66	−0.25	.....	.....	.....	48
			146	86	−86.85	0+	17.22%	.....	.....	.....	.....	.....	1.4
			147	87	−83.87	$\frac{5}{2}$−	11.06 d	±0.59	.....	β⁻0.807(81), 0.365(16), 0.21(2), 0.408(1), . . .	0.898	0.0911(27), 0.531(13), 0.440(1), 0.275(1), . . .	
			148	88	−83.07	0+	5.73%	.....	.....	.....	.....	.....	2.5
			149	89	−79.85	$\frac{5}{2}$−	1.72 h	.....	.....	β⁻1.42(38), 1.02(30), 1.13(26), 1.55(6), . . .	1.67	0.210(27), 0.27(26), 0.114(18), 0.541(10), 0.424(9), 0.654(9), . . .	
			150	90	−79.09	0+	5.62%	.....	.....	.....	.....	.....	1, 3
			151	91	−76.11	.....	12 m	.....	.....	β⁻2.1, 1.8, 1.6, 1.2	2.46	0.118(40), 0.174(10), 1.180(9), 0.138(6), 0.086(5) 0.737(5), . . .	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
61	Pm	Promethium	139	78	−83	.....	~6 m				~4.5		
			140	79	−84.0	.....	5.8 m			ϵ(65), β^+	~6	0.42, 0.77, 1.03	
			141	80	−86.4	.....	23 m	.....	.....	β^+2.6(57), ϵ(43)	3.7	0.195(13), 1.22, 0.89, 1.58, 0.63, . . .	
			142	81	−87.2	1+	36 s	.....	.....	β^+3.80(81), . . . , ϵ(19)	4.82	1.572(0.2)	
			143	82	−89.00	$(\frac{5}{2}+)$	265 d	.....	.....	ϵ(100)	1.07	0.742(46)	
			144	83	−87.3	(5,6−)	363 d	.....	.....	ϵ(100)	2.37	0.618(100), 0.696(100), 0.476(43), . . .	
			145	84	−87.21	$(\frac{5}{2}+)$	17.7 y	.....	.....	ϵ(100)	0.170	0.072(11), 0.067(8)	
			146	85	−85.26	.....	5.5 y	.....	.....	ϵ(65)	1.477	0.454(65), 0.736(21)	84.00
			147	86	−84.83	$\frac{7}{2}+$	2.6231 y	+2.7	+0.7	β^-0.790(32), . . .	1.537	0.747(34), 0.633(2), . . .	
			148*m*	...	.....	(6)−	43 d	.....	.....	β^-0.2247(100)	0.2247	.....	187
										β^-0.397(51), 0.683(23), 0.495(17), 1.0(5)	.....	0.550(92), 0.630(88), 0.915(20), 0.414(18), . . . , ITD.062(6), 0.076(6)	25,000
			148	87	−82.50	1−	5.4 d	+2.0	+0.2	β^-2.465(50), 1.020(37), 1.922(13)	2.465	0.550(28), 1.465(22), 0.912(15)	2,000
			149	88	−81.63	$\frac{7}{2}+$	53.1 h	.....	.....	β^-1.071(97), 0.785(3), . . .	1.071	0.286(3), 0.85(0.2), . . .	1,350
			150	89	−78.9	(1)	2.7 h	.....	.....	β^-2.3(29), 1.8(22), 1.4(22), 3.1(12), . . .	3.4	0.334(71), 1.165(23), 1.33(22), 0.831(18), 0.88(12), 0.71(8), . . .	
			151	90	−78.76	$\frac{5}{2}+$	28 h	±1.6	±1.9	β^-0.85(41), 1.19(10), 1.13(8), 1.02(7), 0.74(7), . . .	1.19	0.340(21), 0.17(18), 0.10(7), 0.275(6), 0.72(6), 0.07(5), . . .	<700
			152	91	−76.6	.....	6 m	.....	.....	β^-2.2	~3.4	0.122, 0.245	
			153	92	−76.0	.....	5.5 m	.....	.....	β^-1.65	1.8	0.09, 0.12, 0.18	
			154	93	−73.	.....	2.5 m	.....	.....	β^-2.5	~4		

62	Sm	Samarium	140	78	.....	.....	14 m	.....	.....	β^+			
			141	79	−82.	.....	23 m	.....	.....	ϵ, β^+	~4.4	0.195, 0.436, 0.780, 0.92, 1.48, . . .	
			142	80	−84.9	0+	72.5 m	.....	.....	ϵ(94), β^+1.03(6)	2.05		
			143*m*	...	.....	($\frac{3}{2}^+$−)	65 s	.....	.....	.....	.....	1T0.750(100)	
			143	81	−85.26	($\frac{3}{2}$+)	8.83 m	.....	.....	β^+2.47(50), ϵ(50)	3.49	1.055(3), 1.31(1), 1.17(1), . . .	
			144	82	−87.93	0+	**3.09%**	.....	.....	.....	.....	.....	~0.7
			145	83	−86.52	($\frac{7}{2}$)−	340 d	.....	.....	ϵ(100)	0.638	0.0614(13), . . .	~110
			146	84	−86.90	0+	1.00×10^8 y	.....	.....	α2.50			
			147	85	−85.08	$\frac{7}{2}$−	1.07×10^{11} y	−0.813	−0.20	α2.232	.....	.....	75
							14.97%						
			148	86	−85.15	0+	**11.24%**	.....	.....	.....	.....	.....	4.73
			149	87	−82.79	$\frac{7}{2}$−	**13.83%**	−0.670	+0.058	.....	.....	.....	40,000
			150	88	−82.70	0+	**7.44%**	.....	.....	.....	.....	.....	102
			151	89	−80.04	($\frac{5}{2}$,$\frac{7}{2}$−)	90 y	.....	.....	β^-0.076(98)	0.076	0.0217(2)	15,000
			152	90	−80.24	0+	**26.72%**	.....	.....	.....	.....	.....	210
			153	91	−77.88	$\frac{3}{2}$+	47 h	−0.022	+1.2	β^-0.70(48), 0.63(32), 0.80(20), . . .	0.801	0.103(28), 0.070(5), . . .	
			154	92	−77.78	0+	**22.71%**	.....	.....	.....	.....	.....	5.5
			155	93	−75.35	$\frac{3}{2}$(−)	23 m	.....	±0.9	β^-1.54(92), 1.4(6), . . .	1.65	0.104(93), 0.246(5), . . .	
			156	94	−74.46	0+	9.4 h	.....	.....	β^-0.72(51), 0.43(44), . . .	0.72	0.088(30), 0.204(20), 0.166(10), 0.25(5), 0.291(3)	
			157	95	.....	.....	0.5 m	.....	.....	β^-	.....	0.57	
63	Eu	Europium	142	79	.....	(1+)	1.2 m	.....	.....	β^+, ϵ	.....	1.03(1), 0.77(1)	
			143	80	−79.9	($\frac{5}{2}$+)	2.6 m	.....	.....	β^+4.0(100)	5.0		
			144	81	−81.13	1+	10.5 s	.....	.....	β^+5.2, . . .	6.33	1.659, 0.820, 2.481	
			145	82	−83.61	($\frac{5}{2}$+)	5.8 d	.....	.....	ϵ(96), β^+1.72(1.5), 0.79(5)	2.72	0.894(67), 0.654(15), 1.658(14), 1.997(7), 0.543(5), . . .	
			146	83	−82.74	(4−)	4.6 d	.....	.....	ϵ(96), β^+1.467(3.5), 0.80(0.5), 2.108(0.2)	3.872	0.747(100), 0.633(40), 0.634(37), 0.704(9), 0.666(7), 1.53(6), . . .	
			147	84	−83.18	($\frac{5}{2}$+)	22 d	.....	.....	ϵ(99), β^+0.747(0.6), 0.622(0.4), 0.548(0.3), α2.90(0.002)	1.767	0.1212(46), 0.1974(32), 0.678(12), 0.602(8), 0.799(7), . . .	
			148	85	−81.81	(5−)	54 d	.....	.....	ϵ(100)	3.10	0.550(100), 0.630(72), 0.611(20), 0.553(17), 0.726(12), 0.414(8), . . .	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
63	Eu	Europium	149	86	−82.	$(\frac{5}{2}+)$	106 d	.....	.....	ϵ(100)	~0.8	0.328(4), 0.277(3), . . .	
			150m	...	.....	(4,5−)	6.2 y	.....	.....	ϵ(100)	.....	0.334(96), 0.439(86), 0.584(60), 0.74(21), 1.049(9), 1.248(5), . . .	
			150	87	−80.21	(0,1−)	12.6 h	.....	.....	β^-1.01(90)	1.010	0.334(4), 0.406(3), . . .	
			151	88	−80.12	$\frac{5}{2}$(+)	47.82%	+3.464	+1.1	ϵ(9), β^+1.24(0.5)	2.25	.....	
			152m_2	...	.....	8−	96 m	.....	.....	.....	.....	.....	8,000
			152m_1	...	.....	(0−)	9.3 h	.....	.....	.....	.....	IT0.0397, 0.0183, 0.0895	
			152	89	−78.22	3−	12 y	±1.024	±3.0	β^-1.87(73), 1.55(2), 0.56(2), ϵ(23), β^+0.89(0.007), . . . ϵ(72), β^+0.71(0.01), . . .	1.88	0.842(13), 0.963(12), 0.122(8), 0.344(3), 1.32(1), 1.39(1) 0.122(37), 1.408(22), 0.965(15), 1.113(14)	
			153	90	−78.74	$\frac{5}{2}$+	52.18%	+1.530	+2.8	β^-0.69(15), 1.48(9), 0.36(2), . . .	1.82	0.344(27), 0.779(14), . . .	
			154	91	−76.99	3−	16 y	±2.000	.....	.....	.....	.....	450
			155	92	−77.10	$(\frac{5}{2}-)$	1.81 y	.....	.....	β^-0.592(38), 0.270(26), 0.861(18), 1.866(11), . . .	1.978	0.123(38), 1.274(37), 1.004(31), 0.723(21), 0.873(12), 0.248(7), . . .	1,500
			156	93	−75.22	0+	15 d	.....	.....	β^-0.16(40), 0.143(34), 0.248(16), 0.188(10)	0.248	0.0865(10), 0.1053(34), 0.060(10), . . .	14,000
			157	94	−74.57	.....	15.2 h	.....	.....	β^-0.48(33), 2.45(31) 0.30(17), . . .	2.45	1.24(16), 1.15(14), 0.812(9), 0.089(8), 1.97(7), 0.723(6), . . .	
			158	95	−72.2	.....	46 m	.....	.....	β^-0.86(30), 1.28(30), 0.90(15), 0.66(15), 1.34(10), . . .	1.36	0.413(23), 0.064(19), 0.37(14), 0.623(6), 0.477(3), 0.055(3), . . .	
										β^-2.5(44), 1.6(36), 1.2(15), 3.4(5), . . .	3.4	0.080(60), 0.95(55), 0.90(20), 0.98(12), 1.19(10), 1.35(7), . . .	

			159	96	−70.77	.....	18 m	.....	.....	β^-2.57(25), 2.35(21), 1.90(21), 1.75(11), 1.50(11), 1.0(10)	2.63	0.07(42), 0.67(21), 0.09(18), 0.15(14), 0.73(10), . . .	
			160	97	−68.	.....	∼2.5 m	.....	.....	β^-3.6(100)	∼4		
64	Gd	Gadolinium	144	80	−77.	0+	4.5 n	.....	.....	β^+	∼4		
			145	81	−78.	.....	23 m	.....	.....	β^+2.5(66), ϵ(34)	5.3	1.76, 1.882, 0.95, 1.04, 0.809, 0.330	
			146	82	−81.	0+	50 d	.....	.....	ϵ(100)	∼1	0.1148(100), 0.1156(100), 0.1547(62)	
			147	83	−80.68	$(\frac{7}{2}-)$	38 h	.....	.....	ϵ(99.8), β^+0.97(0.2), . . .	2 33	0.2292(77), 0.3961(37), 0.370(16), 0.766(10), 1.068(9), 0.894(8), . . .	
			148	84	−81.81	0+	93 y	.....	.....	α3.18	0.01		
			149	85	−80.61	$(\frac{7}{2}-)$	9.3 d	.....	.....	ϵ(99+)		0.150(48), 0.299(26),	
										α3.01(0.0005)	∼1.4	0.347(25), 0.750(11), 0.790(10), 0.94(5), . . .	
			150	86	−81.30	0+	1.8×10^6 y	.....	.....	α2.80			
			151	87	−79.62	$(\frac{7}{2}-)$	120 d	.....	.....	ϵ(100)	.....	0.154(7), 0.244(7),	
										α2.60	0.46	0.175(3), 0.0216(3), 0.308(1)	
			152	88	−80.18	0+	1.1×10^{14} y 0.20%	.....	.....	α2.24	.....	.....	<125
			153	89	−78.52	$\frac{3}{2}+$	242 d	.....	.....	ϵ(100)	0.241	0.099(55), 0.070, . . .	
			154	90	−79.11	0+	2.15%	.....	.....	....	.....	.....	102
			155	91	−77.36	$\frac{3}{2}-$	14.73%	−0.254	+1.3	....	.....	.....	61,000
			156	92	−77.86	0+	20.47%	.....	.....	....	.....	.....	8
			157	93	−77.03	$\frac{3}{2}-$	15.68%	−0.39	+1.5	....	.....	.....	254,000
			158	94	−75.88	0+	24.87%	.....	.....	....	.....	.....	3.5
			159	95	−73.59	$\frac{3}{2}-$	18.0 h	.....	.....	β^-0.95(63), 0.89(24), 0.59(13), . . .	0.95	0.058, 0.363, . . .	
			160	96	−72.93	0+	21.90%	.....	.....	....	.....	.....	0.77
			161	97	−70.31	$(\frac{5}{2})-$	3.6 n	.....	.....	β^-1.56(87), 1.39(5), 1.66(4), 1.50(3), . . .	1.95	0.361(63), 0.315(24), 0.102(18), 0.077(10), 0.284(6), . . .	96,000
			162	98	−69.0	.....	10.4 m	.....	.....	β^-	1.4	0.410, 0.428	
65	Tb	Terbium	147m	...	.....	.....	2.5 n	.....	.....	ϵ(47), β^+(3)	.....	IT(50), 0.799, 0.164	
			147	82	−76.	.....	1.6 h	.....	.....	ϵ(95), β^+(5)	∼5	0.694(32), 0.139(24), 0.119(5)	
			148	83	−75.8	.....	70 m	.....	.....	β^+4.6, . . .	5.6	1.12, 0.78	
			149m	...	.....	.....	4.3 n	.....	.....	ϵ, β^+ α3.99(0.025)	.....	IT	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
65	Tb	Terbium	149	84	−76.62	.....	4.1 h	.....	.....	ϵ(77)	3.70	0.166, 0.352, 0.388, 0.187, ...	
			150	85	−76.28	.....	3 1 h	.....	.....	α3.95(23)			
			151	86	−76.82	.....	18 h	.....	.....	ϵ, β^+3.6(50), α3.49	4.67	0.64(100), 0.93(35), ...	
								.....	.....	ϵ(99+), α3.42(0.0005)	2.61	0.108(35), 0.252(35), 0.288(32), 0.18(18), 0.40, 0.60, ...	
			152*m*	...	.....	.....	4.0 m	.....	.....		.....	0.14, 0.23, ...	
			152	87	−76.08	.....	18 h	.....	.....	ϵ, β+, α(0.002)	3.82	0.344, 0.432, 0.587, 0.271, 1.048, ...	
								.....	.....	ϵ(88), β^-2.80(4), 1.87(2), 2.46(1), ..., $\alpha\sim3$			
			153	88	−77.	($\frac{5}{2}$−)	55 h	.....	.....	ϵ(100)	∼1.8	0.212(30), 0.11(12), 0.083(11), 0.17(9), 0.25, 0.33, 0.88, ...	
			154*m*	...	.....	.....	8.5 h	.....	.....	ϵ	.....	0.123, 0.248, 0.53, 0.65, ...	
			154	89	−75.	.....	21 h	.....	.....	ϵ	∼3.4	0.123, 0.248, 0.30, 0.35, 0.53, 2.5, ...	
			155	90	−76.46	.....	5.0 d	.....	.....	ϵ	0.85	0.087(37), 0.105(25), 0.180(8), 0.163(8), 0.262(7), 0.368(4)	
			156*m*	..	.....	(0+)	5.5 h	.....	.....	ϵ, $\beta^-\sim0.14$	.....	IT0.088	
			156	91	−75.	(3−)	5.4 d	.....	.....	ϵ(100)	2.3	0.535(70), 0.199(40), 1.22(29), 0.089(7), 1.16(17), 1.42(15), ...	
			157	92	−75.96	($\frac{3}{2}$+)	150 y	.....	.....	ϵ(100)	0.064	0.054(0.2)	
			158*m*	...	.....	(2−)	11 s	.....	.....	.....	.....	IT0.11(100)	
			158	93	−74.54	3(−)	1.2×10^9 y	±1.74	+2.7	ϵ(87)	1.20	0.95(69), 0.099(14), 0.080(12), 0.182(10), 0.782(10), ...	
										β^-0.86(12), ...	0.94		

