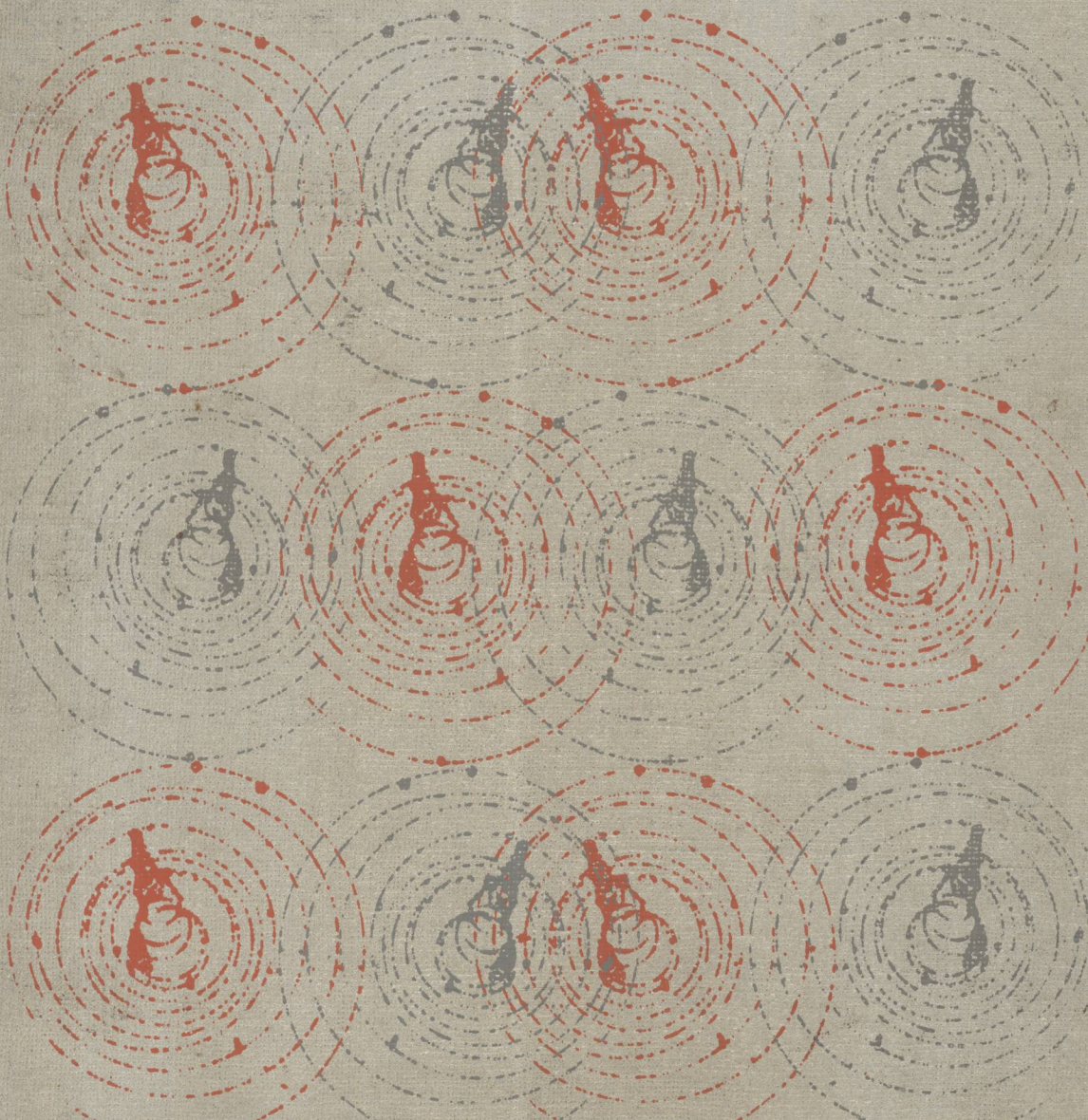
General College Chemistry

Earl S. Huyser



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General College Chemistry

EARL S. HUYSER
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臺灣工業技術學院
圖書館藏書
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Under the editorship of
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University of Kansas

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TABLE OF ATOMIC WEIGHTS, 1971 (Based on Carbon-12)

Values in parentheses are estimated and denote, in most cases, isotopes of longest half-life. Digits given as subscripts are reliable to ±3%; other values are reliable to ±1% in the last digit.

