CHEMISTRY FOR MEDICAL TECHNOLOGISTS

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原书缺页

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Preface

The purpose of this book is to present those aspects of chemistry which are significant to the medical technologist. The material falls into five sections: Essentials of Elementary Chemistry, Urine Analysis, Blood Analysis, Spinal Fluid Analysis, and Gastric and Duodenal Analysis.

The first section, Essentials of Elementary Chemistry, serves as a fulcrum for the less-advanced student and as a review for the more-advanced student. The material in the remaining sections meets the curriculum requirements of the National Registry Examinations.

The more popular methods of analysis are used throughout the text. In the analysis of glucose, for example, about ten different methods are available. Less than half, however, have gained any degree of popularity. In making selections, we were guided by two recent surveys. The first survey, a résumé of the current practices in urine analysis, was conducted by Marion H. Cook, of the Indiana Society of Medical Technologists. The second survey, a summary of the more popular methods of blood analysis, was made by the *Lab World* journal.

Many students, technicians, and chemists assisted in the preparation of the manuscript. I wish to thank the following students, who criticized the manuscript for clarity: Barbara Fischer, Martin Robbins, John Woods, George de Lange, Thomas Trueblood, Larry Shaw, Mike Kurtz, Roddy Jones, Lowell Branson, Mary Rodriques, Ruby Torres, Martha French, Manya Conovaloff, and Earlene McLouth.

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I also wish to express my gratitude for the excellent art work. Several illustrations were made by Robert Pribbenow and Samuel Taylor. The vast majority, however, were drawn by Hilbert Rembrandt Daniello.

In conclusion, I offer belated thanks to a former teacher John Myers Myers, who gave me a much-needed intellectual transfusion when I was suffering from a severe case of mental anemia. This peculiar anemia, which is usually confined to students, may be found in the desert areas of the United States. It is caused by a rare species of campus cactus which is commonly known as Arizona professorium.

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APPENDIXES

PART I

Essentials of Elementary Chemistry

THIS PORTION OF THE TEXT PRESENTS THE ELEMENTARY CHEMISTRY that is significant to the medical technologist. The material is discussed in the following chapters:

At the end of Chapter 4 there is a set of review questions. For the convenience of the student the answers are given and the pages for reference are listed.

CHAPTER 1

Basic Theory

What causes chemical reactions? How are they expressed by the chemist? What are ions? What is the hydrogen ion concentration? These and other basic questions are considered under the following headings:

Elements and Compounds
Chemical Reactions
Chemical Equations
Ionization
Acids, Bases, and Salts
Hydrogen Ion Concentration
Chemical Indicators

ELEMENTS AND COMPOUNDS

All matter is composed of tiny particles called atoms. If a substance is made up of atoms that are all alike, it is known as an element. Atoms of gold, for example, make up the element gold, and in a single speck of gold dust there are millions of gold atoms. Consequently, atoms are the building blocks of elements.

When a substance, however, is composed of different atoms, it is called a compound. To illustrate, salt is made up of sodium atoms and chlorine atoms. One sodium atom and one chlorine atom, when chemically united, form a structure known as a molecule. In a single grain of salt there are millions of molecules. Consequently, molecules become the building blocks of compounds.

The Architect of the universe designed 92 separate and distinct atoms. By making like atoms combine with like atoms, 92 elements were formed. By making different atoms react with different atoms, thousands of compounds were produced. These elements and compounds were used not only in the making of a world but also in the creation of life.

The men of science, by changing the structure of atoms, have made several new elements. These have found little use. By making different atoms react

with different atoms, countless new compounds have been produced. These have simplified our existence.

Of the 92 elements occurring in nature, 80 are solids, 10 are gases, and 2 are liquids. The more commonly known elements are listed in Table 1.

TABLE 1

COMMON ELEMENTS

SOLIDS			GASES	LIQUIDS
Lithium	Manganese	Antimony	Hydrogen	Bromine
Carbon	Iron	Iodine	Helium	Mercury
Sodium	Cobalt	Barium	Nitrogen	
Magnesium	Nickel	Cerium	Oxygen	
Aluminum	Copper	Tungsten	Fluorine	
Silicon	Zinc	Gold	Chlorine	
Phosphorus	Arsenic	Mercury		
Sulfur	Molybdenum	Lead		
Potassium	Silver	Bismuth		
Calcium	Tin	Uranium		

CHEMICAL REACTIONS

As you read these pages your body is undergoing millions of reactions per minute. These and other chemical reactions are all made possible by the simple transfer of material from one substance to another. The essential aspects of this transfer are discussed under the following headings:

Composition of Atoms
Nature of Reactions
Reason for Reactions
Combining Power or Valence
Oxidation and Reduction

Composition of Atoms

An atom is made up of protons and electrons. The protons are stationary particles located in the center or nucleus. The electrons revolve around this nucleus in definite pathways or orbits (Fig. 1).

The number of protons in an atom is known as the atomic number. This varies from 1 to 92 and identifies the atoms of different elements. For example, the sodium atom is the only atom that has 11 protons. This means that it has an atomic number of 11. The chlorine atom is the only atom that has 17 protons and, consequently, the atomic number of 17.

The atomic numbers of the atoms are given in Table 2. As you go down the list, observe that the atomic numbers increase by one. This indicates that the protons increase by one—and, to digress for a second, that the universe was put together by an orderly system of atoms, each successive atom differing by a single proton! Here indeed is the "order under the chaos, the music beneath the noise."

TABLE 2

ATOMIC NUMBERS OF THE ATOMS

ATOM	ATOMIC NUMBER	ATOM	ATOMIC NUMBER
Hydrogen	1	Tin	50
Helium	2	Antimony	51
Lithium	3	Tellurium	52
Beryllium	4	Iodine	53
Boron	5	Xenon	54
Carbon	6	Cesium	55
Nitrogen	7	Barium	56
Oxygen	8	Lanthanum	57
Fluorine	9	Cerium	58
Neon	10	Praseodymium	59
Sodium	11	Neodymium	60
Magnesium	12	Promethium	61
Aluminum	13	Samarium	62
Silicon	14	Europium	63
Phosphorus	15	Gadolinium	64
Sulfur	16	Terbium	65
Chlorine	17	Dysprosium	66
Argon	18	Holmium	67
Potassium	19	Erbium	68
Calcium	20	Thulium	69
Scandium	21	Ytterbium	70
Titanium	22	Lutetium	71
Vanadium	23	Hafnium	72
Chromium	24	Tantalum	73
Manganese	25	Tungsten	74
Iron	26	Rhenium	75
Cobalt	27	Osmium	76
Nickel	28	Iridium	77
Copper	29	Platinum	78
Zinc	30	Gold	79
Gallium	31	Mercury	80
Germanium	32	Thallium	81
Arsenic	33	Lead	82
Selenium	34	Bismuth	83
Bromine	35	Polonium	84
Krypton	36	Astatine	85
Rubidium	37	Radon	86
Strontium	38	Francium	87
Yttrium	39	Radium	88
Zirconium	40	Actinium	89
Niobium	41	Thorium	90
Molybdenum	42	Protactinium	91
Technetium	43	Uranium	92
Ruthenium	44	Neptunium	93
Rhodium	45	Plutonium	94
Palladium	46	Americium	95
Silver	47	Curium	96
Cadmium	48	Berkelium	97
Indium	49	Californium	98