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# Advanced Chemical Reaction Engineering Midterm Exam Solution

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**Principles, Practice and**



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**Economics of Plant and Process Design** Research & Education Assn

A practical approach to chemical reaction kinetics—from basic concepts to laboratory methods—featuring numerous real-world examples and case studies. This book focuses on fundamental aspects of reaction kinetics with an emphasis on mathematical methods for analyzing experimental data and interpreting results. It describes basic concepts of reaction kinetics,

parameters for measuring the progress of chemical reactions, variables that affect reaction rates, and ideal reactor performance. Mathematical methods for determining reaction kinetic parameters are described in detail with the help of real-world examples and fully-worked step-by-step solutions. Both analytical and numerical solutions are exemplified. The book begins with an introduction to the basic concepts of stoichiometry, thermodynamics, and chemical kinetics. This is

followed by chapters featuring in-depth discussions of reaction kinetics; methods for studying irreversible reactions with one, two and three components; reversible reactions; and complex reactions. In the concluding chapters the author addresses reaction mechanisms, enzymatic reactions, data reconciliation, parameters, and examples of industrial reaction kinetics. Throughout the book industrial case studies are presented with step-by-step solutions, and

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further problems are provided at the end of each chapter. Takes a practical approach to chemical reaction kinetics basic concepts and methods Features numerous illustrative case studies based on the author's extensive experience in the industry Provides essential information for chemical and process engineers, catalysis researchers, and professionals involved in developing kinetic models Functions as a student textbook on the basic principles of chemical

kinetics for homogeneous catalysis Describes mathematical methods to determine reaction kinetic parameters with the help of industrial case studies, examples, and step-by-step solutions Chemical Reaction Kinetics is a valuable working resource for academic researchers, scientists, engineers, and catalyst manufacturers interested in kinetic modeling, parameter estimation, catalyst evaluation, process development, reactor modeling, and process

simulation. It is also an ideal textbook for undergraduate and graduate-level courses in chemical kinetics, homogeneous catalysis, chemical reaction engineering, and petrochemical engineering, biotechnology.

Sections 15-17 of 20  
Wiley-VCH

\*Add the convenience of accessing this book anytime, anywhere on your personal device with the eTextbook version for only \$50 at [pi2pass.com/etextbook-program](http://pi2pass.com/etextbook-program).\* Michael R.

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Lindeburg PE's FE Chemical Review Manual offers complete review for the FE Chemical exam. Features of FE Chemical Review include: complete coverage of all exam knowledge areas equations, figures, and tables of the NCEES FE Reference Handbook to familiarize you with the reference you'll have on exam day concise explanations supported by exam-like example problems, with step-by-step solutions to reinforce the theory and

application of fundamental concepts a robust index with thousands of terms to facilitate referencing Topics Covered Chemical Reaction Engineering Computational Tools Engineering Sciences Ethics and Professional Practice Fluid Mechanics/Dynamics Heat Transfer Mass Transfer and Separation Material/Energy Balances Materials Science Mathematics Probability and Statistics Process Control Process Design

and Economics Safety, Health, and Environment Thermodynamics Important notice! It has been brought to our attention that counterfeit PPI books have been circulating. Counterfeit books have missing material as well as incorrect and outdated content. While we are actively working to resolve this issue, we would like our customers to be aware that this issue exists and to be leary of books not purchased directly

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through PPI. If you suspect a fraudulent seller, please email details to [marketing@ppi2pass.com](mailto:marketing@ppi2pass.com). Fundamentals, Engineering and Characterizations (with accompanying presentation slides and instructor's manual) Oxford University Press, USA

This book provides an introduction to the basic concepts of chemical reactor analysis and design. It is intended for both the senior level undergraduate student in chemical engineering and

the working professional who may require an understanding of the basics of this subject.

Introduction to Chemical Engineering Peterson's

This is the Second Edition of the standard text on chemical reaction engineering, beginning with basic definitions and fundamental principles and continuing all the way to practical applications, emphasizing real-world aspects of industrial practice. The two main sections cover applied or engineering kinetics, reactor analysis and design. Includes updated coverage of computer modeling methods and many new worked examples. Most of the

examples use real kinetic data from processes of industrial importance.

