

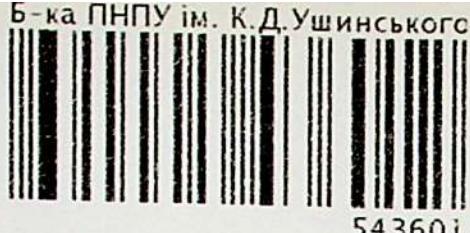
61:54(075)
M 42

Medical chemistry

*Edited by Professor
V.O. Kalibabchuk*

MEDICINE

www.medpublish.com.ua



UDC 61:54(075.8)
LBC 24ya73+5ya73
M42

54360 i

Approved by the Ministry of Education and Science of Ukraine as a textbook
for students of higher education establishments — medical universities, institutes,
and academies (letter No. 1/11-1152 of 5 February 2013)

Published in accordance with the Order of the Ministry of Health of Ukraine
No. 502 of 22 June 2010 as a national textbook for students of higher education
establishments — medical universities, institutes, and academies

Authors:

V.O. Kalibabchuk, V.I. Halynska, L.I. Hryshchenko, S.M. Hozhdzynskyi, T.O. Ovsianikova, V.A. Samarskyi

Reviewers:

V.V. Ohurtsov, Candidate of Pharmaceutical Sciences, Associate Professor, Head of the Chair of General, Bioinorganic, Physical and Colloidal Chemistry of Danylo Halytsky Lviv National Medical University;

V.K. Yakhtsymyrskyi, winner of the State Prize of Ukraine in Science and Engineering, Academician of the Higher Education Academy of Sciences of Ukraine, Doctor of Chemistry, Professor of the Chair of Physical Chemistry of Taras Shevchenko National University of Kyiv;

N.M. Atraptseva, Doctor of Chemistry, Professor, Head of the Chair of General Chemistry of National University of Biological Resources and Environmental Management of Ukraine

Medical chemistry : textbook / V.O. Kalibabchuk, V.I. Halynska, L.I. Hryshchenko et al. ; edited by V.O. Kalibabchuk. — 6th edition, corrected. — Kyiv : AUS Medicine Publishing, 2018. — 224 p.

ISBN 978-617-505-659-2

The textbook outlines the fundamentals of bioenergetics and cybernetics of biochemical reactions; describes the properties of solutions and their role in biochemical processes; presents modern concepts of electrode processes; explains peculiarities of surface phenomena and their value for the vital activity of the body; dwells on the properties of dispersion systems and biopolymer solutions. Special emphasis is placed on biogenic elements and their properties viewed through the spectacle of modern concepts of atomic and molecular structure, and chemical bonds.

The authors touch upon topical problems of ecology.

The textbook is intended for English-speaking students of higher education establishments — medical universities, institutes, and academies, pharmaceutical, biological, and ecological specialties.

ПІВДЕННОУКРАЇНСЬКИЙ
НАЦІОНАЛЬНИЙ ПЕДАГОГІЧНИЙ
УНІВЕРСИТЕТ ІМЕНІ К.Д. УШИНСЬКОГО
БІБЛІОТЕКА

ISBN 978-617-505-659-2

UDC 61:54(075.8)
LBC 24ya73+5ya73

© V.O. Kalibabchuk, V.I. Halynska, L.I. Hryshchenko, S.M. Hozhdzynskyi, T.O. Ovsianikova, V.A. Samarskyi, 2010, 2018
© AUS Medicine Publishing, design, 2018