			159	94	−74.61	$\frac{3}{2}+$	**100%**	±1.99	+1.3	.....	.....	.....	3.0
			160	95	−72.80	3−	72 1d	±1.68	+3.0	β^-0.56(44), 0.86(29), 0.46(10), . . .	1.83	0.879(30), 0.299(27), 0.966(25), 1.178(15), 0.087(13), 1.27(7), . . .	525
			161	96	−72.40	$\frac{3}{2}+$	6.9 d	.....	.....	β^-0.51(64), 0.45(26), 0.58(10), . . .	0.58	0.026(21), 0.049(19), 0.075(10), 0.057(5), . . .	
			162	97	−70.5	.....	7.5 m	.....	.....	β^-1.25(90), 1.5(5), . . .	.....	0.260(80), 0.808(45), 0.888(35), 0.185(16), 0.882(15), 0.080(8), . . .	
			163	98	−69.44	.....	6.5 h	.....	.....	β^-1.4(40), 1.65(30), 1.5(15), 1.1(15)	1.68	0.330(40), 0.025(30), 0.235(15), 0.510(15), . . .	
			163	98	−69.44	.....	19.5 m	.....	.....	β^-0.80, 1.28, 1.40	1.68	0.390(31), 0.351(26), 0.494(23), 0.074(15), . . .	
			164	99	−67.2	.....	23 h	.....	.....	β^-	3.3		
66	Dy	Dysprosium	149	83	−72.	.....	∼15 m	.....	.....	ϵ	∼4		
			150	84	−74.	0+	7.2 m	.....	.....	ϵ, β^+, α4.23(18)	∼2.0	0.39	
			151	85	−74.	.....	18 m	.....	.....	β^+, ϵ, α4.06(6)	3.0	0.145	
			152	86	−75.21	0+	2.4 h	.....	.....	ϵ, α3.65(0.05)	0.8	0.257	
			153	87	−74.17	.....	6.4 h	.....	.....	ϵ, α3.48(0.003)	∼2.1	0.081, 0.100, 0.255, . . .	
			154*m*	...	.....	.....	13 h	.....	.....	α3.37			
			154	88	−75.53	.....	10.7 y	.....	.....	α2.87			
			155	89	−74.20	$(\frac{3}{2}-)$	10.2 h	.....	.....	ϵ(98), β^+0.85(2), . . .	2.10	0.227(68), 0.664(3), 1.090(3), 1.000(3), 0.905(2), . . .	
			156	90	−75.37	0+	**0.052%**						
			157	91	−74.50	$(\frac{3}{2}-)$	8.1 h	.....	.....	ϵ(100)	1.36	0.326(91), . . .	
			158	92	−75.55	0+	**0.090%**	.....	.....	.....	.....	.....	96
			159	93	−74.22	$\frac{3}{2}-$	144 d	.....	.....	ϵ(100)	0.365	0.058(4), . . .	
			160	94	−74.77	0+	**2.29%**	.....	.....	.....	.....	.....	55
			161	95	−73.03	$\frac{5}{2}+$	**18.88%**	−0.46	+2.3	.....	.....	.....	585
			162	96	−73.16	0+	**25.51%**	.....	.....	.....	.....	.....	200
			163	97	−71.23	$\frac{5}{2}-$	**24.97%**	+0.64	+2.5	.....	.....	.....	140
			164	98	−70.80	0+	**28.18%**	.....	.....	.....	.....	.....	2,600
			165m_2		.....	.....	32 s	.....	.....	.....	.....	IT	
			165m_1		.....	$\frac{1}{2}-$	1.26 m	.....	.....	β^-0.89(2), 1.0(0.5)	.....	IT0.108(97), 0.514(2), . . .	
			165	99	−68.25	$\frac{7}{2}+$	139.2 m	±0.50	.....	β^-1.3(83), 1.2(15), 0.3(1), . . .	1.30	0.095(4), . . .	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
66	Dy	Dysprosium	166	100	−67.17	0+	81.5 h	.....	.....	β^-0.40(92), 0.48(5), . . .	0.482	0.082(12), . . .	
67	Ho	Holmium	150	83	−66.	.....	~20 s	.....	.....	β^-			
			151	...	.....	.....	42 s	.....	.....	ϵ, β^+	~7		
			151	84	−68.	.....	36 s	.....	.....	ϵ, β^+, α4.60(30)			
			152	...	.....	.....	52 s	.....	.....	ϵ, β^+, α4.51(20)	~5		
			152	85	−68.4	.....	2.4 m	.....	.....	ϵ, β^+, α4.45(19)			
			153	86	−69.60	.....	9 m	.....	.....	ϵ, β^+, α4.38(30)	6.4		
			154	87	−69.35	1	12 m	.....	.....	ϵ, β^+, α3.95(0.1)	4.3		
			155	88	−71.	$\frac{5}{2}$	50 m	.....	.....	ϵ, β^+, α3.91	5.8	0.335	
			156	89	−70.	1	55 m	.....	.....	β^+2.1, ϵ	~3	0.092, 0.138, 0.117, 0.209, 0.243, 0.326	
								.....	.....	ϵ, β^+1.80, 1.3, 2.9	~5	0.138(100), 0.266(99), 0.367(23), 0.685, 0.89, 1.41, . . .	
			157	90	−72.	$\frac{7}{2}$	14 m	.....	.....	β^+, ϵ	~2.5	0.087, 0.152, 0.196, 0.227, 0.71, 1.20, . . .	
			158m	...	.....	2−	29 m	.....	.....	β^-1.32, ϵ	.....	IT0.067, 0.098, 0.218, 0.32, . . .	
			158	91	−71.29	5+	11 m	.....	.....	ϵ	3.98	0.098, 0.218, 0.320, 0.52, . . .	
			159m	...	.....	.....	6.9 s	.....	.....	.....	.....	IT0.206(100)	
			159	92	−72.	$\frac{7}{2}$	33 m	.....	.....	ϵ	~1.7	0.057, 0.080, 0.17, 0.25, 0.309, . . .	
			160m	.....	.....	2−	5.0 h	.....	.....	ϵ(34)	.....	IT0.060(66)	
			160	93	−71.64	5+	2.6 m	.....	.....	ϵ(99.8), β^+0.57(0.2), . . .	2.92	0.729(50), 0.97(35), 0.880(26), 0.65(20), 0.197(20), 0.539(5), . . .	
			161m	...	.....	$\frac{1}{2}$+	6 s	.....	.....	.....	.....	IT0.211(100)	
			161	94	−72.15	$\frac{7}{2}$−	2.5 h	.....	.....	ϵ(100)	0.82	0.026(23), 0.075(15), 0.176(2), 0.157(1), . . .	

			162*m*	...	.....	6−	68 m	.....	.....	ε(37)	.....	IT0.0578, 0.383(63)	
			162	95	−70.83	1+	15 m	.....	.....	ε(95), β^+1.10, . . .	2.16	0.081(8)	
			163*m*	...	.....	$\frac{1}{2}$+	1.1 s	.....	.....	.....	.....	IT0.30(100)	
			163	96	−71.23	$\frac{7}{2}$−	33 y	.....	.....	ε	0.01		
			164*m*	...	.....	6	38 m	.....	.....	.....	.....	IT0.046, 0.052, 0.037	
			164	97	−69.73	1	25 m	.....	.....	β^-0.97(35), 0.88(22)	0.97	0.091(5)	
			165	98	−69.64	$\frac{7}{2}$−	100%	+4.12	+3.0	ε(43)	1.11	0.073(5)	
			166*m*	...	.....	(7−)	1.2×10^{21} y	.....	.....	.....	.....	.....	65
										β^-0.07, . . .	.....	0.184(90), 0.810(60), 0.711(58), 0.081(12), 0.412(12), 0.532(12), . . .	
			166	99	−67.69	0−	26.7 h	.....	.....	β^-1.84(52), 1.76(47), 0.38(1), . . .	1.84	0.081(5), 1.380(0.1), . . .	
			167	100	−66.9	($\frac{7}{2}$−)	3.1 h	.....	.....	β^-0.30(44), 0.62(21), 0.97(16), 0.39(14), . . .	0.97	0.347(58), 0.079(14), 0.208(13), 0.084(9), . . .	
			168	101	−64.1	.....	3.3 m	.....	.....	β^-2.2	2.8	0.85	
			169	102	−63.1	($\frac{7}{2}$−)	4.6 m	.....	.....	β^-1.20(75), 1.95(25)	2.2	0.065(60), 0.78(30), 0.075(18), 0.850(13), 0.150(13), 0.760(11), . . .	
			170	103	−60.5	.....	45 s	.....	.....	.....	.....	.....	
68	Er	Erbium	152	84	−65.	0+	11 s	.....	.....	β^-3.1	3.7	0.43	
			153	85	−65.	.....	36 s	.....	.....	α4.80(90), ε, β^+	~3		
			154	86	−67.	.....	4.5 m	.....	.....	α4.67(75), ε, β^+	~5		
			155	87	−66.6	.....	5.3 m	.....	.....	α4.15	~2		
			157	89	−68.	$\frac{3}{2}$	24 m	.....	.....	α4.01	~4		
			158	90	−70.	0+	2.3 h	.....	.....	β^+, ε	~4	0.117, 0.386, 1.32, 1.66, 1.82, 2.0	
			159	91	−69.	$\frac{3}{2}$	36 m	.....	.....	ε, β^+0.8	~1.5	0.072, 0.067, 0.315, 0.387, . . .	
			160	92	−71.	0+	29 h	.....	.....	ε, β^+	~3	0.206, 0.627, 1.20, 1.80, 2.60, . . .	
			161	93	−70.	($\frac{3}{2}$−)	3.1 h	.....	.....	ε	~0.8		
										ε(99), β^+1.2(1)	2.0	0.826(63), 0.211(9), 0.592(8), 1.17(8), 1.37(5), 0.305(3), . . .	
			162	94	−71.17	0+	0.136%	.....	.....	.....	.....	.....	
			163	95	−69.92	$\frac{5}{2}$−	75 m	+1.1	+3.9	ε(99.9), β^+0.19(0.004), . . .	1.21	0.44(0.06), 1.11(0.05), . . .	160
			164	96	−70.76	0+	1.56%	.....	.....	.....	.....	.....	
			165	97	−69.21	$\frac{5}{2}$−	10 3 h	±0.65	±2.2	ε(100)	0.37	.....	13

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu × 10^{-3}	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β^--decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
68	Er	Erbium	166	98	−69.69	0+	33.41%						
			167*m*	...	.....	$\frac{1}{2}-$	2.3 s	.....	.....	.....	.....	.....	
			167	99	−67.02	$\frac{7}{2}+$	22.94%	−0.564	+2.8	.....	.....	IT0.2078(100)	30
			168	100	−67.60	0+	27.07%	.....	.....	.....	.....	.....	
			169	101	−65.38	$\frac{1}{2}-$	9.4 d	+0.513	.....	.....	.....	.....	700
			170	102	−64.51	0+	14.88%	.....	.....	β^-0.34(58), 0.33(42)	0.340	0.00842	1.9
			171	103	−61.94	$\frac{5}{2}-$	7.6 h	±0.70	±2.4	.....	.....	.....	
			172	104	−60.63	0+	49 h	.....	.....	β^-1.065(91), 0.58(4), 1.49(2)	1.490	0.308(63), 0.296(28), 0.112(25), 0.124(9), . . .	6
			173	105	−57.3	.....	12 m	.....	.....	β^-0.36(44), 0.29(42), 0.9(10), . . .	0.9	0.407(43), 0.410(40), . . .	
69	Tm	Thulium	153	84	−51.	.....	1.6 s	.....	.....	β^-2.3(70), 1.5(30)	2.8	0.20(60), 0.40(30), 0.18(20), 0.32(20), 0.36(19), 0.16(18), . . .	
			154	...	.....	.....	3.0 s	.....	.....	α5.11	~7		
			155	85	−58.	.....	5 s	.....	.....	α5.04			
			161	92	−66.2	.....	30 m	.....	.....	α4.96			
								.....	.....	ϵ(100)	~8		
			162	...	.....	(3)	77 m	.....	.....		3.5	0.0456, 0.0595, 0.1061, 0.1126, 0.0845, 0.147, 0.172, . . .	
			162	93	−66.0	.....	22 m	.....	.....	ϵ(100)	.....	0.162(100), 0.236(13)	
			163	94	−67.33	$\frac{1}{2}$(+)	1.8 h	±0.08	.....	β^+3.82, 2.3, . . . , ϵ	4.89	0.102	
			164	95	−66.51	(1+)	1.9 m	.....	.....	ϵ, β^+1.1, 0.40	2.42	0.104(8), 0.24(5), 0.29(3), 0.24(3), . . .	
			165	96	−67.56	$\frac{1}{2}+$	30.1 h	.....	.....	ϵ(61), β^+2.94(26), 2.85(13)	3.95	0.091(4), 0.356, 0.39, 0.77, 0.86, 1.16, 1.31, 1.67, . . .	
								.....	.....	ϵ(99+), β^+0.30(0.007)	1.57	0.243(53), 0.297(35), 0.807(15), 0.34(10), 1.13(5), 0.70(2), . . .	

