

## Chemical Reaction Engineering Homework Problem

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*Elements of Chemical Reaction Engineering* John Wiley & Sons

Modeling and Simulation have become endeavors central to all disciplines of science and engineering. They are used in the analysis of physical systems where they help us gain a better understanding of the functioning of our physical world. They are also important to the design of new engineering systems where they enable us to predict the behavior of a system before it is ever actually built. Modeling and simulation are the only techniques available that allow us to analyze arbitrarily non-linear systems accurately and under varying experimental conditions. Continuous System Modeling introduces the student to an important subclass of these techniques. They deal with the analysis of systems described through a set of ordinary or partial differential equations or through a set of difference equations. This volume introduces concepts of modeling physical systems through a set of differential and/or difference equations. The purpose is twofold: it enhances the scientific understanding of our physical world by codifying (organizing) knowledge about this world, and it supports engineering design by allowing us to assess the consequences of a particular design alternative before it is actually built. This text has a flavor of the mathematical discipline of dynamical systems, and is strongly oriented towards Newtonian physical science.

*Introduction to Chemical Process: Fundamentals and Design* University of Toronto Press

This book defines environmental reaction engineering principles, including reactor design, for the development of processes that provide an environmental benefit. With regard to pollution prevention, the focus is primarily on new reaction and reactor technologies that minimize the production of undesirable side-products (pollutants), but the use of reaction engineering as a means of treating wastes that are produced through other means is also considered. First is a section on environmentally benign combustion. The three papers discuss methods of reducing the formation of PAHs and NO<sub>x</sub>, as well as other environmentally sensitive combustion products. The next section contains a collection of contributions that involve the use of a catalyst to support the reaction. Following this is a section on the use of supercritical fluid solvents as environmentally friendly media for chemical reactions. Finally, a series of papers is presented in which novel reactor designs are utilized to obtain product yields not possible in conventional reactor systems. These include the use of reactor-absorber systems, reactive distillation, and reactive membranes. The book concludes with a chapter contributed by the editors which discusses the educational aspects of pollution prevention. It is necessary for future generations of engineers to be trained to design processes that are inherently environmentally benign. This chapter assembles resource materials for educators which will spark the creative instincts of the researchers using the materials contained within this book to develop new resources for pollution prevention education. The broad spectrum of topics included in this book indicates the diversity of this area, and the vibrant nature of the ongoing research. The possibilities of producing desirable products without the formation of waste byproducts are bounded only by the creativity of the reaction engineer.

*Process Analysis and Simulation in Chemical Engineering* John Wiley & Sons

DESCRIPTION The goal of this book is to help the student experience chemical engineering to the fullest extent possible within the constraints of limited time and limited student background. In pursuit of that goal, it teaches the freshman to solve quantitative problems, although at a low level of complexity and within a scope that is narrow and well-defined. These quantitative topics include material balances (reacting and non-reacting systems), fluid flow (including the sizing of pumps), mass transfer (diffusion and convection), chemical reactor design, heat transfer (including the design of heat exchangers), and engineering economics. As examples of the limited scope of these topics, the treatment of material balances for reacting systems is limited to single process units with one chemical reaction, and the treatment of fluid flow applications is restricted to the use of the mechanical energy balance where friction is mentioned, but friction factors and methods for determining friction losses are not introduced. Spreadsheets are also taught, and homework problems throughout the book give the students practice with this tool. In addition, a number of qualitative descriptions are presented in the text, including chapters on problem solving, engineering teamwork, and process control. Finally, the students are given a few writing assignments to illustrate the important role of written communication in engineering.