Elements of Chemical Reaction Engineering Nirali Prakashan

A text- and exercise book for physical chemistry students! This book deals with the fundamental aspects of physical chemistry taught at the undergraduate level in chemistry and the engineering sciences in a compact and practice-oriented form. Numerous problems and detailed solutions offer the possibility of an in-depth reflection of

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topics like chemical thermodynamics and kinetics, atomic structure and spectroscopy. Every chapter starts with a recapitulation of important background information, before leading over to representative exercises and problems. Detailed descriptions systematically present and explain the solutions to the problems, so that readers can carefully check their own solutions and get clear-cut introductions on how to approach similar problems systematically. The book

addresses students at the (upper) undergraduate level, as well as tutors and teachers. It is a rich source of exercises for exam preparation and can be used alongside classical textbooks. Furthermore it can serve teachers and tutors for the conception of their lessons. Its well-thought-through presentation, structure and design make the book appeal to everybody who wants to succeed with the physical chemistry lessons and exercises. Reaction Kinetics and the Development and Operation of

Catalytic Processes CRC Press  
Reaction Kinetics and the Development and Operation of Catalytic Processes is a trendsetter. The Keynote Lectures have been authored by top scientists and cover a broad range of topics like fundamental aspects of surface chemistry, in particular dynamics and spillover, the modeling of reaction mechanisms, with special focus on the importance of transient experimentation and the application of kinetics in reactor design. Fundamental and applied kinetic studies are well represented. More than half of these deal with transient kinetics, a new trend made possible by recent sophisticated experimental

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equipment and the awareness that transient experimentation provides more information and insight into the microphenomena occurring on the catalyst surface than steady state techniques. The trend is not limited to purely kinetic studies since the great majority of the papers dealing with reactors also focus on transients and even deliberate transient operation. It is to be expected that this trend will continue and amplify as the community becomes more aware of the predictive potential of fundamental kinetics when combined with detailed realistic modeling of the reactor operation.

**Chemical Reaction  
Engineering II** Elsevier

A NEWER EDITION OF THIS TITLE IS AVAILABLE. SEE ISBN: 978-0-7386-0427-5 Our savvy test experts show you the way to master the test and score higher. This new and fully expanded edition examines all AP Chemistry areas including in-depth coverage of solutions, stoichiometry, kinetics, and thermodynamics. The comprehensive review covers every possible exam topic: the structure of matter, the states of matter, chemical reactions, and descriptive

chemistry. Features 6 full-length practice exams with all answers thoroughly explained. Follow up your study with REA's test-taking strategies, powerhouse drills and study schedule that get you ready for test day. DETAILS - Comprehensive, up-to-date subject review of every AP Chemistry topic used in the AP exam - Study schedule tailored to your needs - Packed with proven key exam tips, insights and advice - 6 full-length practice exams. All exam answers are fully detailed with easy-to-

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follow, easy-to-grasp explanations. TABLE OF CONTENTS About Research & Education Association Preface About the Test Scoring Contacting the AP Program AP CHEMISTRY COURSE REVIEW CHAPTER 1 - THE STRUCTURE OF MATTER A. ATOMIC PROPERTIES 1. The Atomic Theory and Evidence for the Atomic Theory 2. Chemical and Physical Approaches to Atomic Weight Determination 3. Atomic Number and Mass Number, Isotopes, Mass Spectroscopy 4. Electron Energy Levels 5. The Periodic Table and Periodic Relationships: Symbols, Radii, Ionization Energy, Electron Affinity, Oxidation States B. BONDING 1. Types of Bonds 2. Effects of Bonding Forces on States, Structures, and Properties of Matter 3. Polarity and Electronegativity 4. Geometry of Ions, Molecules, and Coordination Complexes 5. Molecular Models C. NUCLEAR CHEMISTRY, NUCLEAR EQUATIONS, HALF-LIVES, RADIOACTIVITY CHAPTER 2 - STATES OF MATTER A. GASES 1. Ideal Gas Laws 2. Kinetic Molecular Theory B. LIQUIDS AND SOLIDS 1. Kinetic-Molecular View of Liquids and Solids 2. Phase Diagram 3. Changes of State, Critical Phenomena 4. Structure of Crystals C. SOLUTIONS 1. Types of Solutions 2. Factors Affecting Solubility 3. Ways of Expressing Concentrations 4. Colligative Properties 5. Interionic Attractions