	SYMBOL	NO.	WEIGHT
Actinium	Ac	89	(227)
Aluminum	Al	13	26.98154[a]
Americium	Am	95	(243)
Antimony	Sb	51	121.7_5
Argon	Ar	18	39.94_8[b,c,d,g]
Arsenic	As	33	74.9216[a]
Astatine	At	85	(210)
Barium	Ba	56	137.3_4
Berkelium	Bk	97	(249)
Beryllium	Be	4	9.01218[a]
Bismuth	Bi	83	208.9804[a]
Boron	B	5	10.81[c,d,e]
Bromine	Br	35	79.904[c]
Cadmium	Cd	48	112.40
Calcium	Ca	20	40.08
Californium	Cf	98	(249)
Carbon	C	6	12.011[b,d]
Cerium	Ce	58	140.12
Cesium	Cs	55	132.9054[a]
Chlorine	Cl	17	35.453[c]
Chromium	Cr	24	51.996[c]
Cobalt	Co	27	58.9332[a]
Copper	Cu	29	63.54_6[c,d]
Curium	Cm	96	(245)
Dysprosium	Dy	66	162.5_0
Einsteinium	Es	99	(253)
Erbium	Er	68	167.2_6
Europium	Eu	63	151.96
Fermium	Fm	100	(254)
Fluorine	F	9	18.99840[a]
Francium	Fr	87	(223)
Gadolinium	Gd	64	157.2_5
Gallium	Ga	31	69.72
Germanium	Ge	32	72.5_9
Gold	Au	79	196.9665[a]
Hafnium	Hf	72	178.4_9
Hahnium	Ha	105	(260)
Helium	He	2	4.00260[b,c]
Holmium	Ho	67	164.9304[a]
Hydrogen	H	1	1.0080[b,d]
Indium	In	49	114.82
Iodine	I	53	126.9045[a]
Iridium	Ir	77	192.2_2
Iron	Fe	26	55.84_7
Krypton	Kr	36	83.80
Lanthanum	La	57	138.905_5[b]
Lawrencium	Lr	103	(257)
Lead	Pb	82	207.2[d,g]
Lithium	Li	3	6.94_1[c,d,e]
Lutetium	Lu	71	174.97
Magnesium	Mg	12	24.305[c]
Manganese	Mn	25	54.9380[a]
Mendelevium	Md	101	(256)
Mercury	Hg	80	200.5_9
Molybdenum	Mo	42	95.9_4
Neodymium	Nd	60	144.2_4
Neon	Ne	10	20.17_9[c]
Neptunium	Np	93	237.0482[b,f]
Nickel	Ni	28	58.7_1
Niobium	Nb	41	92.9064[a]
Nitrogen	N	7	14.0067[b,c]
Nobelium	No	102	(254)
Osmium	Os	76	190.2
Oxygen	O	8	15.999_4[b,c,d]
Palladium	Pd	46	106.4
Phosphorus	P	15	30.97376[a]
Platinum	Pt	78	195.0_9
Plutonium	Pu	94	(242)
Polonium	Po	84	(210)
Potassium	K	19	39.09_8
Praseodymium	Pr	59	140.9077[a]
Promethium	Pm	61	(145)
Protactinium	Pa	91	231.0359[a,f]
Radium	Ra	88	226.0254[a,f,g]
Radon	Rn	86	(222)
Rhenium	Re	75	186.2
Rhodium	Rh	45	102.9055[a]
Rubidium	Rb	37	85.467_8[c]
Ruthenium	Ru	44	101.0_7
Rutherfordium	Rf	104	(257)
Samarium	Sm	62	150.4
Scandium	Sc	21	44.9559[a]
Selenium	Se	34	78.9_6
Silicon	Si	14	28.08_6[d]
Silver	Ag	47	107.868[c]
Sodium	Na	11	22.98977[a]
Strontium	Sr	38	87.62[g]
Sulfur	S	16	32.06[d]
Tantalum	Ta	73	180.947_9[b]
Technetium	Tc	43	98.9062[f]
Tellurium	Te	52	127.6_0
Terbium	Tb	65	158.9254[a]
Thallium	Tl	81	204.3_7
Thorium	Th	90	232.0381[a,f]
Thulium	Tm	69	168.9342[a]
Tin	Sn	50	118.6_9
Titanium	Ti	22	47.9_0
Tungsten	W	74	183.8_5
Uranium	U	92	238.029[b,c,e]
Vanadium	V	23	50.941_1[b,c]
Xenon	Xe	54	131.30
Ytterbium	Yb	70	173.0_4
Yttrium	Y	39	88.9059[a]
Zinc	Zn	30	65.38
Zirconium	Zr	40	91.22