			166	97	−66.42	2+	7.7 h	±0.047	±4.5	ε(98), β⁺1.94(1.5), 1.1(0.3)	3.04	0.0806(90), 0.134(20), 0.780(19), 2.054(16)		
			167	98	−67.12	1/2+	9.6 d	.....	.....	ε(100)	0.75	0.208(99), 0.057(4), 0.532(2)		
			168	99	−65.77	.....	85 d	.....	.....	ε(100)	1.70	0.816(88), 0.198(77), 0.747(40), 0.447(27), 0.080(11), 0.917(4), . . .		
			169	100	−65.76	1/2−	**100%**	−0.232	.....	.....	.....	.....	.....	115
			170	101	−64.17	1−	129 d	±0.246	±0.57	β⁻0.97(77), 0.885(23)	0.967	0.0843(23)		92
			171	102	−63.54	1/2+	1.92 y	±0.229	.....	β⁻0.098(98), 0.03(2)	0.098	0.0667		4.5
			172	103	−61.39	2−	63.7 h	.....	.....	β⁻1.80(39), 1.88(23), 0.41(14), 0.28(10), 0.71(8), . . .	1.87	1.09(10), 1.39(9), 1.46(7), 1.53(7), 0.079(5), 1.61(5), . . .		
			173	104	−60.35	.....	8.2 h	.....	.....	β⁻0.90(75), 0.86(23), 1.3(2)	1.32	0.399(89), 0.465(8), 0.066(1)		
			174	...	.....	.....	5.2 m	.....	.....	β⁻1.2(80), 0.7(20)	3.0	0.365(93), 0.99(89), 0.273(85), 0.176(67), 0.50(15)		
			174	105	−57.8	.....	5.5 m	.....	.....	β⁻2.5(100)	2.5			
			175	106	−56.1	.....	15 m	.....	.....	β⁻0.90(30), 1.50(20), 1.87(20), . . .	2.5	0.511, 0.362, 0.943, 0.985, . . .		
			176	107	−52.9	.....	1.4 m	.....	.....	β⁻1.15(40), 2.00(40), 3.05(20)	4.1	0.19(100), 0.39(80), 0.29(70), 0.05(60), 1.05(45), 0.87(45), . . .		
70	Yb	Ytterbium	154	84	−54.	.....	0.39 s	.....	.....	α5.33				
			155	85	−54.	.....	1.6 s	.....	.....	α5.21				
			162	92	−64.	.....	~24 m	.....	.....	ε	~2	0.0409		
			163	93	−63.	.....	11 m	.....	.....	ε	~4			
			164	94	−65.	0+	76 m	.....	.....	ε	~1			
			165	95	−64.61	.....	10 m	.....	.....	ε(190), β⁺1.7(10)	2.75	0.080(70), 0.069(10), 1.09(5), 0.118(4), . . .		
			166	96	−66.14	0+	57.5 h	.....	.....	ε(100)	0.26	0.082(17)		
			167	97	−65.02	(5/2−)	18 m	.....	.....	ε(99+), β⁻0.65(0.3)	1.96	0.113(90), 0.176(15), . . .		
			168	98	−66.08	**0+**	**0.135%**	.....	.....	.....	.....	.....	.....	3,200
			169	99	−64.78	(1/2+)	32 d	.....	.....	ε(100)	0.91	0.063(45), 0.198(35), 0.177(22), 0.110(19), 0.308(10), . . .		
			170	100	−65.21	0+	**3.03%**	.....	.....	.....	.....	.....	.....	9.4
			171	101	−63.65	1/2−	**14.31%**	+0.4919	.....	.....	.....	.....	.....	50

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
70	Yb	Ytterbium	172	102	−63.59	0+	21.82%						0.4
			173	103	−60.35	$\frac{5}{2}-$	16.13%	−0.6776	+3.0				19
			174	104	−61.11	0+	31.84%						65
			175	105	−58.70	$\frac{7}{2}-$	101 h			β^-0.467(87), 0.073(11), 0.35(2), 0.22	0.467	0.396(6), 0.283(4), 0.114(2), . . .	
			176m	...	.....	(8−)	11 s					IT0.093, 0.38, 0.294, 0.187, 0.082(100)	
			176	106	−57.42	0+	12.73%						5.5
			177m	..	.....	$\frac{1}{2}-$	6.5 s					IT0.228, 0.104(100)	
			177	107	−54.72	$\frac{9}{2}+$	1.9 h			β^-1.40(60), 1.3, 0.17	1.40	0.151(16), 1.080(5), 0.122(3), 1.24(13), . . .	
71	Lu	Lutetium	155	84	−46.	.....	0.07 s			α5.63			
			156	...	.....	.....	0.23 s			α5.54			
			156	85	−47.	.....	0.5 s			α5.41			
			167	96	−61.73	.....	54 m			ϵ(98), β^+1.5(1), 1.1(1)	3.1	0.030, 0.079, 0.239, 0.100, . . .	
			168	97	−61.40	(1−)	7.1 m			ϵ(95), β^+1.20	4.4	0.99(13), 0.90(10), 0.087(7), . . .	
			169m	...	.....	($\frac{1}{2}-$)	2.7 m					IT0.029(100)	
			169	98	−62.34	$\frac{7}{2}+$	34 h			ϵ, β^+1.2, 0.4	2.26	0.063, 0.024, 0.071, 0.075, 0.087, 0.092, 0.104, 0.111, . . .	
			170m	...	.....	4−	0.7 s					IT0.048, 0.044(100)	
			170	99	−61.51	0+	2.0 d			ϵ(99.8), β^+2.39(0.2)	3.41	0.084, 0.194, . . .	
			171m	...	.....	($\frac{1}{2}-$)	78 s					IT0.071(100)	
			171	100	−62.	$\frac{7}{2}+$	8.3 d			ϵ(99.9), β^+	~1.4	0.741(68), 0.019(20), 0.668(14), 0.075(8), 0.842(7), . . .	
			172m	...	.....	(1−)	3.7 m					IT0.0419(100)	

			172	101	−61.	(4−)	6.70 d	.....	.....	ε	∼2.5	1.093(60), 0.901(45), 0.182(26), 0.810(21), 0.912(21), 0.079(13), . . .	
			173	102	−61.02	($\frac{7}{2}$+)	1.37 y	.....	.....	ε(100)	0.69	0.272(18), 0.079(14), 0.101(7), 0.17(5), . . .	
			174*m*	...	.....	6−	150 d	.....	.....	ε	.....	IT0.0591, 0.0671, 0.0447, 0.994, 0.53, 0.076, 0.176, . . .	
			174	103	−59.65	1−	3.6 y	.....	.....	ε(100)	1.4	1.24(9), 0.076(6), . . .	
			175	104	−59.20	$\frac{7}{2}$+	97.41%	+2.23	+5.6	.....	.....	.....	21
			176*m*	...	.....	1(−)	3.7 h	+0.318	−2.3	β⁻1.22(60), 1.31(40)	.....	0.088(1.0), 0.105, 1.14	
			176	105	−57.29	7(−)	4 × 10¹⁰ y	+3.18	+8.0	β⁻0.43(100)	1.02	0.306(95), 0.203(85), 0.088(15)	2,050
			177*m*	...	.....	$\frac{23}{2}$−	2.59% 161 d	.....	.....	β⁻(78)	.....	IT0.228(22), 0.104(22), 0.208(62), 0.378(29), 0.113(23), 0.418(21), . . .	
			177	106	−56.22	$\frac{7}{2}$+	6.7 d	+2.24	+5.4	β⁻0.497(86), 0.385(7), 0.175(7), 0.249(0.1)	0.497	0.113(14), 0.208(7), . . .	
			178	...	.....	.....	25 m	.....	.....	β⁻1.50(100)	.....	0.089, 0.214, 0.326, 0.427, . . .	
			178	107	−53.7	.....	5 m	.....	.....	β⁻2.25(100)	2.25	0.33, . . .	
			179	108	−52.7	($\frac{7}{2}$+)	4.6 h	.....	.....	β⁻1.34(87), 1.1(13)	1.34	0.213(13), . . .	
			180	109	−49.9	.....	2.5 m	.....	.....	β⁻3.3	3.3		
72	Hf	Hafnium	157	85	−42.	.....	0.12 s	.....	.....	α5.68			
			158	...	−45.	0+	3 s	.....	.....	α5.27			
			168	96	−59.	0+	25 m	.....	.....	ε	∼2	0.117, 0.068, 0.183, 0.160, 0.203, . . .	
			169	97	−58.7	.....	1.5 h	.....	.....	ε, β⁺∼1.3	∼5	0.12, . . .	
			170	98	−60.	0+	12.2 h	.....	.....	ε	∼1	0.165, 0.120, 0.99, 1.28, . . .	
			171	99	−59.	.....	11 h	.....	.....	ε	∼3	0.662, 0.347, 0.470, 0.296, 0.122, 0.319, . . .	
			172	100	−60.	0+	5 y	.....	.....	ε	∼0.4	0.024(22), 0.125(21), 0.082(10), . . .	
			173	101	−59.	($\frac{1}{2}$−)	23.6 h	.....	.....	ε	∼3	0.13(96), 0.30(52), 0.162(5), 0.898(2), 1.04(1), 1.20(0.4), . . .	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
72	Hf	Hafnium	174	102	−59.86	0+	2.0×10^{15} y			α2.50			
							0.18%						390
			175	103	−58.55	$(\frac{5}{2}-)$	70 d			ϵ	0.59	0.343(85), 0.089(3), 0.433(1), . . .	
			176	104	−58.57	0+	5.20%						15
			177*m*	...		$\frac{23}{2}+$	1.1 s					IT0.208(81), 0.228(48), 0.378(37), 0.113(30), 0.418(27), 0.327(23), . . .	
			177	105	−56.75	$\frac{7}{2}-$	18.50%	+0.61	+3				380
			178*m*	...		(8−)	4.3 s					IT0.427(97), 0.326(94), 0.214(75), 0.089(54), 0.093(14)	
			178	106	−56.28	0+	27.14%						75
			179*m*	...		$\frac{1}{2}-$	18.6 s					IT0.161(99), 0.217(99), 0.378(1)	
			179	107	−54.16	$\frac{9}{2}+$	13.75%	−0.47	+3				65
			180*m*	...		8−	5.5 h					IT0.333(93), 0.215(82), 444(80), 0.058(48), 501(17), 0.093(16)	
			180	108	−53.43	0+	35.24%						12.6
			181	109	−50.87	$(\frac{1}{2}-)$	42.4 d			β^-0.41	1.023	0.482(81), 0.133(48), 0.346(13), . . .	40
			182	110	−49.28	0+	9×10^6 y			β^-	0.5	0.271	
			183*m*	...			91 d			β^-2.2, 1.9		0.095, 0.250, 0.340, . . .	
			183	111	−46.40		65 m			β^-1.18(56), 1.54(34), 1.00(10)	2.0	0.784, 0.458, 0.073, . . .	
73	Ta	Tantalum	172	99	−55.		44 m			β^+, ϵ	~5	0.092, 0.208, 0.27, 1.1, 1.3, . . .	

			173	100	−56.	.....	3.7 h	.....	.....	ε	~3	0.0698, 0.172, 0.160, 0.181, 0.090, . . .	
			174	101	−56.	.....	1.2 h	.....	.....	ε, β^+	~4	0.090, 0.125, 0.060, 0.205, 0.28, 0.35, . . .	
			175	102	−56.	.....	10.5 h	.....	.....	ε	~2.3	0.0815, 0.0505, 0.267, 0.0705, 0.104, 0.163, 0.207, . . .	
			176	103	−55.2	(1−)	8.0 h	.....	.....	ε	3.1	0.0884, 0.202, 0.147, 0.176, 0.158, . . .	
			177	104	−55.51	($\frac{7}{2}$+)	56.6 h	.....	.....	ε	1.17	0.113(6), 0.208(1), 1.058, 0.425, . . .	
			178	...	.....	.....	2.1 h	.....	.....	ε	.....	0.328(100), 0.427(97), 0.214(75), 0.089(54), 0.093(13), . . .	
			178	105	−54.2	1+	9.4 m	.....	.....	ε(99), β^+0.8), 0.80(1)	1.9	0.093(35), 1.35(1), . . .	
			179	106	−54.03	($\frac{7}{2}$+)	~600 d	.....	.....	ε(100)	0.119		
			180*m*	...	.....	1(−)	8.1 h	.....	.....	ε(87), β^+0.71(10), 0.61(3)	.....	0.0933(27), 0.103(3)	
			180	107	−52.44	.....	**0.0123%**						
			181	108	−51.97	$\frac{7}{2}$+	**99.988%**	+2.36	+4.2	.....	.....	.....	22
			182*m*	...	.....	(8+)	16.5 m	.....	.....	.....	.....	IT0.184(40), 0.147(40), 0.172(40), 0.319(5), . . .	
			182	109	−49.83	3−	115 d	.....	.....	β^-0.54(45), 0.25(31), 0.41(24), . . .	1.807	0.1001(69), 0.0677(52), 1.122(35), 1.222(28), 0.0847(24), 1.189(16), . . .	8,200
			183	110	−48.57	$\frac{7}{2}$(+)	5.0 d	.....	.....	β^-0.615(87), . . .	1.068	0.0465(48), 0.1079(47), 0.2461(36), 0.0526(36), 0.0991(35), 0.1614(18), . . .	
			184	111	−45.73	(5−)	8.7 h	.....	.....	β^-1.170(80), 1.110(20)	3.0	0.111(84), 0.413(79), 0.252(58), 0.922(33), 0.318(28), 0.793(16), . . .	
			185	112	−44.44	$\frac{7}{2}$(+)	49 m	.....	.....	β^-1.72(100)	1.96	0.060, 0.175, 0.100, 0.24, . . .	
			186	113	−41.4	.....	10 m	.....	.....	β^-2.27, 2.56	3.9	0.20, 0.73, 0.51, 0.61, 0.13, 0.30, . . .	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
74	W	Tungsten	160?	86	.....	.....	.....	.....	.....	α5.75			
			173	99	−52.	.....	16 m	.....	.....	ϵ	~4		
			174	100	−54.	0+	31 m	.....	.....	ϵ	~4		
			175	101	−53.	.....	34 m	.....	.....	ϵ	~3	0.26, 0.80, 1.3, 1.6, . . .	
			176	102	−54.	0+	2.3 h	.....	.....	ϵ(99.5), β^+(0.5)	~1	0.0949, 0.1002, 0.0613, 0.0336, . . .	
			177	103	−54.	.....	135 m	.....	.....	ϵ	~2	0.0705, 0.0305, 0.1157, 0.1864, 0.1560, 0.427, . . .	
			178	104	−54.	0+	21.5 d	.....	.....	ϵ(100)	~0.09		
			179m	...	.....	($\frac{1}{2}$−)	5.2 m	.....	.....	.....	.....	IT0.2218(100)	
			179	105	−53.	($\frac{7}{2}$−)	38 m	.....	.....	ϵ(100)	~1	0.031(22), . . .	
			180	106	−53.3	0+	1.14%	.....	.....	.....	.....	.....	10
			181	107	−51.77	($\frac{9}{2}$+)	140 d	.....	.....	ϵ(100)	0.19	0.006, 0.136, 0.152	
			182	108	−51.75	0+	26.41%	.....	.....	.....	.....	.....	21
			183m	...	.....	($\frac{9}{2}$+)	5.3 s	.....	.....	.....	.....	IT0.105, 0.047, 0.161, 0.210	
			183	109	−49.73	$\frac{1}{2}$−	14.40%	+0.117	.....	.....	.....	.....	10.2
			184	110	−49.03	0+	30.64%	.....	.....	.....	.....	.....	1.8
			185m	...	.....	.....	1.6 m	.....	.....	.....	.....	IT0.131(100), 0.175, 0.060, 0.175, . . .	
			185	111	−46.53	$\frac{3}{2}$−	74 d	.....	.....	β^-0.429(99.98), 0.30(0.02)	0.429	0.125(0.02)	
			186	112	−45.60	0+	28.41%	.....	.....	.....	.....	.....	38
			187	113	−42.80	$\frac{3}{2}$−	23.8 h	.....	.....	β^-0.328(59), 1.315(19), 33(3), 0.71(7), 0.55(4), . . .	1.311	0.1342(30), 0.685(29), 0.480(25), 0.0720(23), 0.618(7), 0.552(6), . . .	90
			188	114	−41.47	0+	69 d	.....	.....	β^-0.349(99), . . .	0.349	0.0636(0.9), . . .	
			189	115	−38.0	.....	11 m	.....	.....	β^-2.0, 2.5	2.5	0.258, 0.417, 0.555, 0.855, 0.955, 0.178, . . .	