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CHAPTER 3 - REACTIONS

A. TYPES 1. Forming and Cleaving Covalent Bonds 2. Precipitation 3. Oxidation and Reduction B. STOICHIOMETRY 1. Recognizing the Presence of Ionic and Molecular Species 2. Balancing Chemical Equations 3. Weight and Volume Relationships C. EQUILIBRIUM 1. Dynamic Equilibrium Both Physical and Chemical 2. The Relationship Between  $K_p$  and  $K_c$  3. Equilibrium Constants for Reactions in Solutions D. KINETICS 1. Rate of Reaction 2. Reaction Order 3. Temperature Changes and Effect on Rate 4. Activation Energy 5. Mechanism of a Reaction E. THERMODYNAMICS 1. State Functions 2. The First Law of Thermodynamics 3. The Second Law of Thermodynamics 4. Change in Free Energy CHAPTER 4 - DESCRIPTIVE CHEMISTRY 1. Horizontal, Vertical, and Diagonal Relationships in the Periodic Table 2. Chemistry of the Main Groups and Transition Elements and Representatives of Each 3. Organic Chemistry 4. Structural Isomerism PRACTICE EXAMS AP CHEMISTRY EXAM I AP CHEMISTRY EXAM II AP CHEMISTRY EXAM III AP CHEMISTRY EXAM IV AP CHEMISTRY EXAM V AP CHEMISTRY EXAM VI FORMULAS AND TABLES EXCERPT About Research & Education Association Research & Education Association (REA) is an organization of educators, scientists, and engineers specializing in various

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academic fields. Founded in 1959 with the purpose of disseminating the most recently developed scientific information to groups in industry, government, high schools, and universities, REA has since become a successful and highly respected publisher of study aids, test preps, handbooks, and reference works. REA's Test Preparation series includes study guides for all academic levels in almost all disciplines. Research & Education Association publishes test preps for students who have not yet completed high school, as well as high school students preparing to enter college. Students from countries around the world seeking to attend college in the United States will find the assistance they need in REA's publications. For college students seeking advanced degrees, REA publishes test preps for many major graduate school admission examinations in a wide variety of disciplines, including engineering, law, and medicine. Students at every level, in every field, with every ambition can find what they are looking for among REA's publications. While most test preparation books present practice tests that bear little resemblance to the actual exams, REA's series presents tests that accurately depict the official exams in both degree of difficulty and types of questions. REA's practice tests are always based upon the most recently administered exams, and include every type of question that can be expected

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on the actual exams. REA's book provides an accurate and complete representation of the Advanced Placement Examination in Chemistry. Our six practice exams are based on the most recently administered Advanced Placement Chemistry Exams. Each exam is three hours in length and includes every type of question that can be expected on the actual exam. Following each exam is an answer key complete with detailed explanations designed to clarify and contextualize the material. By completing all six exams and studying the explanations which follow, you can discover your strengths and weaknesses and thereby become well prepared for the actual exam. The formulas and tables for the AP Chemistry Exam can be found at the back of this book, beginning on page 417. You will be provided these formulas and tables when you take the actual exam. You should also use this material when taking the practice tests in this book.

**ABOUT THE TEST** The Advanced Placement

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Chemistry Examination is offered each May at participating schools and multi-school centers throughout the world. The Advanced Placement Program is designed to allow high school students to pursue college-level studies while attending high school. The participating colleges, in turn, grant credit and/or advanced placement to students who do well on the examinations. The Advanced Placement Chemistry course is designed to be the equivalent of a college introductory chemistry course, often taken by chemistry majors in their first year of college. Since the test covers a broad range of topics, no student is expected to answer all of the questions correctly. The exam is divided into two sections: 1) Multiple-choice: Composed of 75 multiple-choice questions designed to test your ability to recall and understand a broad range of chemical concepts and calculations. This section constitutes 45% of the final grade and you are allowed 90 minutes for this portion of the exam. Calculators are not permitted for this section of the exam. 2) Free-response section: Composed of several comprehensive problems and essay topics. This section constitutes 55% of the final grade and the student is allowed 90 minutes for this portion of the exam. You may choose from the questions provided. These problems and essays are designed to test your ability to think clearly and to present ideas in a logical, coherent fashion. You can bring an