[a] Mononuclidic element.

[b] Element with one predominant isotope (about 99–100 per cent abundance).

[c] Element for which the atomic weight is based on calibrated measurements.

[d] Element for which variation in isotopic abundance in terrestrial samples limits the precision of the atomic weight given.

[e] Element for which users are cautioned against the possibility of large variations in atomic weight due to inadvertent or undisclosed artificial isotopic separation in commercially available materials.

[f] Most commonly available long-lived isotope.

[g] In some geological specimens this element has a highly anomalous isotopic composition corresponding to an atomic weight significantly different from that given.

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MODERN PERIODIC TABLE

PERIODS	I A	II A	TRANSITION METALS III B	IV B	V B	VI B	VII B	VIII			I B	II B	III A	IV A	V A	VI A	VII A	0
	METALS												NONMETALS					
1 0	1.00797 H [1] 1																1.00797 H [1] 1	4.0026 He[2] 2
2 2	6.939 Li [3] 1	9.0122 Be[4] 2											10.811 B [5] 3	12.01115 C [6] 4	14.0067 N [7] 5	15.9994 O [8] 6	18.9984 F [9] 7	20.183 Ne[10] 8
3 2, 8	22.9898 Na[11] 1	24.312 Mg[12] 2											26.9815 Al[13] 3	28.086 Si [14] 4	30.9738 P [15] 5	32.064 S [16] 6	35.453 Cl [17] 7	39.948 Ar[18] 8
4 2, 8	39.102 K [19] 8, 1	40.08 Ca[20] 8, 2	44.956 Sc [21] 9, 2	47.90 Ti [22] 10, 2	50.942 V [23] 11, 2	51.996 Cr[24] 13, 1	54.9380 Mn[25] 13, 2	55.847 Fe[26] 14, 2	58.9332 Co[27] 15, 2	58.71 Ni [28] 16, 2	63.54 Cu[29] 18, 1	65.37 Zn[30] 18, 2	69.72 Ga[31] 18, 3	72.59 Ge[32] 18, 4	74.9216 As[33] 18, 5	78.96 Se[34] 18, 6	79.909 Br[35] 18, 7	83.80 Kr[36] 18, 8
5 2, 8, 18	85.47 Rb[37] 8, 1	87.62 Sr [38] 8, 2	88.905 Y [39] 9, 2	91.22 Zr [40] 10, 2	92.906 Nb[41] 12, 1	95.94 Mo[42] 13, 1	(99) Tc[43] 14, 1	101.07 Ru[44] 15, 1	102.905 Rh[45] 16, 1	105.4 Pd[46] 18	107.870 Ag[47] 18, 1	112.40 Cd[48] 18, 2	114.82 In[49] 18, 3	118.69 Sn[50] 18, 4	121.75 Sb[51] 18, 5	127.60 Te[52] 18, 6	126.9044 I [53] 18, 7	131.30 Xe[54] 18, 8
6 2, 8, 18	132.905 Cs [55] 18, 8, 1	137.34 Ba[56] 18, 8, 2	[57-71] *	178.49 Hf[72] 32, 10, 2	180.948 Ta[73] 32, 11, 2	183.85 W [74] 32, 12, 2	186.2 Re[75] 32, 13, 2	190.2 Os[76] 32, 14, 2	192.2 Ir [77] 32, 15, 2	195.09 Pt [78] 32, 17, 1	196.967 Au[79] 32, 18, 1	200.59 Hg[80] 32, 18, 2	204.37 Tl [81] 32, 18, 3	207.19 Pb[82] 32, 18, 4	208.980 Bi [83] 32, 18, 5	(210) Po[84] 32, 18, 6	(210) At[85] 32, 18, 7	(222) Rn[86] 32, 18, 8
7 2,8,18,32	(223) Fr [87] 18, 8, 1	(226.05) Ra[88] 18, 8, 2	[89-103] †	(257) Rf[104] 32, 10, 2	(260) Ha[105] 32, 11, 2	[106]	[107]	[108]										

