国家卫生健康委员会“十三五”规划教材配套教材

全国高等学校配套教材

供基础、临床、预防、口腔医学类专业用

第3版

Basic Chemistry for Higher Medical Education

基础化学

主编 傅迎 王兴坡

副主编 钮因尧 刘娜 胡新

人民卫生出版社

PEOPLE'S MEDICAL PUBLISHING HOUSE

国家卫生健康委员会“十三五”规划教材配套教材
全国高等学校配套教材
供基础、临床、预防、口腔医学类专业用

Basic Chemistry for Higher Medical Education

基础化学

第3版

主　　编　傅　迎　王兴坡
副 主 编　钮因尧　刘　娜　胡　新
编　　委　（以姓氏笔画为序）

于　昆　大连医科大学
马汝海　中国医科大学
王兴坡　山东大学
尹计秋　大连医科大学
申小爱　中国医科大学
刘　娜　大连医科大学
刘国杰　中国医科大学
乔　洁　山西医科大学
李雪华　广西医科大学
杨　静　南京医科大学
陈志琼　重庆医科大学
武世奎　内蒙古医科大学
林　毅　武汉大学
胡　新　北京大学
钮因尧　上海交通大学
章小丽　昆明医科大学
喻　芳　昆明医科大学
傅　迎　大连医科大学
赖泽锋　广西医科大学

人民卫生出版社

图书在版编目(CIP)数据

基础化学 = Basic Chemistry for Higher Medical Education：英文 / 傅迎，王兴坡主编. —3 版. —北京：人民卫生出版社，2019

全国高等学校五年制本科临床医学专业第九轮规划教材配套教材

ISBN 978-7-117-28803-3

Ⅰ. ①基… Ⅱ. ①傅… ②王… Ⅲ. ①化学－医学院校－教材－英文 Ⅳ. ①O6

中国版本图书馆 CIP 数据核字(2019)第 171291 号

Basic Chemistry for Higher Medical Education

基 础 化 学

第 3 版

主　　编：傅　迎　王兴坡

出版发行：人民卫生出版社（中继线 010-59780011）

地　　址：北京市朝阳区潘家园南里 19 号

邮　　编：100021

E - mail：pmph @ pmph.com

购书热线：010-59787592　010-59787584　010-65264830

印　　刷：北京市艺辉印刷有限公司

经　　销：新华书店

开　　本：787 × 1092　1/16　印张：29　插页：1

字　　数：761 千字

版　　次：2014 年 10 月第 1 版　2019 年 12 月第 3 版

2019 年 12 月第 3 版第 1 次印刷（总第 3 次印刷）

标准书号：ISBN 978-7-117-28803-3

定　　价：65.00 元

打击盗版举报电话：010-59787491　E-mail：WQ @ pmph.com

质量问题联系电话：010-59787234　E-mail：zhiliang @ pmph.com

PREFACE

The 3rd edition English textbook of *Basic Chemistry for Higher Medical Education* corresponds to the 9th edition of Chinese edition textbook *Basic Chemistry* published by the People's Medical Publishing House in August 2018.This textbook can be used for chemistry course in higher education.

The first and the second editions of this textbook have been used widely by freshmen in the past nine years.

Some changes have been made in the 3rd edition. We carefully chose the more appropriate contents, broke down the long chapters into the short texts, adjusted the order of some chapters, added some new examples and exercises, put the key terms and some answers of exercises at the end of each chapter, so as to make it be read more smoothly, better understood and easier learnt.

As we all know, for the students in most majors, Chemistry is always an important course in the higher education. The students will study basic chemistry lesson in the first semester generally. This textbook introduces the basic chemical concepts, the chemical knowledge, the chemical principles and their practical applications, even some living examples related to the medicine. The main contents of basic chemistry include the basic properties of various solutions, the essential and important chemical theories or principles as well as their applications, the changing regularity of elements and normal chemical reactions, the structure of atoms and molecules, the relationship between molecular structure and its properties, qualitative and quantitative analysis to substances, etc.

We still set "Question and thinking" part in each chapter to help students to understand the text better, and still keep the detail solutions of the exercises after each chapter, put them at the end of this textbook to make the students study the main contents conveniently.

Learning chemistry well will be conducive to the subsequent courses, such as organic chemistry, biochemistry, physiology, etc. We expect that the students can master the basic chemical theory and experimental skills by experimental training, and we also hope that chemistry curriculum can improve students' independent thinking ability, provide more ideas and methods, and inspire innovative spirit in

their career.

Finally, we would like to sincerely thank professor Wei Zuqi, the editor-in-chief of the first and the second editions, for his contribution to this textbook. We hope that professor Wei Zuqi will continue to pay attention to this book and make valuable comments for us.

Editors-in-Chief

Fu Ying（傅迎） Wang Xingpo（王兴坡）

May 2019

CONTENTS

Chapter 1
Colligative Properties of Dilute Solution

A **solution** is a homogeneous and stable dispersion system being composed of two or more substances. The solution can exist in three states: gaseous, liquid or solid. The solution usually refers to aqueous solution.

The properties of a solution are neither the same as those of solute nor those of solvent. The properties of solution can be divided into two categories: the first category depends on the nature of solute, such as the color, the volume change and the conductivity of the solution; the second is called **colligative property**, which depends on the number of dissolved solute particles (molecules or ions) instead of the involved solute. These properties include mainly: (1) the lowering of the vapor pressure of the solution relative to that of the pure solvent; (2) the boiling point elevation; (3) the freezing point depression; (4) the phenomenon of osmotic pressure. For example, both of glucose ($C_6H_{12}O_6$) and sucrose ($C_{12}H_{22}O_{11}$) solutions have the same vapor pressure depression, boiling point elevation, freezing point depression and osmotic pressure, as long as they have the same molality.

The colligative property applies only to the change in the properties of dilute solutions, otherwise the results discussed will deviate the facts. So the colligative properties are also called colligative properties of dilute solution.

The colligative properties of solutions on the exchange and transport of substances inside and outside cells, clinical infusion, water and electrolyte metabolism, have some theoretical guiding significance. This chapter mainly introduces the colligative properties of the solution that containing nonvolatile, non-electrolyte of solute in the dilute solution.

1.1 The Composition Scales of Mixture

The **mixture** is a system being composed of two or more substances. Changes of the proportion for each component in the mixture system may lead to changes in the properties of the mixture. For a mixture, the **composition scale** should be specified while determining its composition. The composition scale is the relative content of each component in the mixture. We will learn some terms about the composition scale in this section.

1.1.1 Mass Fraction, Volume Fraction and Mass Concentration

1. Mass fraction

ω_B, the **mass fraction** of solute B is defined as the mass of solute B divided by the mass of the