75	Re	Rhenium	175	100	−48.	.....	5 m	.....	.....	ε	~6	0.240, 0.110	
			176	101	−48.	.....	3 m	.....	.....	ε	~4		
			177	102	−49.	.....	17 m	.....	.....	β^+, ε	~5	0.106, 0.237	
			178	103	−49.	.....	15 m	.....	.....	β^+3.1	~3	0.290, 0.429, 0.415, 0.477, . . .	
			179	104	−50.	.....	20 m	.....	.....	ε	2.8	0.902(100), 0.104(26), 0.826(11), . . .	
			180	105	−49.2	.....	2.4 m	.....	.....	ε(93), β^+1.77(7)	~1	0.365, 0.110, 0.065, 0.0435, 0.0197, 0.1103, . . .	
			181	106	−49.	.....	18 h	.....	.....	ε	.....	0.1001(74), 0.2292(25), 1.428(19), 0.178(18), 0.169(12), 0.0679, . . .	
			182	...	.....	(7+)	64 h	.....	.....	ε	2.86	0.1001(66), 0.0677(62), 1.122(38), 1.222(31), 0.0847(29), 1.189(18), . . .	
			182	107	−48.68	(2+)	13 h	.....	.....	ε(99.8), β^+1.74(0.2),	0.59	0.0465(78), 0.1623(48), 0.0526(25), 0.0991(15), 0.0847(12), 0.1079(11), . . .	
			183	108	−49.14	($\frac{5}{2}$+)	70 d	.....	.....	ε	.....	IT0.083, 0.105(70), 0.1112(18), 0.904(11), 0.793(8), 0.895(6), . . .	
			184m	...	.....	(8+)	165 d	.....	.....	ε(30)	1.62	0.1112(59), 0.904(41), 0.793(36), 0.895(19), 0.253(5), . . .	
			184	109	−47.	(3−)	38 d	.....	.....	ε	.....	.....	110
			185	110	−46.99	$\frac{5}{2}$+	37.07%	+3.172	+2.7	.....	1.07	0.1372(21), 0.1225(2), . . .	
			186	111	−44.96	1(−)	90 h	+1.73	~±0.4	β^-1.07(74), 0.935(21), . . . ε(5)	0.52	....	75
			187	112	−44.21	$\frac{5}{2}$+	5×10^{10} y 62.93%	+3.204	+2.6	β^-0.0026(100)	0.0026	IT0.0024, 0.016, 0.0636, 0.0925, . . .	
			188m	...	.....	(6)−	18.6 m	.....	.....	.....	.....	0.155(16), . . .	<2
			188	113	−41.85	1−	16.8 h	+1.78	~+0.4	β^-2.13(80), 1.98(16), . . .	2.13	0.0309(21), 0.0696(15), 0.186(5), 0.245(5), 0.036(4), . . .	
			189	114	−40.73	($\frac{5}{2}$+)	24 h	.....	.....	β^-1.01(50), 0.79(19), 0.725(7), . . .	1.01		

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-1}$	(7) Spin and parity	(8) % aburdance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
75	Re	Rhenium	190	115	−38.1	.....	2.8 m	.....	.....	β^-1.6	3.2	0.191(10), 0.392(10), 0.57(10), 0.83(3)	
			191	116	−37.	.....	10 m	.....	.....	β^-1.8	1.8		
			192	117	.....	.....	6 s	.....	.....	β^-2.5	.....	0.20, 0.29, 0.37, 0.48, 0.57	
76	Os	Osmium	176	100	−44.	0+	3.6 m	.....	.....	ϵ	~8	0.776, 1.291, 0.857, . . .	
			178	102	−46.	0+	5 m	.....	.....	.....	~7		
			179	103	−47.	.....	8 m	.....	.....	.....	~5		
			180	104	−47.	.....	22 m	.....	.....	ϵ	.....	0.880, . . .	
			181	...	.....	.....	2.7 m	.....	.....	ϵ(34), β^+1.75(5)	.....	0.145, 0.118, . . .	
			181	105	−47.	.....	105 m	.....	.....	ϵ	~3	0.239, 0.118; 1.061, 0.167	
			182	106	.....	0+	21 h	.....	.....	ϵ	.....	0.0276, 0.510, 0.1802, 0.0555, . . .	
			183*m*	...	.....	($\frac{1}{2}$−)	10 h	.....	.....	ϵ(54)	.....	IT0.1707(46), 1.102(26), 1.108(22), 0.3673(6), 1.035(6)	
			183	107	−47.	($\frac{9}{2}$+)	12 h	.....	.....	ϵ(100)	~1	0.382(88), 0.1145(71), 0.168(18), 0.236(6), . . .	
			184	108	−47.40	0+	0.018%	.....	.....	.....	.....	.....	3,000
			185	109	−45.89	($\frac{1}{2}$−)	94 d	.....	.....	ϵ(100)	1.015	0.646(81), 0.879(7), 0.718(4), 0.1253(2), . . .	
			186	110	−46.13	0+	1.59%						
			187	111	−44.21	$\frac{1}{2}$−	1.64%	+0.0643					
			188	112	−44.12	0+	13.3%						
			189	113	−41.82.	$\frac{3}{2}$−	16.1%	+0.6566	+0.8	.....	.....	.....	0.0003
			190*m*	...	.....	(10)−	9.9 m	.....	.....	.....	.....	IT0.616(99), 0.502(98), 0.361(94), 0.187(70)	
			190	114	−41.52	0+	26.4%	.....	.....	.....	.....	.....	13
			191*m*	...	.....	($\frac{3}{2}$−)	13 h	.....	.....	.....	.....	IT0.0742(100)	
			191	115	−39.03	($\frac{9}{2}$−)	15 d	.....	.....	β^-0.143	0.310	0.042, 0.129, . . .	
			192	116	−38.49	0+	41.0%	.....	.....	.....	.....	.....	2.0

			193	117	−35.82	...	31 h	...	...	β^-1.132(70), 0.99(9), 0.67(7), 1.06(6), . . .	1.132	0.460(4), 0.139(3), 0.558(2), 0.387(1), . . .	
			194	118	−34.77	0+	6.0 y	...	...	β^-0.097(67), 0.054(33), . . .	0.097	0.043(33), 0.082(0.05)	
			195	119	−32.0	...	6.5 m	...	...	β^-2	2.0		
77	Ir	Iridium	171	94	−29.	...	1 s	...	...	α5.91			
			172	95	−29.	...	2 s	...	...	α5.81			
			173	96	−31.	...	3 s	...	...	α5.66			
			174	97	−33.	...	4 s	...	...	α5.48			
			175	98	−35.	...	4.5 s	...	...	α5.39			
			176	99	−36.	...	8 s	...	...	α5.12			
			177	100	−38.	...	21 s	...	...	α5.01			
			182	105	−42.	(5−)	15 m	...	...	β^+, ε	~6	0.13, 0.28	
			183	106	−43.	...	58 m	...	...	ε	~3	0.238	
			184	107	−42.3	...	3.2 h	...	...	ε, β^+	4.7	0.264, 0.125, 0.391, 0.840, 0.96, 1.09	
			185	108	−43.	($\frac{3}{2}$+)	14 h	...	...	ε(100)	~2.5	0.0374(72), 0.0599(38), 0.0973(23), 0.1007(15), 0.2542(15), 0.090(11), . . .	
			186	109	−42.00	(7)	15 h	...	...	ε(98), β^+1.94(2), . . .	3.831	0.1372(95), 0.297(75), 0.4348(35), 0.773(9), 0.636(7), 0.933(5), . . .	
			187	110	−43.	($\frac{3}{2}$+)	11 h	...	...	ε(100)	~1.5	0.0743(16), 0.0652(15), 0.0255(4), 0.178(3), 0.427(3), 0.611(3), . . .	
			188	111	−41.08	(2−)	41 h	...	...	ε(99), β^+1.656(1), . . .	2.833	0.1550(57), 0.633(22), 0.478(16), 2.217(12), 1.210(7), 0.635(6), . . .	
			189	112	−41.	($\frac{3}{2}$)+	13.3 d	...	...	ε(100)	~0.5	0.0696(21), 0.2448(8), 0.0591(4), 0.0303(4), . . .	
			190m_2	. . .	...	(11−)	3.2 h	...	...	ε(94)	...	IT0.1487(6), 0.616(93), 0.502(92), 0.361(88), 0.187(66)	
			190m_1	. . .	...	(7+)	1.2 h	...	...	...	...	IT0.0263(100)	
			190	113	−39.3	(4+)	11 d	...	...	ε(100)	2.1	0.56(72), 0.187(51), 0.604(47), 0.518(39), 0.40(39), 0.37(39), . . .	
			191m	. . .	...	$\frac{11}{2}$−	4.9 s	...	...	...	...	IT0.129, . . .	
			191	114	−39.36	$\frac{3}{2}$+	37.3%	+0.145	+1.3	...	...	...	930

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
77	Ir	Iridium	$192m_2$	...	.....	9(+)	>5 y	.....	.....	.....	.....	IT0.161(100)	
			$192m_1$	...	.....	1(+)	1.4 m	.....	.....	β^-1.2(0.008), 1.5(0.007), ...	.....	IT0.058(99+), 0.317(0.008), ...	
			192	115	−37.36	4(−)	74.2 d	±1.8	.....	β^-0.672(49), 0.53(42), 0.24(5), ...	1.457	0.317(81), 0.468(49), 0.308(30), 0.296(29),	1,100
										(4)	1.2	0.604(9), 0.612(6), ...	
			$193m$	...	.....	$\frac{11}{2}-$	12 d	.....	.....	.....	.....	IT0.080(100)	0.05
			193	116	−37.04	$\frac{3}{2}+$	62.7%	+0.158	+1.2	.....	.....	.....	120
			$194m$	...	.....	.....	171 d	.....	.....	β^-<0.25	.....	0.33(100), 0.48(100), ...	
			194	117	−34.88	1−	17.4 h	.....	.....	β^-2.24(89), 1.92(5), 0.98(2), 1.62(1), ...	2.24	0.328(10), 0.64(1), ...	
			$195m$	...	.....	.....	4.0 h	.....	.....	.....	.....	0.685, 0.433, 0.319, 0.365, ...	
			195	118	−34.19	.....	2.8 h	.....	.....	β^-1.0, 0.6	1.0	0.099, 0.130	
			$196m$	119	.....	.....	1.4 h	.....	.....	β^-1.16(80), 0.4(5), ...	.....	0.647(100), 0.522(99), 0.394(95), 0.441(95), 0.356(94), 0.100(33)	
			196	...	−31.6	.....	52 s	.....	.....	β^-3.20(80), 2.1(16), ...	3.2	0.355(20), 0.779(11), 0.447(5), ...	
			197	120	−30.5	.....	7 m	.....	.....	β^-2.0(50), 1.5(50)	2.0	0.50(50)	
78	Pt	Platinum	173	95	−22.	.....	Short	.....	.....	α6.19			
			174	96	−26.	.....	0.7 s	.....	.....	α6.03(80), $\epsilon+\beta^+$(20)	~6		
			175	97	−27.	.....	2.1 s	.....	.....	α5.95			
			176	98	−30.	.....	6 s	.....	.....	$\epsilon+\beta^+$(99), α5.74(1)	~6		
			177	99	−31.	.....	6.8 s	.....	.....	$\epsilon+\beta^+$(99+), α5.51(0.3)	~7		
			178	100	−33.	.....	21 s	.....	.....	$\epsilon+\beta^+$(99), α5.44(1.3), 5.28(0.07)	~5		
			179	101	−34.	.....	33 s	.....	.....	$\epsilon+\beta^+$(99+), α5.15(0.1)	~6		
			180	102	−36.	.....	50 s	.....	.....	$\epsilon+\beta^+$(99+), α5.14(0.3)	~4		

		181	103	−36.	...	51 s	...	...	ε + β⁺(99+), α5.02(0.0006)	~5		
		182	104	−38.	0+	3 m	...	...	ε + β⁺(99+), α4.82(0.02)	~4		
		183	105	−38.	...	6 m	...	...	ε + β⁺(99+), α4.72(0.001)	~5		
		184m	...	...	...	42 m	...	...	ε	...	0.68, 1.72, 1.85	
		184	106	−40.	...	20 m	...	...	ε, α4.47	~2.5	0.155, 0.190	
		185	107	−39.	...	1.1 h	...	...	ε	~4		
		186	108	−40.	...	2.8 h	...	...	ε	~2	0.065, 0.140, 0.190	
		187	109	−39.	...	2.3 h	...	...	ε	~3	0.1064, 0.1101, 0.1795, 2.01, 0.1391, 0.1840, . . .	
		188	110	−40.50	0+	10.2 d	...	...	ε	0.54	0.1376(41), 0.1951(41), 0.0547(11), 0.3816(9), 0.0419(5), 0.424(4), . . .	
		189	111	−39.	(3/2 − 7/2 −)	11 h	...	...	ε	~2	0.0821(50), 0.0942(33), 0.1138(17), 0.1411(17), 0.1867(9), 0.721(8), . . .	
		190	112	−40.03	0+	6 × 10¹¹ y 0.0127%	...	...	α3.18			
		191	113	−38.29	(3/2 −)	3.0 d	...	...	ε(100)	1.00	0.539(9), 0.410(5), 0.082(3), 0.457(2), . . .	
		192	114	−38.92	0+	0.78%	...	...	...	...	...	<14
		193m	...	...	...	4.3 d	...	...	...	...	IT0.0126, 0.1355	
		193	115	−36.96	...	16 y	...	...	ε	0.06		
		194	116	−37.29	0+	32.9%	...	...	...	...	...	≲2
		195m	...	...	13/2+	4.1 d	...	...	...	...	IT0.1299, 0.031, 0.099, . . .	
		195	117	−35.19	1/2 −	33.8%	+0.6060	...	...	...	...	24
		196	118	−35.03	0+	25.3%	...	...	...	...	...	0.9
		197m	...	...	(13/2+)	80 m	...	...	β⁻0.737(3)	...	IT0.346, 0.053(97), 0.279(3)	
		197	119	−32.65	1/2(−)	18 h	...	...	β⁻0.67(90), 0.48(10)	0.75	0.077(100), 0.191(9), . . .	
		198	120	−32.11	0+	7.21%	...	...	...	...	...	4.0
		199m	...	...	...	14.1 s	...	...	...	...	IT0.393, 0.032(100)	
		199	121	−29.42	...	30 m	...	...	β⁻1.08(63), 1.14(14), 0.89(10), 0.95(8), . . .	1.68	0.540(24), 0.475(12), 0.197(9), 0.075(9), 0.715(3), 0.960(2), . . .	15
		200	122	−29.	0+	11.5 h	...	...	β⁻	~0.7		
		201	123	−25.2	...	2.5 m	...	...	β⁻2.66, . . .	2.66	0.15, 0.23, 1.76	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
79	Au	Gold	177	98	−22.	.....	1.3 s	.....	.....	α6.12			
			178	99	−23.	.....	2.6 s	.....	.....	α5.92			
			179	100	−26.	.....	7.2 s	.....	.....	α5.85			
			181	102	−30.	.....	11.5 s	.....	.....	α5.62(55), 5.48(45)			
			183	104	−32.	.....	50 s	.....	.....	α5.34			
			184	105	−32.	.....	1.0 m	.....	.....	ϵ, β^+	~7	0.163, 0.273, 0.362	
			185	106	−34.	.....	4.3 m	.....	.....	ϵ, β^+, α5.07(0.01)	~5		
			186	107	−34.	.....	12 m	.....	.....	ϵ	~6	0.16, 0.22, 0.30, 0.40	
			187	108	−35.	.....	8 m	.....	.....	ϵ, α4.69	~4		
			188	109	−35.	.....	8 m	.....	.....	ϵ	~5	0.25, 0.33, 0.63	
			189*m*	...	.....	.....	4.7 m	.....	.....	ϵ	.....	0 168(80)	
			189	110	−36.	.....	30 m	.....	.....	ϵ	~3	0.713, 0.448, 0.813, 0.168, ...	
			190	111	−35.	1−	39 m	±0.066	.....	ϵ, β^+	~4.4	0.29, 0.60, ...	
			191	112	−36.	$\frac{3}{2}$+	3.2 h	±0.137	.....	ϵ	~2.0	0.030, 0.048, 0.091, 0.278, 0.133, ...	
			192	113	−35.15	1(−)	5.0 h	±0.00785	.....	ϵ(99), β^+2.19, 2.49	3.5	0.316, 0.157, 0.0451, 0.295, 0.105, 1.140, ...	
			193*m*	...	.....	$\frac{1}{2}$−	3.9 s	.....	.....	ϵ(0.03)	.....	IT0.0323, 0.258, 0.220, 0.291, ...	
			193	114	−36.	$\frac{3}{2}$+	16 h	±0.139	.....	ϵ(100)	~1	0.18(11), 0.26(9), 0.114(5), 0.440(3), ...	
			194	115	−34.58	1−	39.5 h	±0.074	.....	ϵ(97), β^+1.5(2), 1.2(1)	2.51	0.328(68), 0.294(12), 1.469(8), 1.887(4), 2.044(4), 1.596(3), ...	
			195*m*	...	.....	$\frac{1}{2}$−	31 s	.....	.....	.....	.....	IT0.0567, 0.2615(97), 0.200(2), ...	
			195	116	−34.95	$\frac{3}{2}$+	183 d	±0.147	.....	ϵ(100)	0.229	0.0985, 0.0308, ...	
			196*m*	...	.....	12(−)	9.7 h	.....	.....	.....	.....	IT0.148(42), 0.188(32), 0.285(5), 0.316(5)	