* LANTHANIDE SERIES	138.91 La[57] 18, 9, 2	140.12 Ce[58] 20, 8, 2	140.907 Pr[59] 21, 8, 2	144.24 Nd[60] 22, 8, 2	(145) Pm[61] 23, 8, 2	150.35 Sm[62] 24, 8, 2	151.96 Eu[63] 25, 8, 2	157.25 Gd[64] 25, 9, 2	158.924 Tb[65] 27, 8, 2	162.50 Dy[66] 28, 8, 2	164.930 Ho[67] 29, 8, 2	167.26 Er[68] 30, 8, 2	168.934 Tm[69] 31, 8, 2	173.04 Yb[70] 32, 8, 2	174.97 Lu[71] 32, 9, 2
† ACTINIDE SERIES	(227) Ac[89] 18, 9, 2	232.038 Th[90] 18, 10, 2	(231) Pa[91] 20, 9, 2	238.03 U [92] 21, 9, 2	(237) Np[93] 23, 8, 2	(242) Pu[94] 24, 8, 2	(243) Am[95] 25, 8, 2	(245) Cm[96] 25, 9, 2	(245) Bk[97] 26, 9, 2	(248) Cf [98] 28, 8, 2	(253) Es[99] 29, 8, 2	(254) Fm[100] 30, 8, 2	(256) Md[101] 31, 8, 2	(253) No[102] 32, 8, 2	(257) Lw[103] 32, 9, 2

General College Chemistry

Preface

General College Chemistry was written for those college students whose major interests are in areas other than chemistry. For many in this group a chemistry course is still required for their particular programs (for example, home economics, many engineering disciplines, nursing, and the several allied health programs). For others of the group a chemistry course fulfills a science requirement for a degree; for still others the course may simply satisfy a desire to become acquainted with chemistry.

The various needs that must be met for those who will use this text have been kept in mind by the author and editors throughout its entire preparation. We trust that our concern is reflected both in the subject matter included and in the manner of its presentation.