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electronic hand-held calculator for use on the 40-minute free-response section. Essay and chemical-reaction questions comprise the last 50 minutes of the test, during which calculators are not permitted. A final note about calculators: Most hand-held models are allowed in the test center; the only notable exceptions are those with typewriter-style (QWERTY) keypads. If you are unsure if your calculator is permitted, check with your teacher or Educational Testing Service. **SCORING**

The multiple-choice section of the exam is scored by crediting each correct answer with one point, and deducting only partial credit (one-fourth of a point) for each incorrect answer. Omitted questions receive neither a credit nor a deduction. The essay section is scored by a group of more than 1,000 college and high school educators familiar with the AP Program. These graders evaluate the accuracy and coherence of the essays accordingly. The grades given for the essays are combined with the results of

the multiple-choice section, and the total raw score is then converted to the program's five-point scale: 5 - Extremely well qualified 4 - Well qualified 3 - Qualified 2 - Possibly qualified  
**Chemical Engineering** John Wiley & Sons  
Today's Definitive, Undergraduate-Level Introduction to Chemical Reaction Engineering Problem-Solving For 30 years, H. Scott Fogler's Elements of Chemical Reaction Engineering has been the #1 selling text for

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courses in chemical reaction engineering worldwide. Now, in *Essentials of Chemical Reaction Engineering, Second Edition*, Fogler has distilled this classic into a modern, introductory-level guide specifically for undergraduates. This is the ideal resource for today's students: learners who demand instantaneous access to information and want to enjoy learning as they deepen their critical thinking and creative problem-solving skills. Fogler successfully integrates text, visuals, and computer simulations, and links theory to practice through many relevant examples. This updated second edition covers mole balances, conversion and reactor sizing, rate laws and stoichiometry, isothermal reactor design, rate data collection/analysis, multiple reactions, reaction mechanisms, pathways, bioreactions and bioreactors, catalysis, catalytic reactors, nonisothermal reactor designs, and more. Its multiple improvements include a new discussion of activation energy, molecular simulation, and stochastic modeling, and a significantly revamped chapter on heat effects in chemical reactors. To promote the transfer of key skills to real-life settings, Fogler presents three styles of problems: Straightforward problems that reinforce the principles of chemical reaction engineering Living Example Problems (LEPs) that allow students to rapidly explore the issues and look for optimal solutions Open-ended problems that encourage students to use

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inquiry-based learning to practice creative problem-solving skills About the Web Site (umich.edu/~elements/5e/index.html) The companion Web site offers extensive enrichment opportunities and additional content, including Complete PowerPoint slides for lecture notes for chemical reaction engineering classes Links to additional software, including Polymath, MATLAB, Wolfram Mathematica, AspenTech, and COMSOL Multiphysics Interactive learning resources linked to each chapter, including Learning Objectives, Summary Notes, Web Modules, Interactive Computer Games, Computer Simulations and Experiments, Solved Problems, FAQs, and links to LearnChemE Living Example Problems that provide more than 75 interactive simulations, allowing students to explore the examples and ask “what-if” questions Professional Reference Shelf, containing advanced content on reactors, weighted least squares, experimental planning, laboratory reactors, pharmacokinetics, wire gauze reactors, trickle bed reactors, fluidized bed reactors, CVD boat reactors, detailed explanations of key derivations, and more Problem-solving strategies and insights on creative and critical thinking Register your product at [informit.com/register](http://informit.com/register) for convenient access to downloads, updates, and/or corrections as they become available.

[Chemical Reaction Engineering](#) Peterson's

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All formulas, equations, tables, and data you are most likely to require during the exam are drawn from the Chemical Engineering Reference Manual, organized by topic, and indexed for speedy retrieval.