			196	117	−33.44	2−	6.18 d	+0.58 or −0.62	.....	ε(94)	1.48	0.356(94) 0.333(25), 0.426(6) 1.091(0.2)	
										β⁻0.259(6)	0.684		
			197*m*	...	.....	$\frac{1}{2}$−	7.4 s	.....	.....	.....	.....	IT0.130, 0.279, . . . , (100)	
			197	118	−33.45	$\frac{3}{2}$+	**100%**	+0.14486	+0.58	.....	.....	.....	98.8
			198	119	−31.769	2−	2.697 d	+0.590	.....	β⁻0.961(99), 0.29(1), . . .	1.374	0.412(99) 0.676(1), 1.088(0.2)	25,800
			199	120	−31.23	$\frac{3}{2}$+	3.15 d	+0.270	.....	β⁻0.30(73), 0.25(2), 0.46(6)	0.45	0.1584(73), 0.2082(21)	30
			200	121	−29.3	(1−)	48.4 m	.....	.....	β⁻2.2(70), 0.7(25), . . .	2.2	0.368(24) 1.227(23), 1.593(1) . . .	
			201	122	−28.1	.....	26 m	.....	.....	β⁻1.5	1.5	0.54	
			202	123	−25.6	.....	30 s	.....	.....	β⁻3.5(90), 3(10)	3.5	0.44(10), 0.52(0.3)	
			203	124	−24.	.....	55 s	.....	.....	β⁻1.9	~2.5	0.69	
			204	125	−21.7	.....	4 s	.....	.....	β⁻4.5	4.5	0.43	
80	Hg	Mercury	179	99	−17.	.....	3.5 s	.....	.....	α6.08			
			180	100	−21.	.....	5.9 s	.....	.....	α5.96			
			181	101	−22.	.....	3.6 s	.....	.....	α6.00, 5.91			
			182	102	−24.	.....	10.5 s	.....	.....	α5.86			
			183	103	−25.	.....	8.8 s	.....	.....	α5.91, 5.83			
			184	104	−27.	.....	32 s	.....	.....	α5.54			
			185	105	−28.	.....	52 s	.....	.....	ε, α5.65, 5.57	~6		
			186	106	−30.	.....	1.4 m	.....	.....	ε, α5.11	~3.5	0.12, 0.27, 0.35, 0.44	
			187	107	−30.	.....	3 m	.....	.....	ε	~5	0.175, 0.255, 0.400	
			188	108	−32.	.....	3.3 m	.....	.....	ε, α5.14	~3	0.140	
			189	109	−32.	.....	9 m	.....	.....	ε	~4	0.165, 0.240, 0.320, 0.500	
			190	110	−33.	0+	20 m	.....	.....	ε	~2	0.0288, 0.143, 0.130, 0.155, . . .	
			191	111	−33.	.....	55 m	.....	.....	ε	~3	0.26, . . .	
			192	112	−31.	0+	4.8 h	.....	.....	ε	~0.9	0.274(100), 0.157(20), 0.114(10), . . .	
			193*m*	...	.....	$\frac{13}{2}$+	10 h	−1.063	−1.2	ε(82), β⁺1.17(2)	.....	IT0.0395, 0.1012(16), 0.257, 0.218, 0.574, 0.220, . . .	
			193	113	−33.	$\frac{3}{2}$−	4 h	−0.62	−2	ε	2.34	0.038, 0.137, 0.564, 0.762, 0.855, 1.040, . . .	
			194	114	−34	0+	1.2 y	.....	.....	ε(100)	0.05		
			195*m*	...	.....	$\frac{13}{2}$(+)	40 h	−1.049	+1.3	ε(50)	.....	IT0.123(52), 0.261(30), 0.560(8), . . .	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
80	Hg	Mercury	195	115	−33.	$\frac{1}{2}(-)$	9.5 h	+0.538	.....	ϵ(100)	~1.4	0.780(8), 0.062(7), 0.585(3), 0.207(2), 0.261(2), 1.11(1), . . .	
			196	116	−34.18	0+	**0.146%**	.....	.....	.....	.....	.....	3,100
			197*m*	...	.....	$\frac{13}{2}+$	24 h	+1.032	+1.5	ϵ(6)	.....	IT0.165, 0.134(94), 0.279(6), 0.130	
			197	117	−33.00	$\frac{1}{2}-$	65 h	+0.524	.....	ϵ(100)	0.42	0.077(18), 0.191(2), 0.268, . . .	
			198	118	−33.252	0+	**10.02%**	.....	.....	.....	.....	.....	0.02
			199*m*	...	.....	$\frac{13}{2}+$	43 m	.....	.....	.....	.....	IT0.375, 0.158(100)	
			199	119	−31.725	$\frac{1}{2}-$	**16.84%**	+0.5027	.....	.....	.....	.....	2,000
			200	120	−31.679	0+	**23.13%**	.....	.....	.....	.....	.....	<60
			201	121	−29.696	$\frac{3}{2}-$	**13.22%**	−0.5567	+0.45	.....	.....	.....	<60
			202	122	−29.358	0+	**29.80%**	.....	.....	.....	.....	.....	4.9
			203	123	−27.125	$\frac{5}{2}-$	46.9 d	+0.84	$\pm\leq 13$	ϵ 0.214(100)	0.492	0.279(100)	
			204	124	−26.502	0+	**6.85%**	.....	.....	.....	.....	.....	0.43
			205	125	−23.92	$(\frac{1}{2}-)$	5.5 m	.....	.....	β^-1.5	1.5	0.203	
			206	126	−22.49	0+	8.2 m	.....	.....	β^-1.3(59), 1.0(36), 0.65(5), . . .	1.31	0.31, 0.65	
81	Tl	Thallium	191	110	−27.	.....	10 m	.....	.....	ϵ, β^+	~5		
			192	111	−27.	.....	11 m	.....	.....	ϵ, β^+	~6.3	0.424, 0.64	
			193*m*	...	.....	$(\frac{9}{2}+)$	2.1 m	.....	.....	.....	.....	IT0.365	
			193	112	−29.	$(\frac{1}{2}+)$	23 m	.....	.....	ϵ, β^+	~4.2	0.241, 0.252, 0.261, 0.309, 0.270, 0.330, . . .	
			194*m*	...	.....	.....	32.8 m	.....	.....	ϵ(100)	.....	0.097, 0.748, 0.636, 0.427	
			194	113	−29.	.....	33.0 m	.....	.....	ϵ(100)	~5.5	0.427	
			195*m*	...	.....	$(\frac{9}{2}-)$	3.5 s	.....	.....	.....	.....	IT0.099, 0.383(100)	
			195	114	−30.	$\frac{1}{2}+$	1.2 h	.....	.....	ϵ, β^+ ~1.8	~3.2	0.0372, 0.242, 0.226, 0.562, . . .	

			196m	...	.....	(7+)	1.41 h	.....	.....	ε(96)	.....	IT0.12)(4), 0.084, 0.428, 0.636, 0.696	
			196	115	−29.	(2−)	1.84 h	.....	.....	ε	~4.4	0.428	
			197m	...	.....	($\frac{9}{2}$−)	0.54 s	.....	.....	.....	.....	IT0.222, 0.385(100)	
			197	116	−30.	$\frac{1}{2}$+	2.8 h	+1.55	.....	ε	~2.4	0.152, 0.426, 0.134, . . .	
			198m	...	.....	7+	1.87 h	.....	.....	ε(45)	.....	IT0.261, . . . (55), 0.412(45), 0.586(35), 0.635(35), 0.283(30), . . .	
			198	117	−29.5	2−	5.3 h	± <0.002	.....	ε(99), β+2.4, 2.1, 1.4, . . .	3.5	0.412(90), 0.65(40), 1.42(24), 1.20(21), 2.01(15), 2.45(5), . . .	
			199	118	−30.	$\frac{1}{2}$+	7.4 h	+1.59	.....	ε(100)	~1.4	0.455(4), 0.208(12), 0.247(9), 0.158(5)	
			200	119	−29.04	2−	26.1 h	± ≤0.15	.....	ε(99.6), β+1.07(0.3), 1.44(0.06), . . .	2.454	0.368(88), 1.21(35), 0.579(10), 0.829(8), 1.364(4), 1.517(4), . . .	
			201	120	−29.25	$\frac{1}{2}$+	7? h	+1.60	.....	ε(100)	0.41	0.167(8), 0.135(2), . . .	
			202	121	−28.03	2−	1?.2 d	± ≤0.15	.....	ε(100)	1.24	0.439(95), 0.522(0.1), 0.961(0.07)	
			203	122	−27.65	$\frac{1}{2}$+	**29.50%**	+1.6115	.....	.....	.....	.....	11.0
			204	123	−26.13	2−	3.83 y	±0.089	.....	β−0.763(98)	0.763	.....	22
										ε(2)	0.34		
			205	124	−25.56	$\frac{1}{2}$+	**70.50%**	+1.6274	.....	.....	.....	.....	0.5
			206	125	−23.88	0(−)	4.19 m	.....	.....	β−1.53	1.533		
			207m	...	.....	($\frac{1}{2}$−)	1.3 s	.....	.....	.....	.....	IT1.06, 0.35(100)	
			207	126	−22.55	($\frac{1}{2}$+)	4.79 m	.....	.....	β−1.43(99)	1.43	0.898(0.2)	
			208	127	−17.99	(5+)	3.06 m	.....	.....	β−1.80(40), 1.29(24), 1.52(23), 1.04(5), . . .	4.904	2.614(100), 0.583(86), 0.511(23), 0.860(12)	
			209	128	−14.63	($\frac{1}{2}$+)	2.2 m	.....	.....	β−1.99(100)	3.98	0.45(100), 1.56(100), 0.12(50), . . .	
			210 (RaC)	129	−9.90	.....	1.3 m	.....	.....	β−1.9(56), 1.3(25), 2.3(19)	5.50	0.795(100), 0.296(80), 1.31(21), 1.21(17), 1.06(12), 2.43(9), . . .	
82	Pb	Lead	194	112	−25.	0+	11 m	.....	.....	ε	~3.2	0.204	
			195	113	−25.	.....	17 m	.....	.....	ε	~4.6	0.099, 0.383, 0.393	
			196	114	−27.	0+	37 m	.....	.....	ε	~2.4	0.253, 0.240, 0.367, 0.192, . . .	
			197m	...	.....	($\frac{13}{2}$+)	43 m	.....	.....	ε(80)	.....	IT0.234(20), 0.222(80), 0.387, 0.0849	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-1}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
82	Pb	Lead	197	115	−26.	$(\frac{5}{2}-)$	?	.....	.....	ϵ	~3.7	0.386	
			198	116	−28.	0+	2.4 h	.....	.....	ϵ(100)	~1.5	0.38(40), 0.173(28), 0.290(16), 0.259(8), 0.865(6), 0.575(4), . . .	
			199m	...	.....	$(\frac{13}{2}+)$	12.2 m	.....	.....	.....	.....	IT0.424(100)	
			199	117	−27.	$(\frac{5}{2}-)$	90 m	.....	.....	ϵ, β^+2.8	~3	0.367(80), 0.353(17), 0.720(10)	
			200	118	−28.	0+	21.5 h	.....	.....	ϵ	~0.7	0.1476, 0.1423, 0.2356, 0.1095, 0.2384, 0.2572, . . .	
			201m	...	.....	.....	61 s	.....	.....	.....	.....	IT0.629(100)	
			201	119	−27.	.....	9.4 h	.....	.....	ϵ, β^+0.55	~1.8	0.331, 0.361, 0.406, 0.585, . . .	
			202m	..	.....	9−	3.62 h	.....	.....	ϵ(10)	.....	IT0.422(90), 0.961(90), 0.787(45), 0.658(35), 0.490(10), 0.460(8), . . .	
			202	120	−27.97	0+	~3 × 10^5 y	.....	.....	ϵ(100)	0.05		
			203m	...	.....	$(\frac{13}{2}+)$	6.1 s	.....	.....	.....	.....	IT0.825(92), 0.820(10), . . .	
			203	121	−26.60	$(\frac{5}{2}-)$	52.1 h	.....	.....	ϵ(100)	0.98	0.279(81), 0.401(5), 0.680(1)	
			204m	...	.....	9−	66.9 m	.....	.....	.....	.....	IT0.90, 0.375, . . .	
			204	122	−26.96	0+	1.48%	.....	.....	.....	.....	.....	0.66
			205	123	−25.52	$(\frac{5}{2}-)$	3 × 10^7 y	.....	.....	ϵ(100)	0.04		
			206	124	−25.53	0+	23.6%	.....	.....	.....	.....	.....	0.30
			207m	...	.....	$\frac{13}{2}+$	0.77 s	.....	.....	.....	.....	IT1.064, 0.570(100)	
			207	125	−24.097	$\frac{1}{2}-$	22.6%	+0.5895	.....	.....	.....	.....	0.71
			208	126	−23.34	0+	52.3%	.....	.....	.....	.....	.....	0.015
			209	127	−18.90	$(\frac{9}{2}+$	3.30 h	.....	.....	β^-0.635	0.64		

			210 (RaD)	128	−15.80	0+	22 y			β⁻0.017(31), 0.063(19) α3.72	0.063	0.0465
			211 (AcB)	129	−11.23	(9/2+)	36.1 m			β⁻1.37(92), 0.53(6), 0.95(1), 0.25(0.7), . . .	1.37	0.405(3), 0.832(3), 0.427(2), 0.766(1), . . .
			212 (ThB)	130	−8.11	0+	10.64 h			β⁻0.34(81), 0.58(14), . . .	0.57	0.239(47), 0.300(3), . . .
			213	131	−3.4	.....	10.2 m			β⁻	2	
			214 (RaB)	132	−0.16	.....	26.8 m			β⁻0.69(42), 0.74(36), 1.03(6), . . .	1.04	0.352(42), 0.295(25), 0.242(12), 0.053(11), . . .
83	Bi	Bismuth	190	107	.....	.....	?	.....	.....	α6.46		
			191m	...	.....	.....	?	.....	.....	α6.90		
			191	108	−13.	.....	15 s	.....	.....	α6.31		
			192	109	−14.	.....	40 s	.....	.....	α6.06		
			193m	...	.....	.....	3.2 s	.....	.....	α6.50		
			193	110	−16.	.....	70 s	.....	.....	α5.90		
			194	111	−16.	.....	85 s	.....	.....	α5.61		
			195m	...	.....	.....	60 s	.....	.....	α6.10		
			195	112	−19.	.....	2.5 m	.....	.....	α5.42		
			196?	113	−19.	.....	7.8 m	.....	.....	ε, α5.8	~8	
			197	114	−21.	.....	8 m	.....	.....	ε(90+), α5.81(0.05)	~5.5	
			198	115	−21.	.....	11.9 m	.....	.....	.....	~7	0.20, 0.32, 0.56, 1.06
			199	116	−22.	9/2	21.7 m	.....	.....	ε(99+), α5.48(0.01)	~5	
			200	117	−22.	7	35 m	.....	.....	ε	~6	
			201m	...	.....	.....	59, n	.....	.....	ε(90+), α5.24(0.01)		
			201	118	−23.	9/2−	1.8 h	.....	.....	ε	~4	0.629
			202	119	−22.	5	95 m	.....	.....	ε	~5	0.422, 0.961
			203	120	−23.17	9/2−	11.8 h	+4.59	−0.64	ε, β⁺1.35, 0.74	3.19	0.82(78), 1.87(35), 1.52(31), 1.034(16), 0.381(9), 0.186(6), . . .
			204	121	−22.	6+	11.2 h	+4.25	−0.41	ε(100)	~4.4	0.375, 0.0785, 0.176, 0.249, 0.216, 0.899, . . .
			205	122	−22.62	9/2−	15.3 d	+5.5	.....	ε(99.9), β⁺0.98(0.06)	2.70	0.703(28), 1.766(27), 0.988(17), 0.57(14), 1.044(8), 1.864(6), . . .
			206	123	−21.61	6+	6.24 d	+4.56	−0.19	ε	3.65	0.803(99), 0.890(72), 0.516(46), 1.720(36), 0.538(34), 0.343(26), . . .
			207	124	−21.52	(9/2−)	30 y	.....	.....	ε	2.40	0.570(98), 1.063(77), 1.771(9)

