

UDC 54;546(075)

*Published by the decision of the Editorial Review Board
of the Kazan National Research Technological University*

Reviewers:
Ph. D. N. Ulakhovich
Ph. D. S. Podyachev

Starodubets E.

Atomic structure and Mendeleev's Periodic System of chemical elements : tutorial / E. Starodubets, A. Kuznetsov; The Ministry of Science and Higher Education of the Russian Federation, Kazan National Research Technological University. – Kazan : KNRTU Press, 2019. – 88 p.

ISBN 978-5-7882-2750-4

The tutorial is dedicated to the 150th anniversary of the Mendeleev Periodic Table and the International Year of the Periodic Table of chemical elements. The study guide contains the facts from the history of the Periodic Table discovery, the modern information about the structure of the atom and periodic properties of chemical elements and their relation with the Periodic Law.

The tutorial is intended for the students learning in the educational program in the area “Chemical Technology”, who study the discipline “General and Inorganic Chemistry”, as well as for students from foreign countries to study in the framework of international educational programs, and for graduate students and teachers of chemistry.

The tutorial was prepared by Department of Inorganic Chemistry.

UDC 54;546(075)

ISBN 978-5-7882-2750-4

© Starodubets E., Kuznetsov A., 2019

© Kazan National Research Technological
University, 2019

CONTENTS

PREFACE.....	3
HISTORY OF THE PERIODIC TABLE.....	4
Mendeleev and the Periodic Table.....	7
THE STRUCTURE OF THE ATOM.....	15
Discovery of the Electron.....	16
The Nuclear Model of the Atom.....	17
Nuclear Structure. Isotopes.....	18
Atomic Weights.....	20
Relative Atomic Masses.....	20
Atomic Mass Units.....	21
Radioactivity.....	21
Nature and Radioactive Radiation.....	22
Nuclear Equations.....	23
CONTEMPORARY THEORY OF ATOMIC STRUCTURE.....	26
Fundamentals of Quantum Mechanics.....	27
1. The Quantum Character of the Emission and Absorption of Energy.....	28
2. The Wave Nature of Microparticles.....	29
3. The Uncertainty Principle.....	30
4. The Schrödinger Equation.....	31
Quantum Numbers.....	33
Atomic Orbitals.....	36
Solution of the Schrödinger Equation for Many-Electron Atoms.....	38
Radial Distribution Function of the Electron Density.....	38
ELECTRONIC STRUCTURE OF ATOMS.....	41
Electron Configuration of Atoms.....	41
The Aufbau Principle.....	42
Pauli's Exclusion Principle.....	43
Hund's Rule.....	43
STRUCTURE OF THE MENDELEEV'S PERIODIC TABLE.	
MODERN FORMULATION OF THE PERIODIC LAW.....	45
SOME PERIODIC PROPERTIES.....	52
Concept of Periodicity. Types of Periodicity.....	52
Atomic Radius.....	53
Ionization Energy.....	58
Electron Affinity.....	65
Electronegativity.....	67

Oxidation state of elements.....	70
PERIODICITY IN PROPERTIES OF CHEMICAL COMPOUNDS....	73
Simple substances.....	73
Complex substances.....	79
CONCLUSION.....	82
SELF-CONTROL QUESTIONS.....	83
RECOMMENDABLE LITERATURE.....	86

Elena E. Starodubets

Andrey M. Kuznetsov

ATOMIC STRUCTURE AND MENDELEEV'S PERIODIC SYSTEM OF CHEMICAL ELEMENTS

Елена Евгеньевна Стародубец

Андрей Михайлович Кузнецов

СТРОЕНИЕ АТОМА И ПЕРИОДИЧЕСКАЯ СИСТЕМА ХИМИЧЕСКИХ ЭЛЕМЕНТОВ Д. И. МЕНДЕЛЕЕВА

Responsible for publishing O. Mikhailov

Signed in print 30.12.2019

Offset paper

5,5 publ. sh.

Riso print

Edition 100 copies

Sheet size 60×84 1/16

5,12 conv. pr. sh.

Order 263/19

Kazan National Research Technological University Press

Offset laboratory of Kazan National Research Technological University

420015, Kazan, Karl Marx street, 68