*Chemically Reacting Flow* Pearson Education

*Principles of Chemical Engineering Processes: Material and Energy Balances* introduces the basic principles and calculation techniques used in the field of chemical engineering, providing a solid understanding of the fundamentals of the application of material and energy balances. Packed with illustrative examples and case studies, this book: Discusses problems in material and energy balances related to chemical reactors Explains the concepts of dimensions, units, psychrometry, steam properties, and conservation of mass and energy Demonstrates how MATLAB® and Simulink® can be used to solve complicated problems of material and energy balances Shows how to solve steady-state and transient mass and energy balance problems involving multiple-unit processes and recycle, bypass, and purge streams Develops quantitative problem-solving skills, specifically the ability to think quantitatively (including numbers and units), the ability to translate words into diagrams and mathematical expressions, the ability to use common sense to interpret vague and ambiguous language in problem statements, and the ability to make judicious use of approximations and reasonable assumptions to simplify problems This Second Edition has been updated based upon feedback from professors and students. It features a new chapter related to single- and multiphase systems and contains additional solved examples and homework problems. Educational software, downloadable exercises, and a solutions manual are available with qualifying course adoption.

*The Engineering of Chemical Reactions* Elsevier

This text provides an introduction to supercritical fluids with easy-to-use Excel spreadsheets suitable for both specialized-discipline (chemistry or chemical engineering student) and mixed-discipline (engineering/economic student) classes. Each chapter contains worked examples, tip boxes and end-of-the-chapter problems and projects. Part I covers web-based chemical information resources, applications and simplified theory presented in a way that allows students of all disciplines to delve into the properties of

supercritical fluids and to design energy, extraction and materials formation systems for real-world processes that use supercritical water or supercritical carbon dioxide. Part II takes a practical approach and addresses the thermodynamic framework, equations of state, fluid phase equilibria, heat and mass transfer, chemical equilibria and reaction kinetics of supercritical fluids. Spreadsheets are arranged as Visual Basic for Applications (VBA) functions and macros that are completely (source code) accessible for students who have interest in developing their own programs. Programming is not required to solve problems or to complete projects in the text. Property worksheets/spreadsheets that are easy to use in learning environments Worked examples with Excel VBA Worksheet functions allow users to design their own processes Fluid phase equilibria and chemical equilibria worksheets allow users to change conditions, study new solutes, co-solvents, chemical systems or reactions Chemical Engineering Design CRC Press

A guide to the theoretical underpinnings and practical applications of chemically reacting flow *Chemically Reacting Flow: Theory, Modeling, and Simulation, Second Edition* combines fundamental concepts in fluid mechanics and physical chemistry while helping students and professionals to develop the analytical and simulation skills needed to solve real-world engineering problems. The authors clearly explain the theoretical and computational building blocks enabling readers to extend the approaches described to related or entirely new applications. New to this Second Edition are substantially revised and reorganized coverage of topics treated in the first edition. New material in the book includes two important areas of active research: reactive porous-media flows and electrochemical kinetics. These topics create bridges between traditional fluid-flow simulation approaches and transport within porous-media electrochemical systems. The first half of the book is devoted to multicomponent fluid-mechanical fundamentals. In the second half the authors provide the necessary fundamental background needed to couple reaction chemistry into complex reacting-flow models. Coverage of such topics is presented in self-contained chapters, allowing a great deal of flexibility in course curriculum design. • Features new chapters on reactive porous-media flow, electrochemistry, chemical thermodynamics, transport properties, and solving differential equations in MATLAB • Provides the theoretical underpinnings and practical applications of chemically reacting flow • Emphasizes fundamentals, allowing the analyst to understand fundamental theory underlying reacting-flow simulations • Helps readers to acquire greater facility in the derivation and solution of conservation equations in new or unusual circumstances • Reorganized to facilitate use as a class text and now including a solutions manual for academic adopters Computer simulation of reactive systems is highly efficient and cost-effective in the development, enhancement, and optimization of chemical processes. *Chemically Reacting Flow: Theory, Modeling, and Simulation, Second Edition* helps prepare graduate students in mechanical or chemical engineering, as well as research professionals in those fields take utmost advantage of that powerful capability.

