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RADIOACTIVE ELEMENTS IN THE STANDARD ATOMIC WEIGHTS TABLE

Norman E. Holden

National Nuclear Data Center
Brookhaven National Laboratory
P.O. Box 5000
Upton, NY 11973-5000
www.nndc.bnl.gov

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National Nuclear Data Center
Brookhaven National Laboratory
Upton, New York 11973-5000, USA

Introduction

In the 1949 Report of the Atomic Weights Commission[1], a series of new elements were added to the Atomic Weights Table. Since these elements had been produced in the laboratory and were not discovered in nature, the atomic weight value of these artificial products would depend upon the production method. Since atomic weight is a property of an element as it occurs in nature, it would be incorrect to assign an atomic weight value to that element. As a result of that discussion, the Commission decided to provide only the mass number of the most stable (or longest-lived) known isotope as the number to be associated with these entries in the Atomic Weights Table.

As a function of time, the mass number associated with various elements has changed as longer-lived isotopes of a particular element has been found in nature, or as improved half-life values of an element's isotopes might cause a shift in the longest-lived isotope from one mass to another.

In the 1957 Report of the Atomic Weights Commission[2], it was decided to discontinue the listing of the mass number in the Atomic Weights Table on the grounds that the kind of information supplied by the mass number is inconsistent with the primary purpose of the Table, i.e., to provide accurate values of "these constants" for use in various chemical calculations. In addition to the Table of Atomic Weights, the Commission included an auxiliary Table of Radioactive Elements for the first time, where the entry would be the isotope of that element which was the most stable, i.e., the one with the longest known half-life.

In their 1973 Report[3], the Commission noted that the users of the main Table of Atomic Weights were dissatisfied with the omission of values for some elements in that Table and it was decided to reintroduce the mass number for the radioactive elements into the main Table.

In their 1983 Report[4], the Commission decided that radioactive elements were considered to lack a characteristic terrestrial isotopic composition, from which an atomic weight value could be calculated to five or more figure accuracy, without prior knowledge of the sample involved. These elements were again listed in the Atomic Weights Table with no further information, i.e., with no mass number or atomic weight value.

Preamble to the Table of the Radioactive Elements

For the elements, which have no stable characteristic terrestrial isotopic composition, the data on the half-lives and the relative atomic masses for the nuclides of interest for those elements have been evaluated. The values of the half-lives with their uncertainties are listed in the table. The uncertainties are given for the last digit quoted of the half-life and are given in parentheses. A half-life entry for the Table having a value and an uncertainty of 7 ± 3 is listed in the half-life column as 7 (3).

The criteria to include data in this Table, is to be the same as it has been for over sixty years. It is the same criteria, which are used for all data that are evaluated for inclusion in the Standard Table of Atomic Weights. If a report of data is published in a peer-reviewed journal, that data is evaluated and considered for inclusion in the appropriate table of the biennial report of the Atomic Weights Commission. As better data becomes available in the future, the information that is contained in either of the Tables of Standard Atomic Weights or in the Table of Radioactive Elements may be modified.

It should be noted that the appearance of any datum in the Table of the Radioactive Elements is merely for the purposes of calculating an atomic mass value for any sample of a radioactive material, which might have a variety of isotopic compositions and it has no implication as to the priority for claiming discovery of a given element and is not intended to.

The atomic mass values have been taken primarily from the 2003 Atomic Mass Table[5]. Mass values for those radioisotopes that do not appear in the 2003 Atomic mass Table have been taken from preliminary data of the Atomic Mass Data Center[6]. Most of the quoted half-lives in the Table have already been documented in various book, journal and conference sources[7, 8, 9, 10, 11, 12].

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TABLE OF THE RADIOACTIVE ELEMENTS