Four general areas of chemistry are covered in the book. The first of these (Chapters 1–8) is for the purpose of providing the student with an understanding of some important principles of chemistry, more specifically those related to atomic and molecular structure, stoichiometry and chemical reactions, and the physical properties of matter in terms of the kinetic molecular theory of matter. The general topic of the second of the areas covered (Chapters 9–15) is elementary organic chemistry. Although the material here is largely descriptive, it is based on the principles developed in the earlier chapters. The portion of the book dealing with biochemistry (Chapters 16–19) includes material on some of the kinds of substances (sugars, amino acids, proteins, nucleotides, and nucleic acids) encountered in living organisms, as well as on some of the more important biochemical reactions (for example, oxidative metabolism and biosynthetic processes such as photosynthesis). The details of these reactions are given in Appendices 2–8. Several nonorganic topics are covered in the remainder of the text (Chapters 20–25). Among these are electrochemistry, nuclear chemistry, and the chemistry of some of the more important metallic and nonmetallic elements.

General College Chemistry is organized and presented in a manner that allows for substantial flexibility in its use as a text. It can be used for either a two-semester (three-quarter) course or a one-semester (two-quarter) course. For a two-semester course the material may be presented in the order that exists in the book. In this case, some of the organic chemistry will be taught in the first semester. If, however, an emphasis on nonorganic chemistry is desired early in the two-semester sequence, it is possible to skip from Chapter 8 (or for that matter, Chapter 6) to Chapter 20 without any loss of conti-

nuity. The organic and biochemistry material would then constitute the major part of the second semester. A one-semester course would include the basic concepts found in the first part of the book (particularly in Chapters 2–6) and would be followed by selected portions of the remainder of the book. (Suggested choices of material for one-semester courses with different emphases are outlined in the instructor's manual.)

Throughout the book the interrelationships are shown between chemistry and topics in areas such as history, economics, sociology, ecology and environmental concerns, and matters related to energy. The discussions relating chemistry to such topics are not relegated to special parts of the book but are always presented in the framework of the chemical principles under consideration. This manner of presentation was adopted to assure attainment of the goal of making *General College Chemistry* a *chemistry* textbook and not a book that merely tells about some of the interesting aspects of chemistry.

At the beginning of each chapter there is a *Note to the Student* and at the end of each chapter a list of *Key Terms and Concepts*. The note to the student is not an "abstract." Rather, it is a statement designed to prepare the student for what he or she will encounter in the chapter. The list of key terms and concepts is not exhaustive, being limited to only those items that pertain to the *significant* chemistry developed in the chapter. These two features are included primarily as aids to the student. Exercises are also given at the end of each chapter and are so designed as to be of maximum value to the student. Each exercise is directed toward a further understanding of an important concept developed in the chapter. Exercises of a numerical nature are based on the problems (with solutions) that were used in the chapter to demonstrate the quantitative aspects of chemical principles, and do not in any way test mathematical skills. Every attempt has been made to provide exercises of such a nature that the student's study does not become a frustrating experience with numerical problems. Answers are provided for all exercises that involve numerical calculations.

The author has been helped by a number of people in many ways in the preparation of this book. He not only wishes to acknowledge their efforts but also to express his sincere appreciation for their counsel and encouragement. The original manuscript was reviewed by Professors William T. Mooney, Jr., El Camino College; John W. Coutts, Lake Forest College; John T. Healey, Chabot College; Allan Cunningham, Monterey Peninsula College; H. LeRoy Nyquist, California State University (Northridge); and Reverend John R. Trzaska, Boston College. The comments and constructive criticisms of these reviewers were invaluable, and many of their suggested alterations were incorporated in the final manuscript. The author also owes a debt of gratitude to Professor David Paretsky, University of Kansas, for his aid in the preparation of the material related to biochemistry. The assistance of Mrs. Nancy Murray in the typing of the manuscript was of no small significance and is gratefully acknowledged.

A special debt of gratitude is owed to the author's colleague and friend, Professor Jacob Kleinberg, who served as the consulting editor for this book. Professor Kleinberg was actively involved in every stage of the development of this book, offering counsel in matters relating to organization of material,

writing, and scientific accuracy. Finally, the author wishes to express his thanks to Dr. Paul Bryant of D. C. Heath and Company who played a most significant role in transforming a manuscript into a book. He made this phase of the project not only an education to the author but also a pleasant experience.

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