*Quick Reference for the Chemical Engineering PE Exam* Pearson Educación

Chemical Kinetics and Catalysis is a comprehensive guide to chemical kinetics and catalysis, and focuses on the use of computational tools for studying chemical kinetics and catalytic phenomena. Provides a thorough and up-to-date treatment of chemical kinetics

and catalysis, combining traditional background information with the latest computational methods for fitting data to appropriate rate equations. Demonstrates how the vastly improved computational tools now available allow application of kinetic concepts to understanding and predicting the behavior of diverse and complex phenomena, including biological systems, semiconductor growth, and corrosion. Contains chapters reviewing of kinetic concepts, introducing kinetics via rate equations and mechanisms,

explaining the theory of reaction rates (a section on trajectory calculations to simulate reactions), predicting potential energy surfaces (methods for directing the reaction rate), and discussing catalysis with a focus on modifying the reaction rate. A useful reference guide, providing the essential basics along with numerous solved examples, problems, and illustrative computer programs. **Fundamentals of Chemical Engineering Thermodynamics, SI Edition** John Wiley & Sons Peterson's Graduate Programs in Engineering & Applied Sciences 2012 contains a wealth of information on accredited



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institutions offering graduate degree programs in these fields. Up-to-date data, collected through Peterson's Annual Survey of Graduate and Professional Institutions, provides valuable information on degree offerings, professional accreditation, jointly offered degrees, part-time and evening/weekend programs, postbaccalaureate distance degrees, faculty, students, requirements, expenses, financial support, faculty research, and unit head and application contact information. There are helpful links to in-depth descriptions about a specific graduate program or department, faculty members and their research, and more. There are also valuable articles on

financial assistance, the graduate admissions process, advice for international and minority students, and facts about accreditation, with a current list of accrediting agencies.

*Advanced Chemical Kinetics*  
Peterson's

The field of chemical engineering is undergoing a global "renaissance," with new processes, equipment, and sources changing literally every day. It is a dynamic, important area of study and the basis for some of the most lucrative and integral fields of science. Introduction to Chemical

Engineering offers a comprehensive overview of the concept, principles and applications of chemical engineering. It explains the distinct chemical engineering knowledge which gave rise to a general-purpose technology and broadest engineering field. The book serves as a conduit between college education and the real-world chemical engineering practice. It answers many questions students and young engineers often ask which include: How is what I studied in the classroom

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being applied in the industrial new chemical engineering setting? What steps do I need to take to become a professional chemical engineer? What are the diversities in chemical engineering and the engineering knowledge required? How is chemical engineering design done in real-world? What are the chemical engineering computer tools and their applications? What are the prospects, present and future challenges of chemical engineering? And so on. It also provides the information

hires would need to excel and cross the critical novice engineer stage of their career. It is expected that this book will enhance students understanding and performance in the field and the development of the profession worldwide. Whether a new-hire engineer or a veteran in the field, this is a must—have volume for any chemical engineer's library.

Sections 5-7 of 20 John Wiley & Sons Peterson's Graduate Programs

in Engineering & Applied Sciences 2015 contains comprehensive profiles of more than 3,850 graduate programs in all relevant disciplines—including aerospace/aeronautical engineering, agricultural engineering & bioengineering, chemical engineering, civil and environmental engineering, computer science and information technology, electrical and computer engineering, industrial engineering, telecommunications, and more. Two-page in-depth descriptions, written by

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featured institutions, offer complete details on a specific graduate program, school, or department as well as information on faculty research. Comprehensive directories list programs in this volume, as well as others in the Peterson's graduate series.

*Exam Survival Guide: Physical Chemistry* CRC Press

Elements of Chemical Reaction Engineering Pearson Educación

Kinetics of Chemical

Reactions Professional

Publications Incorporated

A comprehensive introduction to chemical engineering kinetics

Providing an introduction to reactor design. For those chemical engineering kinetics seeking an introduction to the and describing the empirical subject, the book provides a approaches that have firm and lasting foundation successfully helped engineers for continuing study and describe reacting systems, An practice.