At. No.	Element Name	Elem. Symbol	Mass No.	Atomic Mass	Half-life ± Uncertainty	Units
43	technetium	Tc	97	96.9064	4.21 (16) x10^{6}	a
			98	97.9072	6.6 (10) x 10^{6}	a
			99	98.9063	2.1 (3) x 10^{5}	a
61	promethium	Pm	145	144.9127	17.7 (4)	a
			146	145.9147	5.53 (5)	a
			147	146.9151	2.623 (3)	a
84	polonium	Po	208	207.9812	2.90 (1)	a
			209	208.9824	1.28 (7) x 10^{2}	a
			210	209.9829	138.4 (1)	d
85	astatine	At	210	209.9871	8.1(4)	h
			211	210.9875	7.21 (1)	h
86	radon	Rn	210	209.9897	2.4 (1)	h
			211	210.9906	14.6 (2)	h
			222	222.0176	3.823 (4)	d
87	francium	Fr	212	211.9962	20.0 (6)	min
			222	222.0176	14.2 (3)	min
			223	223.0197	22.0 (1)	min
88	radium	Ra	226	226.0254	1599. (4)	a
			228	228.0311	5.76 (3)	a
89	actinium	Ac	225	225.0232	10.0 (1)	d
			227	227.0278	21.77 (2)	a
90	thorium	Th	230	230.0331	7.56 (3) x 10^{4}	a
			232	232.0381	1.40 (1) x 10^{10}	a
91	protactinium	Pa	231	231.0359	3.25 (1) x 10^{4}	a
			233	233.04025	27.0 (1)	d
92	uranium	U	233	233.0396	1.590 (3) x 10^{5}	a
			234	234.0410	2.454 (2) x 10^{5}	a
			235	235.0439	7.034 (2) x 10^{8}	a
			236	236.0456	2.342 (4) x 10^{7}	a
			238	238.0508	4.468 (5) x 10^{9}	a
93	neptunium	Np	236	236.0466	1.55 (6) x 10^{5}	a
			237	237.0482	2.14 (1) x 10^{6}	a
94	plutonium	Pu	238	238.0496	87.7 (1)	a
			239	239.0522	2.410 (3) x 10^{4}	a
			240	240.0538	6.56 (1) x 10^{3}	a
			241	241.0569	14.33 (3)	a
			242	242.0587	3.75 (2) x 10^{5}	a
			244	244.0642	8.12 (3) x 10^{7}	a

TABLE OF THE RADIOACTIVE ELEMENTS (Continued)

At. No.	Element Name	Elem. Symbol	Mass No.	Atomic Mass	Half-life ± Uncertainty	Unit
95	americium	Am	241	241.0568	432.7 (6)	a
			243	243.0614	7.37 (2) x10^3	a
96	curium	Cm	243	243.0614	29.1 (1)	a
			244	244.0628	18.3 (1)	a
			245	245.0655	8.48 (6) x 10^3	a
			246	246.0672	4.73 (3) x 10^3	a
			247	247.0704	1.56 (5) x 10^7	a
			248	248.0723	3.48 (6) x 10^5	a
97	berkelium	Bk	247	247.0703	1.4 (3) × 10^3	a
			249	249.0750	3.20 (3) x 10^2	d
98	californium	Cf	249	249.0749	351. (2)	a
			250	250.0764	13.1 (1)	a
			251	251.0796	9.0 (5) × 10^2	a
			252	252.0816	2.65 (1)	a
99	einsteinium	Es	252	252.0830	472. (2)	d
			254	254.0880	276. (1)	d
100	fermium	Fm	253	253.0852	3.0 (1)	d
			257	257.0951	100.5 (2)	d
101	mendelevium	Md	258	258.0984	51.5 (3)	d
			260	260.1037	27.8 (3)	d
102	nobelium	No	255	255.0932	3.1 (2)	min
			259	259.1010	58. (5)	min
103	lawrencium	Lr	251	251.0944	~ 39.	min
			261	261.1069	~ 40.	min
			262	262.1095	3.6 (3)	h
104	rutherfordium	Rf	263	263.1125	~ 11.	min
			267	267.122	~ 1	h
105	dubnium	Db	267	267.123	~ 1.2	h
			268	268.126	1.2 (4)	d
106	seaborgium	Sg	267	267.1244	~ 1.3	min
			271	271.134	~ 2	min
107	bohrium	Bh	270	270.1333	~ 1	min
			274	274.143	~ 0.9	min
108	hassium	Hs	269	269.1338	~ 10.	s
			270	270.1343	23.	s
109	meitnerium	Mt	270	270.1404	~ 0.8	s
			278	278.156	7.6	s
110	darmstadtium	Ds	280	280.161	~ 7.6	s
			281	281.164	13. (5)	s

TABLE OF THE RADIOACTIVE ELEMENTS (Continued)

At. No.	Element Name	Elem. Symbol	Mass No.	Atomic Mass	Half-life ± Uncertainty	Units
111	roentgenium	Rg	280	280.165	~ 3.6	s
			281	281.166	2.6	s
112	copernicium	Cn	283	283.172	4. (1)	s
			285	285.176	~ 29.	s
113	ununtrium	Uut	285	285.179	~ 5.5	s
			286	286.181	~ 20.	s
114	ununquadium	Uuq	288	288.187	0.7 (2)	s
			289	289.190	2.1 (8)	s
115	ununpentium	Uup	288	288.192	~ 0.09	s
			289	289.193	0.22	s
116	ununhexium	Uuh	291	291.200	0.02	s
			292	292.201	18. (16)	ms
			293	293.204	0.06 (5)	s
117	ununseptium	Uus	293	293.208	~ 14.	ms
			294	294.209	~0.08	s
118	ununoctium	Uuo	294	294.213	~ 0.9	ms