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
83	Bi	Bismuth	208	125	−20.27	(5+)	3.7×10^5 y	.....	.....	ϵ(100)	2.87	2.614(100)	
			209	126	−19.60	$\frac{9}{2}-$	100%	+4.080	−0.35	.....	.....	.....	0.034
			210*m*	...	.....	.....	3×10^6 y	.....	.....	α4.96(58), 4.92(36), 4.57(6), 4.43(0.4), β^-(0.4)	.....	0.266(45), 0.305(23), 0.344, 0.650, . . .	0.054
			210 (RaE)	127	−15.87	1−	5.01 d	±0.0442	±0.13	β^-1.160(99+), α4.65, 4.39	1.160		
			211 (AcC)	128	−12.70	$(\frac{9}{2}-)$	2.15 m	.....	.....	α6.62(84), 6.28(16), . . . , β^-(0.3)	0.59	0.351(14)	
			212 (ThC)	129	−8.72	1(−)	60.6 m	.....	.....	β^-2.25(54), 1.52(5), . . . , α6.05(25), 6.09(10), . . .	2.246	0.727(7), 1.620(2), 0.040(2), 0.785(1), . . .	
			213	130	−5.62	$(\frac{9}{2}-)$	46 m	.....	.....	β^-1.42(66), 1.02(31), . . . , α5.87(2), 5.55	1.42	0.440(32), . . .	
			214 (RaC)	131	−1.27	(1−)	19.8 m	.....	.....	β^-3.28(20), 1.51(18), 1.55(15), 1.88(9), . . . , α5.45, 5.511, . . . , (0.02)	3.28	0.609(42), 1.764(17), 1.120(15), 0.769(6), 1.378(5), . . .	
			215	132	1.8	$(\frac{9}{2}-)$	7.4 m	.....	.....	β^-	2.24		
84	Po	Polonium	192	108	.....	.....	0.5 s	.....	.....	α6.58			
			193	109	−8.	.....	4 s	.....	.....	α7.0			
			194	110	−10.	0+	0.6 s	.....	.....	α6.85			
			195*m*	...	.....	.....	2.0 s	.....	.....	α6.71			
			195	111	−11.	.....	4.5 s	.....	.....	α6.62			
			196	112	−13.	0+	5 s	.....	.....	α6.52			
			197*m*	...	.....	.....	27 s	.....	.....	α6.38			
			197	113	−14.	.....	56 s	.....	.....	α6.28			
			198	114	−16.	0+	1.7 m	.....	.....	ϵ, α6.18	~4		
			199*m*	...	.....	.....	4.1 m	.....	.....	ϵ(74), α6.05(26)			

		199	115	−16.	.....	5.1 m	.....	.....	ε(97), α5.94(3)	~6		
		200	116	−18.	0+	11.4 m	.....	.....	ε(88), α5.86(12)	~3.7		
		201m	...	.....	.....	9 m	.....	.....	ε(97), α5.78(3)			
		201	117	−18.	$\frac{3}{2}$	15.4 m	.....	.....	ε(99), α5.68(1)	~5		
		202	118	−19.	0+	44 m	.....	.....	ε(98), α5.58(2)	~3		
		203m	...	.....	.....	30 m	.....	.....	ε(99+), α5.38(0.1)			
		203	119	−19.	$\frac{5}{2}$(−)	42 m	.....	.....	ε(99+), α5.49(0.02)	~4		
		204	120	−20.	0+	3.6 h	.....	.....	ε(99+), α5.38(0.7)	~2.3		
		205	121	−19.	$\frac{5}{2}$−	1.8 h	~+0.26	+0.17	ε(99+), α5.22(0.07)	~3.4		
		206	122	−19.65	0+	8.8 d	.....	.....	ε(95), α5.22(5)	1.82	0.51(100), 1.02(85), 0.807(60), 0.338(40), 0.286(35)	
		207m	...	.....	.....	2.8 s	.....	.....	.....	.....	IT0.82(100), 0.26(42), 0.31(40)	
		207	123	−18.39	$\frac{5}{2}$−	5.7 h	~+0.27	+0.28	ε(99), β^+0.89(0.3), 1.14(0.2), α5.12(0.01)	2.91	0.95(84), 0.74(36), 0.41(13), 1.15(6), 0.25(5), 1.37(4), . . .	
		208	124	−18.76	0+	2.93 y	.....	.....	α5.12(99+), 4.22(0.0002), ε(0.006)	1.41	0.285(0.006), . . .	
		209	125	−17.56	$\frac{1}{2}$	103 y	+0.76	.....	α4.88(99), 4.32,(0.5), . . . , ε(0.5)	1.89	0.91(0.5), 0.261(0.4)	
		210 (RaF)	126	−17.12	0+	138.4 d	.....	.....	α5.305(100)	.....	.....	<0.03
		211m	...	.....	($\frac{9}{2}^-$+)	25 s	.....	.....	α7.28(91), 8.88(7), 8.09(1.7), 8.31(0.25)	.....	0.570(92), 1.063(77)	
		211 (AcC')	127	−13.34	($\frac{9}{2}$+)	0.52 s	.....	.....	α7.45(99), 6.89(0.5), . . .	.....	0.57(0.5), 0.90(0.5)	
		212m	...	.....	(18+)	45 s	.....	.....	α11.65(97), . . .	.....	2.61(3), 0.57(2)	
		212 (ThC')	123	−11.135	0+	3.04×10^{-7} s	.....	.....	α8.78(100), . . .			
		213	129	−7.15	($\frac{9}{2}$+)	4.2×10^{-6} s	.....	.....	α8.38(100), . . .			
		214 (RaC')	130	−4.79	0+	1.62×10^{-4} s	.....	.....	α7.688(100), . . .			
		215 (AcA)	131	−0.55	($\frac{7}{2}$, $\frac{9}{2}$+)	1.78×10^{-3} s	.....	.....	α8.384(100), . . . β^-(0.0002)	0.740	0.44	
		216 (ThA)	132	1.92	0+	0.15 s	.....	.....	α6.777(100), . . .			
		217	133	6.	.....	<10 s	.....	.....	α6.54(>80), β^-(<20)	~1.6		
		218 (RaA)	134	9.01	0+	3.05 m	.....	.....	α6.000(99.98), . . . β^-(0.02)	0.27		

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half-life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
85	At	Astatine	196	111	−4.	.....	0.3 s	.....	.....	α7.06			
			197	112	−6.	.....	0.4 s	.....	.....	α6.96			
			198*m*	...	.....	.....	1.5 s	.....	.....	α6.85			
			198	113	−7.	.....	4.9 s	.....	.....	α6.75			
			199	114	−9.	.....	7.2 s	.....	.....	α6.64			
			200*m*	...	.....	.....	4.3 s	.....	.....	α6.54			
			200	115	−9.	.....	42 s	.....	.....	α6.46, 6.41, ϵ			
			201	116	−11.	.....	1.5 m	.....	.....	α6.34, ϵ			
			202*m*	...	.....	.....	2.6 m	.....	.....	α6.23			
			202	117	−11.	.....	3.0 m	.....	.....	ϵ(90), α6.13(10)	~7		
			203	118	−13.	.....	7.4 m	.....	.....	ϵ(86), α6.09(14)	~6		
			204	119	−13.	.....	9.3 m	.....	.....	ϵ(95), α5.95(5)	~7		
			205	120	−14.	.....	26 m	.....	.....	ϵ(82), α5.90(18)	~5		
			206	121	−14.	.....	32 m	.....	.....	α5.70(88), ϵ(12)	~6		
			207	122	−14.3	.....	1.8 h	.....	.....	ϵ(90), α5.76(10)	3.84		
			208	123	−13.	.....	1.6 h	.....	.....	ϵ(99.5), α5.65(0.5)	~4.9	0.685(99), 0.660(80), 0.177(20), . . .	
			209	124	−13.83	$(\frac{9}{2}-)$	5.5 h	.....	.....	ϵ(95), α5.05(5)	3.48	0.780(94), 0.545(62), 0.195(23)	
			210	125	−12.96	(5+)	8.3 h	.....	.....	ϵ(99.8), α5.36, 5.53, 5.44	3.87	1.80(100), 0.245(79), 1.483(48), 1.436(29), 1.599(14), . . .	
			211	126	−12.49	$\frac{9}{2}(-)$	7.21 h	.....	.....	ϵ(59), α5.87(41)	0.79	0.67	
			212*m*	...	.....	.....	0.12 s	.....	.....	α7.82(80), 7.88(20)	.....	0.063	
			212	127	−9.26	.....	0.30 s	.....	.....	α7.56(80), 7.60(20)	.....	0.063	
			213	128	−7.1	.....	Short	.....	.....	α9.06			
			214	129	−3.67	.....	Short	.....	.....	α8.78(99.8), 8.45, 8.24			
			215	130	−1.34	.....	1×10^{-4} s	.....	.....	α8.00(99.95), 7.60(0.05)	.....	0.40	

			216	131	2.42	.....	3×10^{-4} s	.....	.....	α7.81(97), 7.69(2), 7.61, 7.57, 7.48, 7.40, 7.33, 7.25				
			217	132	4.71	.....	0.03 s	.....	.....	α7.066(99.9), 6.82, 6.62, 6.49, . . .	.....	0.260, 0.455, 0.595		
			218	133	8.71	.....	~2s	.....	.....	α6.70(90), 6.65(6), 6.76(3.4)				
										β^-(0.1)	2.88			
			219	134	11.3	.....	0.9 m	.....	.....	α6.27(97)				
										β^-(3)	1.69			
86	Rn	Radon	201	115	−4.	.....	3 s	.....	.....	α6.77				
			202	116	−6.	0+	13 s	.....	.....	α6.64				
			203m	...	.....	.....	28 s	.....	.....	α6.55				
			203	117	−6.	.....	45 s	.....	.....	α6.50				
			204	118	−8.	0+	75 s	.....	.....	α6.42				
			205	119	−8.	.....	1.8 m	.....	.....	α6.26				
			206	120	−8.	0+	6.5 m	.....	.....	α6.26(65), ε(35)	~4			
			207	121	−9.	.....	11 m	.....	.....	ε(96), α6.15(4)	~5			
			208	122	−10.	0+	23 m	.....	.....	ε(80), α6.14(20)	~3			
			209	123	−10.	.....	30 m	.....	.....	ε(83), α6.04(17)	~4			
			210	124	−10.46	0+	2.42 h	.....	.....	α6.04(96), ε(4)	2.33			
			211	125	−9.38	$(\frac{1}{2}-)$	14.6 h	.....	.....	ε(74), α5.73(17), 5.85(9), 5.62(0.5)	2.89	0.680(74), 1.37(38), 0.445(29), 1.13(23), 0.946(21), 0.865(18)		
			212	126	−9.29	0+	25 m	.....	.....	α6.26				
			213	127	−6.11	.....	0.019 s	.....	.....	α8.10				
			215	129	−1.25	.....	Short	.....	.....	α8.6				
			216	130	0.27	0+	4.5×10^{-5} s	.....	.....	α8.05				
			217	131	3.94	.....	5.4×10^{-4} s	.....	.....	α7.74				
			218	132	5.61	0+	0.03 s	.....	.....	α7.13(99.8), 6.54(0.2)	.....	0.61(0.2)		
			219	133	9.51	$(\frac{3}{2}, \frac{5}{2}+)$	3.96 s	.....	.....	α6.817(81), 6.551(12), 6.423(7), 6.53, 6.31, 6.16, . . .	.....	0.272(9), 0.401(5), . . .		
			220 (Tn)	134	11.40	0+	55.6 s	.....	.....	α6.29(99.9), 5.75(0.07)	.....	0.542(0.07)		<0.2
			221	135	15.	.....	25 m	.....	.....	β^-(80), α(20)	~1.1			
			222 (Rn)	134	17.61	0+	3.824 d	.....	.....	α5.486(99.9), 4.98, 4.82	.....	0.51		0.72
			223	135	.....	.....	43 m	.....	.....	β^-	1.85			
			224	136	.....	0+	1.90 h	.....	.....	β^-	0.55			
			225	137	.....	.....	4.5 m	.....	.....	β^-				
			226	138	.....	0+	6 m	.....	.....	β^-				

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu × 10^{-3}	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
87	Fr	Francium	203	116	2.	.....	0.7 s	.....	.....	α7.13			
			204m	...	.....	.....	2.2 s	.....	.....	α7.03			
			204	117	1.	.....	3.3 s	.....	.....	α6.97			
			205	118	−0.8	.....	3.7 s	.....	.....	α6.92			
			206	119	−1.	.....	15.7 s	.....	.....	α6.79			
			207	120	−3.	.....	15 s	.....	.....	α6.77			
			208	121	−3.	.....	59 s	.....	.....	α6.65			
			209	122	−4.	.....	52 s	.....	.....	α6.65			
			210	123	−4.	.....	3.2 m	.....	.....	α6.57			
			211	124	−4.5	.....	3.1 m	.....	.....	α6.53			
			212	125	−4.	.....	19 m	.....	.....	ε(56), α6.39(17), 6.42(16), 6.35(11), . . .	~5.1	0.039, 0.123, . . .	
			213	126	−3.82	.....	35 s	.....	.....	α6.27(99.5), ε(0.5)	2.14		
			214m	...	.....	(9−)	3.4×10^{-8} s	.....	.....	α8.48(51), 8.55(46), 7.71(1), 8.05(1), . . .			
			214	127	−1.02	.....	5.0×10^{-8} s	.....	.....	α8.43(68), 7.45(10), 7.83(10), 8.36(7), . . .			
			215	128	0.36	.....	$\ll 10^{-8}$ s	.....	.....	α9.4			
			217	130	4.64	.....	Short	.....	.....	α8.31			
			218	131	7.52	.....	Short	.....	.....	α7.85(93), 7.55(5), 7.52(1), 7.71, 7.37			
			219	132	9.25	.....	0.02 s	.....	.....	α7.30(98.4), 6.95(1), 7.14, 6.68, 6.72	.....	0.163, 0.189, 0.352, 0.493, 0.530	
			220	133	12.32	.....	27.5 s	.....	.....	α6.68(80), 6.63(14), 6.57(4), 6.52(2), 6.48, 6.43, 6.40			
			221	134	14.26	.....	4.8 m	.....	.....	α6.34(82), 6.12(16), 6.24(1), 5.98(5), 5.94, 6.07, 5.78, . . .	.....	0.22(13), . . .	
			222	135	17.57	.....	14.8 m	.....	.....	β⁻(100)	2.028		
			223 (AcK)	136	19.76	.....	22 m	.....	.....	β⁻1.10, . . . , (99+), α5.34(0.005)	1.15	0.050(40), 0.080(13), 0.234(4), . . .	