Introduction to Chemical Engineering Kinetics &

Reactor Design is an excellent resource for

students of chemical engineering. Truly introductory in nature, the

text emphasizes those aspects of chemical kinetics and material and energy balances that form the broad foundation for understanding

*Bulletin* Elsevier

"The fourth edition of Elements of Chemical Reaction Engineering is a completely revised version of the book. It combines authoritative coverage of the principles of chemical reaction engineering with an unsurpassed focus on critical thinking and creative problem solving, employing open-ended questions and stressing the

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Socratic method. Clear and organized, it integrates text, visuals, and computer simulations to help readers solve even the most challenging problems through reasoning, rather than by memorizing equations."--BOOK JACKET. *Annual Catalog - United States Air Force Academy* Elsevier A Comprehensive Reference for Electrochemical Engineering Theory and Application From chemical and electronics manufacturing, to hybrid vehicles, energy storage, and beyond, electrochemical engineering touches many industries—any

many lives—every day. As energy conservation becomes of central importance, so too does the science that helps us reduce consumption, reduce waste, and lessen our impact on the planet. Electrochemical Engineering provides a reference for scientists and engineers working with electrochemical processes, and a rigorous, thorough text for graduate students and upper-division undergraduates. Merging theoretical concepts with widespread application, this book is designed to provide critical knowledge in a real-world context. Beginning with

the fundamental principles underpinning the field, the discussion moves into industrial and manufacturing processes that blend central ideas to provide an advanced understanding while explaining observable results. Fully-worked illustrations simplify complex processes, and end-of-chapter questions help reinforce essential knowledge. With in-depth coverage of both the practical and theoretical, this book is both a thorough introduction to and a useful reference for the field. Rigorous in depth, yet grounded in relevance, Electrochemical

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<p>Engineering: Introduces basic principles from the standpoint of practical application</p> <p>Explores the kinetics of electrochemical reactions with discussion on thermodynamics, reaction fundamentals, and transport</p> <p>Covers battery and fuel cell characteristics, mechanisms, and system design</p> <p>Delves into the design and mechanics of hybrid and electric vehicles, including regenerative braking, start-stop hybrids, and fuel cell systems</p> <p>Examines electrodeposition, redox-flow batteries, electrolysis, regenerative fuel cells, semiconductors, and other</p>	<p>applications of electrochemical engineering principles</p> <p>Overlapping chemical engineering, chemistry, material science, mechanical engineering, and electrical engineering, electrochemical engineering covers a diverse array of phenomena explained by some of the important scientific discoveries of our time. Electrochemical Engineering provides the critical understanding required to work effectively with these processes as they become increasingly central to global sustainability.</p> <p><i>Peterson's Graduate Programs</i></p>	<p><i>in Management of Engineering &amp; Technology, Materials Sciences &amp; Engineering, and Mechanical Engineering &amp; Mechanics 2011</i> John Wiley &amp; Sons</p> <p>The Engineering of Chemical Reactions focuses explicitly on developing the skills necessary to design a chemical reactor for any application, including chemical production, materials processing, and environmental modeling.</p> <p>Peterson's</p> <p>The introductory chapter reviews the test specifications and the author's recommendation on the best</p>
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strategy for passing the exam. The first chapter reviews English and SI units and conversions. A complete conversion table is given. Chapter 3 covers heat transfer, conduction, transfer coefficients and heat transfer equipment. Chapter 4 covers evaporation principles, calculations and example problems. Distillation is thoroughly covered in chapter 5. The subsequent chapters review fundamentals of fluid mechanics, hydraulics and typical pump and piping problems: absorption, leaching, liquid-liquid extraction, and the

rest of the exam topics. Each of the topics is reviewed followed by examples of examination problems. This book is the ideal study guide bringing all elements of professional problem solving together in one Big Book. The first truly practical, no-nonsense review for the difficult PE exam. Full Step-by-Step solutions included.

*Concepts, Methods and Case Studies* Prentice Hall

The book presents in a clear and concise manner the fundamentals of chemical reaction engineering. The structure of the book allows

the student to solve reaction engineering problems through reasoning rather than through memorization and recall of numerous equations, restrictions, and conditions under which each equation applies. The fourth edition contains more industrial chemistry with real reactors and real engineering and extends the wide range of applications to which chemical reaction engineering principles can be applied (i.e., cobra bites, medications, ecological engineering)