*Elements of Chemical Reaction Engineering, Global Edition* Pearson Higher Ed

Chemical reaction engineering is concerned with the exploitation of chemical reactions on a commercial scale. It's goal is the successful design and operation of chemical reactors. This text emphasizes qualitative arguments, simple design methods, graphical procedures, and frequent comparison of capabilities of the major reactor types. Simple ideas are treated first, and are then extended to the more complex.

John Wiley & Sons

Filling a longstanding gap for graduate courses in the field, *Chemical Reaction Engineering: Beyond the Fundamentals* covers basic concepts as well as complexities of chemical reaction engineering, including novel techniques for process intensification. The book is divided into three parts: Fundamentals Revisited, Building on Fundamentals, and Beyond the Fundamentals. Part I: Fundamentals Revisited reviews the salient features of an undergraduate course, introducing concepts essential to reactor design, such as mixing, unsteady-state operations, multiple steady states, and complex reactions. Part II: Building on Fundamentals is devoted to "skill building," particularly in the area of catalysis and catalytic reactions. It covers chemical thermodynamics, emphasizing the thermodynamics of adsorption and complex reactions; the fundamentals of chemical kinetics, with special emphasis on microkinetic analysis; and heat and mass transfer effects in catalysis, including transport between phases, transfer across interfaces, and effects of external heat and mass transfer. It also contains a chapter that provides readers with tools for making accurate kinetic measurements and analyzing the data obtained. Part III: Beyond the Fundamentals presents material not commonly covered in textbooks, addressing aspects of reactors involving more than one phase. It discusses solid catalyzed fluid-phase reactions in fixed-bed and fluidized-bed reactors, gas – solid noncatalytic reactions, reactions involving at least one liquid phase (gas – liquid and liquid – liquid), and multiphase reactions. This section also describes membrane-assisted reactor engineering, combo reactors, homogeneous catalysis, and phase-transfer catalysis. The final chapter provides a perspective on future trends in reaction engineering.

*Electrochemical Engineering* John Wiley & Sons

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)

*Chemical Reactor Analysis and Applications for the Practicing Engineer* Pearson Education

Very Good, No Highlights or Markup, all pages are intact.

CEE. Chemical Engineering Education John Wiley & Sons

The Leading Integrated Chemical Process Design Guide: Now with New Problems, New Projects, and More More than ever, effective design is the focal point of sound chemical engineering. Analysis, Synthesis, and Design of Chemical Processes, Third Edition, presents design as a creative process that integrates both the big picture and the small details – and knows which to stress when, and why. Realistic from start to finish, this book moves readers beyond classroom exercises into open-ended, real-world process problem solving. The authors introduce integrated techniques for every facet of the discipline, from finance to operations, new plant design to existing

process optimization. This fully updated Third Edition presents entirely new problems at the end of every chapter. It also adds extensive coverage of batch process design, including realistic examples of equipment sizing for batch sequencing; batch scheduling for multi-product plants; improving production via intermediate storage and parallel equipment; and new optimization techniques specifically for batch processes. Coverage includes Conceptualizing and analyzing chemical processes: flow diagrams, tracing, process conditions, and more Chemical process economics: analyzing capital and manufacturing costs, and predicting or assessing profitability Synthesizing and optimizing chemical processing: experience-based principles, BFD/PFD, simulations, and more Analyzing process performance via I/O models, performance curves, and other tools Process troubleshooting and “debottlenecking” Chemical engineering design and society: ethics, professionalism, health, safety, and new “green engineering” techniques Participating successfully in chemical engineering design teams Analysis, Synthesis, and Design of Chemical Processes, Third Edition, draws on nearly 35 years of innovative chemical engineering instruction at West Virginia University. It includes suggested curricula for both single-semester and year-long design courses; case studies and design projects with practical applications; and appendixes with current equipment cost data and preliminary design information for eleven chemical processes – including seven brand new to this edition.