Contents

Preface	5
Chapter 1. Chemical bonding and complexing	7
1.1. Chemical bond and its experimental characteristics	7
1.2. Covalent bond.....	8
1.3. Ionic bond.....	14
1.4. Metallic bond.....	15
1.5. Hydrogen bond	15
1.6. Complexing.....	16
<i>Self-test questions and tasks</i>	<i>23</i>
Chapter 2. Theoretical principles of bioenergetics.....	24
2.1. Subject of thermodynamics	24
2.2. Thermodynamic systems. Thermodynamic functions.....	25
2.3. First law of thermodynamics	26
2.4. Heat of chemical reactions. Thermochemical equations.....	28
2.5. Thermochemistry laws	29
2.6. Application of thermochemical calculations for describing the energy of biochemical processes	31
2.7. Second law of thermodynamics	33
2.8. Gibbs equation.....	34
<i>Self-test questions and tasks</i>	<i>36</i>
Chapter 3. Physical and chemical fundamentals of biochemical reaction kinetics	37
3.1. Dependence of reaction rate on reactant concentration. Mass action law.....	39
3.2. Molecularity and order of reaction.....	40
3.3. Simple and complex reactions	42
3.4. Effect of temperature on reaction rate.....	44
3.5. Catalysis	46
3.6. Chemical equilibrium. Equilibrium constant.....	49
<i>Self-test questions and tasks</i>	<i>53</i>
Chapter 4. Solutions and their role in biochemical processes.....	55
4.1. Modern ideas about solutions.....	56
4.2. Solution concentration	58
4.3. Solubility of gases in liquids	60
4.4. Solubility of liquids and solid substances in liquids	61
4.5. Colligative properties of diluted solutions.....	62
4.6. Solutions of electrolytes	70
4.7. Dissociation of water	73
4.8. Acid-base theories	76
4.9. Buffer solutions.....	80
4.10. Formation and dissolution of precipitates.....	86
<i>Self-test questions and tasks</i>	<i>89</i>
Chapter 5. Electrode processes and their significance for physiology and medicine.....	92
5.1. Electrode potentials	92
5.2. Classification of electrodes.....	95
5.3. Diffusion and membrane potentials	99
5.4. Potentials in biological systems.....	100
5.5. Oxidation-reduction reactions	103
<i>Self-test questions and tasks</i>	<i>107</i>

Chapter 6. Physical chemistry of surface phenomena and their role in the processes taking place in the human body	108
6.1. Surface tension of liquids. Surface activity	109
6.2. Adsorption at the liquid-gas and liquid-liquid interfaces.....	111
6.3. Orientation of molecules of surface-active substances in the surface layer	112
6.4. Langmuir isotherm equation	114
6.5. Structure of biological membranes.....	115
6.6. Solute adsorption at solid interface.....	116
6.7. Laws of solute adsorption at solid interface	117
6.8. Adsorption therapy fundamentals	120
6.9. Adsorption of electrolytes.....	124
6.9.1. Selective adsorption	124
6.9.2. Ion exchange adsorption.....	125
6.10. Chromatographic methods of analysis.....	128
6.10.1. Principles of chromatographic methods classification	129
6.10.2. Application of chromatography in biology and medicine	131
<i>Self-test questions and tasks</i>	132
Chapter 7 . Physical chemistry of disperse systems	134
7.1. Classification of disperse systems.....	135
7.2. Methods of colloid system preparation.....	137
7.2.1. Methods of dispergation	138
7.2.1. Methods of condensation	138
7.3. Methods of colloid system purification	139
7.4. Molecular-kinetic properties of disperse systems	140
7.5. Optical properties of colloid systems	141
7.6. Double electrical layer. Structure of colloid particles. Electrokinetic phenomena	143
7.6.1. Electrokinetic phenomena	146
7.7. Stability and coagulation of disperse systems.....	151
7.7.1. Stability factors of disperse systems	151
7.7.2. Theory of coagulation and stability of disperse systems	152
7.7.3. Kinetics of coagulation	154
7.7.4. Special cases of coagulation	155
7.7.5. Peptization as inverse process of coagulation	158
7.7.6. Coagulation in biological systems.....	159
7.8. Aerosols. Powders. Suspensions. Pastes. Foams	160
7.9. Emulsions.....	162
7.10. Colloid surface-active substances.....	163
<i>Self-test questions and tasks</i>	165
Chapter 8. Physical chemistry of biopolymers and their solutions	168
8.1. Biological macromolecules	169
8.2. Biopolymer structure.....	170
8.3. Isoelectric state of proteins	171
8.4. HMC solutions and their properties	173
8.5. Thermodynamic stability of HMC solutions. Methods of protein precipitation	175
8.6. Osmosis. Osmotic pressure in HMC solutions	177
8.7. Viscosity of HMC solutions	180
8.8. Jellies: formation and properties	180
<i>Self-test questions and tasks</i>	183
Chapter 9. Chemistry of biogenic elements	184
9.1 General information about biogenic elements.....	184
9.2. s-Elements: biological role, application in medicine.....	192
9.3. p-Elements: biological role, application in medicine	196
9.4. General characteristic of d-elements	209
<i>Self-test questions and tasks</i>	215
Index	217