			224	137	23.	.....	<2 m	.....	.....	β^-	~2.9		
			225	138	.....	.....	3.9 m	.....	.....	β^-			
			226	139	.....	.....	1.4 m	.....	.....	β^-			
88	Ra	Radium	206	118	5.	0+	0.4 s	.....	.....	α7.27			
			207	119	4.	.....	1.3 s	.....	.....	α7.13			
			208	120	2.	0+	1.2 s	.....	.....	α7.13			
			209	121	2.	.....	4.7 s	.....	.....	α7.01			
			210	122	0.5	0+	3.8 s	.....	.....	α7.02			
			211	123	0.8	.....	15 s	.....	.....	α6.91			
			212	124	−0.3	0+	13 s	.....	.....	α6.87			
			213	125	0.1	.....	2.7 m	.....	.....	α6.62(49), 6.73(15), 6.52(6)			
			214	126	−0.03	.....	2.6 s	.....	.....	α7.14			
			215	127	2.74	.....	1.6×10^{-3} s	.....	.....	α8.70(96), 7.88(3), . . .			
			216	128	3.49	0+	$<10^{-3}$ s	.....	.....	α9.3			
			217	129	6.32	.....	Short	.....	.....	α8.98			
			218	130	7.15	0+	Short	.....	.....	α8.39			
			219	131	10.08	.....	Short	.....	.....	α8.0			
			220	132	11.03	0+	0.023 s	.....	.....	α7.45(99), . . .	.....	0.465(1)	
			221	133	13.93	.....	30 s	.....	.....	α6.61(35), 6.76(31), 6.67(21), 6.59(8), 6.58(3), 6.25(0.7), . . .	.....	0.152(13), 0.176(2), 0.320(0.7), . . .	
			222	134	15.38	0+	38 s	.....	.....	α6.55(96), . . .	.....	0.325(4), . . .	
			223	135	18.53	$(\frac{1}{2}+)$	11.4 d	.....	.....	α5.714(53), 5.605(24), 5.715(9), 5.538(9), 5.432(2), 5.870(1), . . .	.....	0.270(14), 0.154(5), 0.180(5), . . .	130 Fission 1.0
			(AcX)										
			224	136	20.20	0+	3.64 d	.....	.....	α5.684(95), 5.45(5), . . .	.....	0.241(4), . . .	12.0
			(ThX)										
			225	137	23.63	$(\frac{5}{2})-$	14.8 d	.....	.....	β^-0.32(60), . . .	0.387	0.04(30)	
			226	138	25.44	0+	1,600 y	.....	.....	α4.731(94), 4.593(5), . . .	.....	0.186(3), . . .	20
			(Ra)										
			227	139	29.20	.....	41 m	.....	.....	β^-1.31	1.31	0.027, 0.30, 0.50	
			228	140	31.10	0+	5.75 y	.....	.....	β^-0.048(70), 0.024(30)	0.055	0.0067, 0.0263	36
			($MsTh_1$)										
			229	141	35.	.....	Short	.....	.....	β^-	~2		
			230	142	37.	.....	1 h	.....	.....	β^-	~0.8		
89	Ac	Actinium	209	120	10.	.....	0.19 s	.....	.....	α7.59			
			210	121	10.	.....	0.35 s	.....	.....	α7.46			
			211	122	8.	.....	0.25 s	.....	.....	α7.48			

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
89	Ac	Actinium	212	123	8.	.....	0.93 s	.....	.....	α7.38			
			213	124	7.	.....	0.80 s	.....	.....	α7.36			
			214	125	7.	.....	8.2 s	.....	.....	α7.21(52), 7.08(44), 7.00(4)			
			215	126	6.	.....	0.17 s	.....	.....	α7.60			
			216	127	9.	.....	3.9×10^{-4} s	.....	.....	α9.14			
			218	129	11.54	.....	Short	.....	.....	α9.21			
			219	130	12.43	.....	Short	.....	.....	α8.66			
			220	131	14.76	.....	0.024 s	.....	.....	α7.64, 7.43			
			221	132	15.60	.....	Short	.....	.....	α7.63(73), 7.42(30)			
			222	133	17.78	.....	4.2 s	.....	.....	α7.00(93), 6.96(6), ϵ(1)	2.237		
			223	134	19.13	$(\frac{5}{2}-)$	22 m	.....	.....	α6.65(42), 6.46(38), 6.56(13), 6.22(4), . . . , ϵ(1)	0.563	0.082, 0.096, 0.12, . . .	
			224	135	21.72	.....	2.9 h	.....	.....	ϵ(90), α6.04(3), 6.20(3), 6.13(3), . . .	1.40	0.216, 0.32, . . .	
			225	136	23.23	$(\frac{3}{2}-)$	10.0 d	.....	.....	α5.83(52), 5.79(29), 5.72(10), 5.63(4), 5.72(3), . . .	.....	0.084, 0.088, 0.100, 0.150, 0.110, 0.063	
			226	137	26.10	.....	29 h	.....	.....	β^-0.89(46), 1.1(31)	1.12	0.072(30), 0.230, 0.253	
			227 (Ac)	138	27.77	$\frac{3}{2}(-)$	21.8 y	+1.1	+1.7	ϵ(23) β^-0.044, . . . (98.6), α4.95(0.7), 4.94(0.5), . . .	0.63 0.044	0.158, 0.185, 0.068 0.009, 0.025, 0.015	810
			228 ($MsTh_2$)	139	31.04	3(+)	6.13 h	.....	.....	β^-1.19(25), 1.76(20), 2.10(13), 0.62(6), . . .	2.14	0.911(23), 0.966(20), 0.338(15), 0.0575, 0.129, 1.593, . . .	
			229	140	33.	.....	66 m	.....	.....	β^-	1		
			230	141	36.	.....	<1 m	.....	.....	β^-~2.2	2.9		
			231	142	38.6	.....	15 m	.....	.....	β^-2.1	2.1	0.185, 0.28, 0.39, 0.71	
90	Th	Thorium	213	123	13.	.....	0.15	.....	.....	α7.69			
			214	124	12.	.....	0.13 s	.....	.....	α7.58			

			215	125	12.	.....	1.2 s	.....	.....	α7.39(52), 7.52(40), 7.633(8)			
			216	126	11.	.....	0.03 s	.....	.....	α7.92			
			217	127	13.	.....	<0.0003 s	.....	.....	α9.25			
			221	131	18.19	.....	0.0017 s	.....	.....	α8.48			
			222	130	18.48	0+	~0.0028 s	.....	.....	α7.98			
			223	133	20.69	.....	0.9 s	.....	.....	α7.55			
			224	134	21.47	0+	1.05 s	.....	.....	α7.17(79), 6.99(19), 6.77(1), 6.70(0.4)	.....	0.177(9), 0.410(1), . . .	
			225	135	23.96	$(\frac{3}{2}+)$	8.0 m	.....	.....	α6.48(41), 6.44(14), 6.50(13), 6.80(9), . . .	.....	0.322(30), 0.246(5), 0.362(5), . . .	
										ε(5)	0.680		
			226	136	24.92	0+	30.9 m	.....	.....	α6.33(79), 6.22(19), 6.10(1), . . .	.....	0.111(5), 0.242(1), . . .	
			227 (Rdac)	137	27.73	$(\frac{3}{2}+)$	18.5 d	.....	.....	α6.037(25), 5.976(23), 5.755(20), 5.707(8), 5.712(5), 5.699(4), . . .	.....	0.236(12), 0.050(10), 0.256(6), 0.330(3), . . .	Fission 150
			228 (RdTh)	138	28.73	0+	1.913 y	.....	.....	α5.42(71), 5.31(28), . . .	.....	0.0845(16), 0.216(3), . . .	120
			229	139	31.78	$\frac{5}{2}+$	7340 y	+0.38	~4.6	α4.84(58), 4.90(11), 4.81(11), 4.97(10), 5.05(7)	.....	0.20(10), 0.137(3), . . .	Fission 32
			230 (Io)	140	33.16	0+	8.0×10^4 y	.....	.....	α4.68(76), 4.62(4), . . .	.....	0.07(0.6), 0.14, 0.18, 0.25	33
			231 (UY)	141	36.32	$(\frac{5}{2}+)$	25.5 h	.....	.....	β⁻0.30(46), 0.22(27), 0.14(20), 0.09(7)	0.387	0.084(10), 0.026(2), 0.090, . . .	
			232 (Th)	142	38.08	0+	1.41×10^{10} y 100%	.....	.....	α4.01(76), 3.95(24)	.....	0.059	7.4
			233	143	41.60	.....	22.2 m	.....	.....	β⁻1.244(~85), 1.158, 1.073, 0.88, 0.79, 0.58	1.244	0.0869(3), 0.0292(2), 0.453(1), 0.171(0.7), . . .	1,500 Fission 15
			234 (UX_1)	144	43.64	0+	24.1 d	.....	.....	β⁻0.19(81), 0.10(19)	0.263	0.093(4), 0.063(3), . . .	1.8
			235	145	.....	.....	≪10 m	.....	.....	β⁻			
91	Pa	Protactinium	224	133	25.55	.....	0.60 s	.....	.....	α			
			225	134	26.12	.....	2 s	.....	.....	α7.25			
			226	135	27.88	.....	1.8 m	.....	.....	α6.86(38), 6.82(34), 6.73(1)			
										ε(26)	2.77		
			227	136	28.80	$(\frac{5}{2}-)$	38.3 m	.....	.....	α6.46(43), 6.41(13), 6.42(10), 6.40(8), . . .		0.065(6), 0.110(2), . . .	
										ε(15)	1.000		

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
91	Pa	Protactinum	228	137.	31.01	(3+)	26 h	.....	....	ϵ(98) α6.08, 6.11, 6.12, 6.14, ... (2)	2.11	0.95(93), 0.46(32), 0.33(18), 0.41(13), 0.20(9), 1.57(7), . . .	
			229	138	32.10	$(\frac{5}{2}-)$	1.5 d	.....	.....	ϵ(99+), α5.58(0.1), 5.62, 5.67, . . .	0.29	0.0424, . . .	
			230	139	34.56	(2−)	17.7 d	.....	.....	ϵ(90) β^-0.41(10), α5.34, . . . , (0.003)	1.29 0.56	0.954(50), 0.91(24), 0.45(18), 0.51(8), . . .	Fission 1,500
			231	140	35.90	$\frac{3}{2}-$	3.24×10^4 y	±1.98	.....	α5.01(24), 5.02(23), 4.95(22), 4.73(11), 5.06(10)	.....	0.027(6), 0.29(6), . . .	200 Fission 0.01
			232	141	38.59	.....	1.31 d	.....	.....	β^-0.32(98), 1.19(0.8), 1.30(0.7)	1.34	0.87(51), 0.971(40), 0.150(12), 0.46(9), 0.57(8), 0.107(5), . . .	760
			233	142	40.27	$\frac{3}{2}-$	27.0 d	+3.4	−3.0	β 0.26(55), 0.15(10), 0.57(5)	0.571	0.31(31), 0.300(6), 0.341(4), . . .	43
			234*m* (UX_2)	...	.....	(0−)	1.17 m	.....	.....	β^-2.29(98), . . .	.....	IT0.07(0.1), 0.043(2), 1.00(0.6), . . .	
			234 (UZ)	143	43.35	(4+)	6.75 h	.....	.....	β^-0.51(66), 0.23(14), 0.73(11), 1.02(7), 1.35(2)	2.22	0.90(70), 0.100(50), 0.126(26), 0.70(24), 0.56(15), 0.22(14), . . .	
			235	144	45.4	.....	23.7 m	.....	....	β^-1.4	1.4		
			236	145	49.0	.....	12 m	.....	....	β^-3.3	~3		
			237	146	52.22	.....	39 m	.....	....	β^-2.30(60), 1.30(30), 0.8(10)	2.30	0.46, 0.87, 0.92, 0.205, 0.090, 0.75, . . .	
92	U	Uranium	227	135	31.	.....	1.3 m	.....	.....	α6.8			
			228	136	31.38	0+	9.2 m	.....	.....	α6.68(66), 6.59(29), . . . , ϵ(5)	0.35	0.246, 0.187, 0.152	
			229	137	33.50	$(\frac{3}{2}+)$	58 m	.....	.....	ϵ(80), 6.36(13), 6.33(4), 6.30(2), . . .	1.32		

			230	138	33.94	0+	20.8 d	.....	.....	α5.89(67), 5.82(32), . . .		0.072(0.5), 0.231(0.2), . . .	Fission 25
			231	139	36.29	$(\frac{5}{2}-)$	4.3 d	.....	.....	ε(99+), α5.46(0.006)	0.36	0.026(12), 0.084(7), 0.220(1), . . .	Fission 400
			232	140	37.15	0+	72 y	.....	.....	α5.32(68), 5.27(32), 5.14(0.3), . . .	.....	0.058(0.2), . . .	150 Fission 75
			233	141	39.65	$\frac{5}{2}+$	1.62×10^5 y	+0.54	+3.5	α4.82(83), 4.78(15), 4.72(1.5), . . .	.....	0.042, 0.097, 0.055, 0.029, 0.22, 0.32, . . .	579 Fission 532
			234 (UII)	142	40.98	0+	2.47×10^5 y 0.0057%	.....	.....	α4.77(72), 4.72(28), . . .	.....	0.053(0.2), . . .	95
			235m	...	.....	$\frac{1}{2}+$	26.1 m	.....	.....	....	.....	IT0.000075	
			235 (AcU)	143	43.94	$\frac{7}{2}-$	7.1×10^8 y 0.72%	−0.35	+4.1	α4.396(57), 4.366(18), 4.216(5.7), 4.597(4.6), 4.415(4), 4.323(3), . . .	.....	0.185(54), 0.143(11), 0.163(5), 0.204(5), 0.110(3), . . .	681 Fission 582
			236	144	45.59	0+	2.39×10^7 y	.....	.....	α4.49, . . .	.....	0.05	6.0
			237	145	48.75	$\frac{1}{2}+$	6.75 d	.....	.....	β⁻0.25(96), 0.10(4), . . .	0.517	0.060(36), 0.208(23), 0.026(2), 0.175(2), 0.33(1), . . .	480 Fission 2
			238 (UI)	146	50.82	0+	4.51×10^9 y 99.27%	.....	.....	α4.20(75), 4.15(25)	.....	0.048	2,720
			239	147	54.33	$(\frac{5}{2}+)$	23.5 m	.....	.....	β⁻1.21(80), 1.28(20)	1.28	0.075(51), 0.044(4), . . .	36 Fission 14
			240	148	56.63	0+	14.1 h	.....	.....	β⁻0.36(100)	0.51	0.044	
93	Np	Neptunium	228 or 227	135 or 134	.....	.....	60 s	.....	.....	SF			
			229	136	36.25	.....	4.0 m	.....	.....	α6.89			
			230	137	37.79	.....	4.6 m	.....	.....	α6.66			
			231	138	38.27	.....	≈50 m	.....	.....	α6.29			
			232	139	40.	.....	≈13 m	.....	.....	ε	2.7		
			233	140	41.	.....	35 m	.....	.....	ε(99+) α5.54(0.001)	1.1		
			234	141	42.91	(0+)	4.40 d	.....	.....	ε(99+), β⁺0.8(0.05)	1.80	1.56(20), 1.53(12), 1.60(10), 1.44(7), 1.19(6), 1.57(6), . . .	Fission 900
			235	142	44.08	$\frac{5}{2}+$	410 d	.....	.....	ε(99+), α5.02, 5.10, . . . (0.002)	0.113		
			236m	...	.....	.....	$>5 \times 10^3$ y	.....	.....	β⁻?	.....	.....	2,800

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu × 10^{-4}	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
93	Np	Neptunium	237	144	48.19	$\frac{5}{2}$+	2.14 × 10^6 y	+3.3	−	α4.79(49), 4.77(26), 4.76(8), 4.64(7), 4.66(5), 4.87(3), . . .	.....	0.029(14), 0.087(14), 0.145(1), . . .	169 Fission 0.019
			238	145	50.97	2(+)	2.1 d	.....	.....	β^-1.25(45), 0.26(38), 0.26(15), . . .	1.29	1.01(42), 0.044, . . .	Fission 2,000
			239	146	52.95	$\frac{5}{2}$+	2.35 d	.....	.....	β^-0.437(48), 0.332(32), 0.393(7), 0.713(7), 0.654(4), . . .	0 723	0.106(23), 0.278(14), 0.228(12), 0.209(4), . . .	63
			240*m*	...	.....	1(−)	7.3 m	.....	.....	β^-2.18(41), 1.60(32), 1.30(10), 0.7(7), . . .	.....	0.56(21), 0.60(13), 0.92(3), 1.5(3), . . .	
			240	147	56.08	.....	67 m	.....	.....	β^-0.89	2.1	0.56, 0.160, 0.245, 0.296, 1.00, 1.16, . . .	
			241	...	.....	.....	3.4 h	.....	.....	β^-			
			241	148	58.3	.....	16 m	.....	.....	β^-1.4	1.4		
94	Pu	Plutonium	232	138	41.17	0+	36 m	.....	.....	ϵ(98), α6.59(2)	1.1		
			233	139	42.99	.....	20 m	.....	.....	ϵ(99+), α6.31(0.1)	2.0		
			234	140	43.33	0+	9.0 h	.....	.....	ϵ(94), α6.20(4), 6.19(2), . .	0.39		
			235	141	45.28	.....	26 m	.....	.....	ϵ(99−), α5.86(0.003)	1.12		
			236	142	46.05	0+	2.85 y	.....	.....	α5.77(69), 5.72(31), 5.62(0.2), . . .	.....	0.048(0.3), 0.109(0.01)	Fission 170
			237*m*	...	.....	($\frac{1}{2}$+)	0.18 s	.....	.....	.....	.....	IT0.145(100)	
			237	143	48.43	($\frac{7}{2}$−)	45.6 d	.....	.....	ϵ(99+), α5.37, 5.86	0.22	0.060(5), 0.033, 0.044, . . .	Fission 2,500
			238	144	49.58	0+	86 y	.....	.....	α5.50(72), 5.46(28), . . .	.....	0.043(0.04), . .	577 Fission 16.5
			239	145	52.18	$\frac{1}{2}$+	2.44 × 10^4 y	+0.200	.....	α5.157(73), 5.144(15), 5.107(11), . . .	.....	0.052(0.02), 0.039(0.007), . . .	1,005 Fission 736
			240	146	53.84	0+	6,580 y	.....	.....	α5.17(76), 5.12(24), 5.02(0.1), . . .	.....	0.045, . . .	290 Fission 0.05