**Chemical Reactor Analysis and Design Fundamentals** John Wiley & Sons

The Omnibook aims to present the main ideas of reactor design in a simple and direct way. It includes key formulas, brief explanations, practice exercises, problems from experience and it skims over the field touching on all sorts of reaction systems. Most important of all it tries to show the reader how to approach the problems of reactor design and what questions to ask. In effect it tries to show that a common strategy threads its way through all reactor problems, a strategy which involves three factors: identifying the flow pattern, knowing the kinetics, and developing the proper performance equation. It is this common strategy which is the heart of Chemical Reaction Engineering and identifies it as a distinct field of study.

**Analysis, Synthesis and Design of Chemical Processes** Prentice Hall

The Number One Guide to Chemical Engineering Principles, Techniques, Calculations, and Applications: Now Even More Current, Efficient, and Practical Basic Principles and Calculations in Chemical Engineering, Eighth Edition goes far beyond traditional introductory chemical engineering topics, presenting applications that reflect the full scope of contemporary chemical, petroleum, and environmental engineering. Celebrating its fiftieth Anniversary as the field’s leading practical introduction, it has been extensively updated and reorganized to cover today’s principles and calculations more efficiently, and to present far more coverage of bioengineering, nanoengineering, and green engineering. Offering a strong foundation of skills and knowledge for successful study and practice, it guides students through formulating and solving material and energy balance problems, as well as describing gases, liquids, and vapors.

Throughout, the authors introduce efficient, consistent, student-friendly methods for solving problems, analyzing data, and gaining a conceptual, application-based understanding of modern chemical engineering processes.

This edition’s improvements include many new problems, examples, and homework assignments. Coverage includes Modular chapters designed to support introductory chemical engineering courses of any length Thorough introductions to unit conversions, basis selection, and process measurements Consistent, sound strategies for solving material and energy balance problems Clear introductions to key concepts ranging from stoichiometry to enthalpy Behavior of gases, liquids, and solids: ideal/real gases, single component two-phase systems, gas-liquid systems, and more Self-assessment questions to help readers identify areas they don’t fully understand Thought/discussion and homework problems in every chapter New biotech and bioengineering problems throughout New examples and homework on nanotechnology, environmental engineering, and green engineering Extensive tables, charts, and glossaries in each chapter Many new student projects Reference appendixes presenting atomic weights and numbers, Pitzer Z factors, heats of formation and combustion, and more Practical, readable, and exceptionally easy to use, Basic Principles and Calculations in Chemical Engineering, Eighth Edition, is the definitive chemical engineering introduction for students, license candidates, practicing engineers, and scientists. This is the digital version of the print title. Access to the CD content that accompanies the print title is available through product registration. See the instructions in back pages of your digital edition. CD-ROM INCLUDES The latest Polymath trial software for solving linear, nonlinear, and differential equations and regression problems Point-and-click physical property database containing 700+ compounds Supplemental Problems Workbook containing 100+ solved problems Descriptions and animations of modern process equipment Chapters on degrees of freedom, process simulation, and unsteady-state material balances Expert advice for beginners on problem-solving in chemical engineering

**Introduction to Supercritical Fluids** Prentice Hall

Employment opportunities for chemical engineers are moving away from petroleum and petrochemicals toward new applications such as materials processing, pharmaceuticals, and foods. Chemical reactors remain at the center of any chemical process; they are essential to improving existing processes and to designing new ones. Today and in the future chemical engineers must be able to use their knowledge of reactors in combination with other skills in order to think creatively and strategically about new processes and growing applications. The Engineering of Chemical Reactions addresses these issues by focusing on the analysis of chemical reactors while simultaneously providing a description of industrial chemical processes and the strategies by which they operate. Ideal for upper-level undergraduate courses in chemical reactor engineering and kinetics, this text provides a concise, up-to-date alternative to similar texts. In addition to the analysis of simple chemical reactors, it considers more complex situations such as multistage reactors and reactor-separation systems. Energy management and the role of mass transfer in chemical reactors are also integrated into the text. The evolution of chemical engineering from petroleum refining, through petrochemicals and polymers, to new applications is described so that students can see the relationships between past, present, and future technologies. Applications such as catalytic