95	Am	Americium	241	147	56.87	$\frac{5}{2}+$	14.0 y	−0.73	+5.6	β^-0.0208(99+), α4.90(0.002), . . .	0.0208	. . .	1,371; Fission 1,011
			242	148	58.77	0+	3.79 × 10^5 y	. . .	. . .	α4.90(76), 4.86(24)	. . .	. . .	20
			243	149	62.03	($\frac{7}{2}+$)	4.98 h	. . .	. . .	β^-0.58(61), 0.49(38), . . .	0.59	0.084(21), 0.381(0.7), . . .	271; Fission 196
			244	150	64.24	0+	8 × 10^7 y	. . .	. . .	α	. . .	. . .	1.8
			245	151	67.83	. . .	10.5 h	. . .	. . .	β^-0.93(48), 1.2, . . .	1.26	0.327(49), . . .	260
			246	152	70.13	0+	10.9 d	. . .	. . .	β^-0.15(90), 0.33(10)	0.37	0.044(30), 0.224(25), 0.180(10)	
			237	142	50.	. . .	~1.3 h	. . .	. . .	ε(99+), α6.02(0.005)	1.5		
			238	143	52.	. . .	1.9 h	. . .	. . .	ε(100)	~2.3	0.98(80), 1.35(76), 0.58(29), 0.36(12)	
			239	144	53.04	($\frac{5}{2}-$)	12.1 h	. . .	. . .	ε(99+), α5.78(0.005)	0.81	0.228(18), 0.278(17), 0.209(5), 0.068, 0.057, 0.049, . . .	
			240	145	55.	. . .	51 h	. . .	. . .	ε(100)	1.4	1.00(77), 0.90(23), 1.40	
			241	146	56.85	$\frac{5}{2}-$	433 y	+1.59	+4.9↝	α5.49(86), 5.44(13), 5.39(1), 5.55(0.3), . . .	. . .	0.060(36), 0.026(3), . . .	787; Fission 3.3
			242m_2	. . .	. . .	. . .	0.014 s	. . .	. . .	SF			
			242m_1	. . .	. . .	5(−)	152 y	. . .	. . .	α5.21(0.4), . . .	. . .	IT0.048(99.5), . . .	Fission 2,100
			242	147	59.57	1(−)	16.0 h	±0.382	±2.8	β^-0.62(50), 0.66(34); ε(16)	0.66; 0.75	0.042; 0.045	
			243	148	61.39	$\frac{5}{2}-$	7.37 × 10^3 y	+1.4	+4.9	α5.28(88), 5.23(11), 5.18(1), . . .	. . .	0.075(61), 0.044(5), . . .	189
			244m	. . .	. . .	(1−)	26 m	. . .	. . .	β^-1.50(80), . . . , (20); ε(0.04)	. . .	0.043, . . .	
			244	149	64.31	(6−)	10.1 h	. . .	. . .	β^-0.387(100)	1.43	0.746(66), 0.900(25), 0.154(19), 0.099(5), . . .	Fission 2,300
			245	150	66.48	($\frac{5}{2}+$)	2.05 h	. . .	. . .	β^-0.91(78), 0.65(17), 0.60(5)	0.91	0.253(20), 0.240(1), 0.296(1)	
			246m	. . .	. . .	. . .	39 m	. . .	. . .	β^-	. . .	0.680, 0.205, 0.154, 0.757, . . .	
			246	151	69.72	(2+)	25.0 m	. . .	. . .	β^-1.31(79), 1.60(14), 2.10(7)	2.30	1.079(32), 0.799(29), 1.063(19), 1.037(14), 1.086(2), 0.834(2), . . .	
			247	152	72.	. . .	22 m	. . .	. . .	β^-	~1.6	0.285, 0.227	
96	Cm	Curium	238	142	53.03	0+	2.5 h	. . .	. . .	ε(90), α6.51(10)	~0.9		
			239	143	55.	. . .	2.9 h	. . .	. . .	ε(100)	1.7	0.188	

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu $\times 10^{-3}$	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
96	Cm	Curium	240	144	55.52	0+	26.8 d	.....	.....	α6.29(72), 6.25(28), 6.15(0.04)	0.77	0.475(93), 0.60, 0.145	
			241	145	57.68	$(\frac{1}{2}+)$	35 d	.....	.....	ϵ(99), α5.94(0.7), 5.93(0.2), . . .	.....	0.044(0.04), . . .	20
			242	146	58.86	0+	163 d	.....	.....	α6.12(73), 6.07(27), 5.97(0.03), . . .		0.278(14), 0.228(12), 0.209(4), 0.106	950
			243	147	61.40	$\frac{5}{2}+$	32 y	.....	.....	α5.79(73), 5.74(12), 5.99(6), 5.06(6) 5.69(2), . . . , ϵ(0.3)	0.007		Fission 700
			244	148	62.78	0+	18.0 y	.....	.....	α5.81(77), 5.77(23), . .	.....	0.043(0.02), . . .	14
			245	149	65.51	$\frac{7}{2}+$	9.3×10^3 y	.....	.....	α5.36(87), 5.46(5), 5.31(4), 5.25(2), 5.53(2), . . .	.....	0.173(14), 0.13(5)	Fission 1.0
			246	150	67.25	0+	5.5×10^3 y	.....	.....	α5.39(81), 5.34(19)	.....	.....	2,250
			247	151	70.38	.....	1.6×10^7 y	.....	.....	α	.....	.....	Fission 250
			248	152	72.38	0+	4.7×10^5 y	.....	.....	α5.08(73), 5.04(16), SF(11)	.....	.....	8.4
			249	153	75.99	.....	64 m	.....	.....	β^-0.9	.....	.....	288
97	Bk	Berkelium	250	154	78.	0+	1.2×10^4 y	.....	.....	SF	0.9	.....	Fission 108
			243	146	63.02	$(\frac{3}{2}-)$	4.6 h	.....	.....	ϵ(99+), α6.57(0.04), 6.54(0.03), 6.76(0.02), 6.21(0.02), . . .	1.51	0.76, 0.84, 0.95, . . .	6
			244	147	65.	.....	4.4 h	.....	.....	ϵ(99+), α6.67(0.003), 6.62(0.003)	2.3	0.218, 0.892, 0.922, 0.188, 0.490, 0.334 . . .	1.6
			245	148	66.39	$(\frac{3}{2}-)$	4.98 d	.....	.....	ϵ(99+), α5.89(0.02), 6.15(0.02), 6.36(0.02), . . .	0.82	0.253(31), 0.381(4), 0.385(1), . . .	

			246	149	69.	...	1.8 d	...	...	ε(100)	~1.6	0.800(40), 1.082(4), 1.124(3), 0.834(3), . . .	
			247	150	70.32	$(\frac{9}{2}-)$	1.4×10^3 y	...	...	α5.52(58), 5.68(37), 5.31(5)	...	0.084(40), 0.27(30)	
			248	...	...	(8−)	>9 y	...	...	?			
			248	151	73.	(0−)	16 h	...	...	β^-0.65(70) ε(30)	0.7 0.6		
			249	152	75.00	$\frac{7}{2}+$	314 d	...	...	β^-0.125(99+), α5.42(0.002), . . .	0.125	0.32, . . .	1,600
			250	153	78.34	(2−)	3.22 h	...	...	β^-0.73(89), 1.76(11)	1.76	0.990(47), 1.032(39), . . .	Fission 960
			251	154	81.	...	57 m	...	...	β^-~0.5, ~1.0	~1.1	0.037, 0.94, 0.140, 0.184	
98	Cf	Californium	242	144	63.72	...	3.3 m	...	...	α7.37	...		
			243	145	65.	...	11 m	...	...	ε(90), α7.06, 7.17	~2.2		
			244	146	65.99	0+	20 m	...	...	α7.21(75), 7.17(25)			
			245	147	68.07	...	44 m	...	...	ε(70), α7.13(30)	1.56		
			246	148	68.84	0+	36 h	...	...	α6.76(78), 6.72(22), 6.63(0.2), . . .	...	0.042(0.01), 0.096(0.01), 0.146(0.004)	
			247	149	71.2	...	2.5 h	...	...	ε(100)	~0.7	0.295(1), 0.417, 0.460, . . .	
			248	150	72.22	0+	350 d	...	...	α6.27(82), 6.22(18)	...	...	2,035 Fission 300
			249	151	74.87	$\frac{9}{2}-$	360 y	...	...	α5.81(84), 5.76(4), 5.95(3), 5.91(3), 6.20(2), 5.85(1), . . .	...	0.388(72), 0.333(15), 0.253(3), . . .	
			250	152	76.43	0+	13 y	...	...	α6.03(83), 5.99(17), 5.89(0.3), . . .	...	0.043	1,500
			251	153	79.61	$\frac{1}{2}+$	~800 y	...	...	α5.67(35), 5.85(28), 6.01(12), 5.63(5), . . .	...	0.177(19), 0.224(7)	6,100 Fission 4,000
			252	154	81.66	0+	2.65 y	...	...	α6.12(82), 6.08(15), . . . , SF(3.1)	...	0.043(0.01), 0.100, (0.01), 0.16	20
			253	155	85.17	$(\frac{7}{2}+)$	17.6 d	...	...	β^-0.27(99+), α5.98(0.31), . . .	0.27	...	1,500
			254	156	87.	0+	60.5 d	...	...	SF(99+), α5.84(0.2), . . .	...	...	150
99	Es	Einsteinium	245	146	71.	...	1.3 m	...	...	ε(83), α7.70(17)	~3		
			246	147	73.	...	7.3 m	...	...	ε(90), α7.33(10)	~4		
			247	148	73.62	...	5.0 m	...	...	ε(93), α7.33(7)	2.3		
			248	149	75.	...	25 m	...	...	ε(99+), α6.88(0.3)	~3		
			249	150	76.38	...	2 h	...	...	ε(99+), α6.77(0.13)	1.41		

TABLE 8b-1. PROPERTIES OF NUCLIDES (*Continued*)

(1) Atomic number Z	(2) Symbol	(3) Name	(4) Mass number A	(5) Number of neutrons N	(6) Mass excess, amu × 10^{-3}	(7) Spin and parity	(8) % abundance or half life	(9) Magnetic moment, nuclear magnetons	(10) Quadrupole moment, barns	(11) Mode of decay, energy, and intensity, MeV (%)	(12) β-decay Q values, MeV	(13) Energy and intensity of γ-ray transitions, MeV (%)	(14) 2,200-m/s neutron-absorption cross section, barns
99	Es	Einsteinium	250	151	79.	.....	8 h	.....	.....	ε(100)	~2		
			251	152	80.00	.....	1.5 d	.....	.....	ε(99+), α6.48(0.53)	0.35		
			252	153	83.	(7+)	~140 d	.....	.....	α6.61(82), 6.58(13), 6.44(2), 6.26(1), . . .	.....	0.40(1), 0.074(0.3), 0.23(0.2), 0.28(0.2), . . .	
			253	154	84.85	($\frac{7}{2}$+)	20.47 d	.....	.....	α6.64(90), 6.60(7), 6.55(1), . . .	.....	0.387(0.05), 0.429, . . .	150
			254m	...	.....	(2−)	39.3 h	.....	.....	β^-0.48(75), 1.127(25), ε(0.08), 6.39	.....	0.69(38), 0.65(31), . . .	Fission, 1,840
			254	155	88.05	(7+)	276 d	.....	.....	α6.44(93), 6.37(3), 6.42(2), 6.36(1), . . .	.....	0.063(2), 0.31(0.2), 0.27(0.1), 0.39(0.07), . . .	Fission, 3,060
			255	156	90.	.....	38.3 d	.....	.....	β^-(91.5)	~0.3	.....	~40
			256	157	93.71	.....	25 m	.....	.....	α6.31(8.5), SF			
			257	158	.....	.....	<20 h	.....	.....	β^-	1.8		
100	Fm	Fermium	244	144	.....	.....	0.0033 s	.....	.....	β^-			
			245	145	.....	.....	4.2 s	.....	.....	SF			
			246	146	75.31	.....	1.6 s	.....	.....	α8.15			
			247	147	77.	.....	30 s	.....	.....	α8.25			
			248	148	77.19	0+	0.6 m	.....	.....	α7.87(70), 7.93(30)			
			249	149	79.	.....	~2.5 m	.....	.....	α7.87(80), 7.83(20), SF(0.1)			
								.....	.....	α7.9			

			250	150	79.54	0+	30 m	....	....	α7.44			
			251	151	82.	....	7 h	....	....	ε(99), α6.90(1)	~1.5		
			252	152	82.49	0+	23 h	....	....	α7.05			
			253	153	85.21	....	3 d	....	....	ε(89), α6.96(9), 6.91(2)	0.34		
			254	154	86.88	0+	3.24 h	....	....	α7.20(85), 7.16(14), 7.06(0.9), . . . , SF(0.055)	....	0.041(0.2), 0.098(0.03), 0.151	75
			255	155	89.98	$\frac{7}{2}$+	20.1 h	....	....	α7.03(93), 6.97(5), 6.90(0.6), . . . , SF	....	0.081(1.1), 0.059(0.9), . . .	26
			256	156	91.81	0+	2.0 h	....	....	SF(92), α6.92(8)			
			257	157	95.15	($\frac{9}{2}$+)	80 d	....	....	α6.52(94), 6.70(3), 6.4(2), . . .	....	0.242(10), 0.180(8), . . .	
			258	158	....	....	<5 s	....	....	SF			
101	Md	Mendelevium	255	154	91.	....	27 m	....	....	ε(90), α7.34(10)	~1.1		
			256	155	94.	....	77 m	....	....	ε(97), α7.23(3)	~2.0		
			257	156	96.	....	4.5 h	....	....	ε(92), α7.08(8)	~0.4		
			258	157	....	....	54 d	....	....	α6.73, 6.78			
102	No	Nobelium	251	149	89.	....	0.8 s	....	....	α8.60(80), 8.68(20)			
			252	150	88.97	....	2.3 s	....	....	α8.41(70), SF(30)			
			253	151	91.	....	95 s	....	....	α8.01			
			254	152	90.98	0+	55 s	....	....	α8.10			
			255	153	93.	....	180 s	....	....	α8.11			
			256	154	94.28	0+	3.1 s	....	....	α8.43(99+), SF(0.5)			
			257	155	97.	....	23 s	....	....	α8.27(50), 8.23(50)			
103	Lr	Lawrencium	256	153	99.	....	35 s	....	....	α8.42, . . . , ε(?)			
			257	154	100.	....	0.7 s	....	....	α8.87, 8.81			
			258	155	....	....	4.05	....	....	α8.6			
104	....	....	257	153	....	....	~4.5	....	....	α9.00, 8.95, 8.78, 8.70			
			258?	154	....	....	0.1 s	....	....	SF			
			259	155	....	....	~3 s	....	....	α8.77, 8.86			
105	....	....	260	155	....	....	1.6 s	....	....	α9.06(55), 9.10(75), 9.14(20)			