processes, environmental modeling, biological reactions, reactions involving solids, oxidation, combustion, safety, polymerization, and multiphase reactors are also described. The text uses a notation of reaction stoichiometry and reactor mass balances which is kept simple so that students can see the principles of reactor design without becoming lost in complex special cases. Numerical methods are used throughout to consider more complex problems. Worked examples are given throughout the text, and over 300 homework problems are included. Both the examples and problems cover real-world chemistry and kinetics.

**Applied Mathematics And Modeling For Chemical Engineers** World Scientific Publishing Company

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 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 inquiry-based learning to practice creative problem-solving skills About the Web Site ([umich.edu/~elements/5e/index.html](http://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.

**Biotransformations and Bioprocesses** John Wiley & Sons

An innovative introduction to chemical engineering computing As chemical engineering technology advances, so does the complexity of the problems that arise. The problems that chemical engineers and chemical engineering students face today can no longer be answered with programs written on a case-by-case basis. Introduction to Chemical Engineering Computing teaches professionals and students the kinds of problems they will have to solve, the types of computer programs needed to solve these problems, and how to ensure that the problems have been solved correctly. Each chapter in Introduction to Chemical Engineering Computing contains a description of the physical problem in general terms and in a mathematical context, thorough step-by-step instructions, numerous examples, and comprehensive explanations for each problem and program. This indispensable text features Excel, MATLAB(r), Aspen PlusTM, and FEMLAB programs and acquaints readers with the advantages of each. Perfect for students and professionals, Introduction to Chemical Engineering Computing gives readers the professional tools they need to solve real-world problems involving: \* Equations of state \* Vapor-liquid and chemical reaction equilibria \* Mass balances with recycle streams \* Mass transfer equipment \* Process simulation \* Chemical reactors \* Transfer processes in 1D \* Fluid flow in 2D and 3D \* Convective diffusion equations in 2D and 3D

**Reaction Engineering for Pollution Prevention** John Wiley & Sons

**Essentials of Chemical Reaction Engineering** Pearson Education

**Chemical and Catalytic Reaction Engineering** John Wiley & Sons

Accompanying DVD-ROM contains many realistic, interactive simulations.

**Thermodynamics for the Practicing Engineer** CRC Press

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. Chemical Reactor Omnibook- soft cover Oxford University Press, USA Enables you to easily advance from thermodynamics principles to applications Thermodynamics for the Practicing Engineer, as the title suggests, is written for all practicing engineers and anyone studying to become one. Its focus therefore is on applications of thermodynamics, addressing both technical and pragmatic problems in the field. Readers are provided a solid base in thermodynamics theory; however, the text is mostly dedicated to demonstrating how theory is applied to solve real-world problems. This text's four parts enable readers to easily gain a foundation in basic principles and then learn how to apply them in practice: Part One: Introduction. Sets forth the basic principles of thermodynamics, reviewing such topics as units and dimensions, conservation laws, gas laws, and the second law of thermodynamics. Part Two: Enthalpy Effects. Examines sensible, latent, chemical reaction, and mixing enthalpy effects. Part Three: Equilibrium Thermodynamics. Addresses both principles and calculations for phase, vapor-liquid, and chemical reaction equilibrium. Part Four: Other Topics. Reviews

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such important issues as economics, numerical methods, open-ended problems, environmental concerns, health and safety management, ethics, and exergy. Throughout the text, detailed illustrative examples demonstrate how all the principles, procedures, and equations are put into practice. Additional practice problems enable readers to solve real-world problems similar to the ones that they will encounter on the job. Readers will gain a solid working knowledge of thermodynamics principles and applications upon successful completion of this text. Moreover, they will be better prepared when approaching/addressing advanced material and more complex problems.