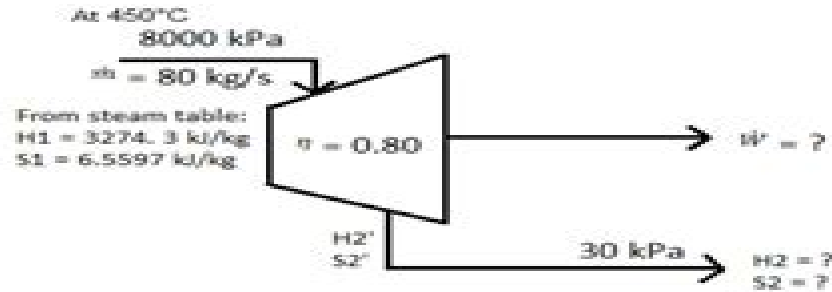


Introduction to Chemical Engineering Thermodynamics  
Problem Set

1. A turbine operates adiabatically with superheated steam entering at 450°C and 8,000 kPa with a mass flowrate of 80 kg/s. The exhaust pressure is 30 kPa and the turbine efficiency is 0.80. Determine the power output of the turbine and the enthalpy and entropy of the exhaust steam.

Given:



Required:

- a.  $\dot{W}$ , power output of the turbine
- b.  $H_2$ , enthalpy of exhaust stream
- c.  $S_2$ , entropy of exhaust stream

Solution:

From steam table under superheated steam, Table F.2, for inlet conditions:

$$H_1 = 3274.3 \frac{\text{kJ}}{\text{kg}}$$

$$S_1 = 6.5597 \frac{\text{kJ}}{\text{kg} \cdot \text{K}}$$

For discharge conditions:

$$H_2^L = 289.302 \frac{\text{kJ}}{\text{kg}}, H_2^V = 2625.4 \frac{\text{kJ}}{\text{kg}}$$

$$S_2^L = 0.9441 \frac{\text{kJ}}{\text{kg} \cdot \text{K}}, S_2^V = 7.7695 \frac{\text{kJ}}{\text{kg} \cdot \text{K}}$$

If the expansion at 30 kPa is isentropic, then:  $S_2^L = S_1 = 6.5597 \frac{\text{kJ}}{\text{kg} \cdot \text{K}}$ . Steam with this entropy at 10 kPa is wet, yielding the equation:

$$S_2^L = S_2^L + x_2'(S_2^V - S_2^L)$$

Substituting the values:

$$6.5597 \frac{\text{kJ}}{\text{kg} \cdot \text{K}} = 0.9441 \frac{\text{kJ}}{\text{kg} \cdot \text{K}} + x_2' \left( 7.7695 \frac{\text{kJ}}{\text{kg} \cdot \text{K}} - 0.9441 \frac{\text{kJ}}{\text{kg} \cdot \text{K}} \right)$$

$$x_2' = 0.8228$$

This is the quality (fraction vapor) of the discharge stream at point 2'. The enthalpy  $H_2^L$  is also given by the equation:

$$H_2^L = H_2^L + x_2'(H_2^V - H_2^L)$$

Thus,

# Chemical Engineering Thermodynamics Problems And Solutions

**Karin Nielsen-Saines**



## **Chemical Engineering Thermodynamics Problems And Solutions:**

**Solutions Manual For Chemical Engineering Thermodynamics** Y. V. C. Rao, 1998 This book is a very useful reference that contains worked out solutions for all the exercise problems in the book Chemical Engineering Thermodynamics by the same author Step by step solutions to all exercise problems are provided and solutions are explained with detailed and extensive illustrations It will come in handy for all teachers and users of Chemical Engineering Thermodynamics Fundamentals of Chemical Engineering Thermodynamics Themis Matsoukas, 2013 Fundamentals of Chemical Engineering Thermodynamics is the clearest and most well organized introduction to thermodynamics theory and calculations for all chemical engineering undergraduates This brand new text makes thermodynamics far easier to teach and learn Drawing on his award winning courses at Penn State Dr Themis Matsoukas organizes the text for more effective learning focuses on why as well as how offers imagery that helps students conceptualize the equations and illuminates thermodynamics with relevant examples from within and beyond the chemical engineering discipline Matsoukas presents solved problems in every chapter ranging from basic calculations to realistic safety and environmental applications

**Chemical Engineering License Problems and Solutions** Dilip K. Das, Rajaram K. Prabhudesai, 2003-09-18 This is a review book for people planning to take the PE exam in Chemical Engineering Prepared specifically for the exam used in all 50 states It features 188 new PE problems with detailed step by step solutions The book covers all topics on the exam and includes easy to use tables charts and formulas It is an ideal desk Companion to DAS s Chemical Engineer License Review It includes sixteen chapters and a short PE sample exam as well as complete references and an index Chapters include the following topical areas material and energy balances fluid dynamics heat transfer evaporation distillation absorption leaching liq liq extraction psychrometry and humidification drying filtration thermodynamics chemical kinetics process control mass transfer and plant safety The ideal study guide this book brings all elements of professional problem solving together in one BIG BOOK Ideal desk reference Answers hundreds of the most frequently asked questions The first truly practical no nonsense problems and solution book for the difficult PE exam Full step by step solutions are included **A TEXTBOOK OF CHEMICAL ENGINEERING THERMODYNAMICS, SECOND EDITION** NARAYANAN, K. V., 2013-01-11 Designed as an undergraduate level textbook in Chemical Engineering this student friendly thoroughly class room tested book now in its second edition continues to provide an in depth analysis of chemical engineering thermodynamics The book has been so organized that it gives comprehensive coverage of basic concepts and applications of the laws of thermodynamics in the initial chapters while the later chapters focus at length on important areas of study falling under the realm of chemical thermodynamics The reader is thus introduced to a thorough analysis of the fundamental laws of thermodynamics as well as their applications to practical situations This is followed by a detailed discussion on relationships among thermodynamic properties and an exhaustive treatment on the thermodynamic properties of solutions The role of phase equilibrium

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**Thermodynamics** Stanley I. Sandler, 1989 A revised edition of the well received thermodynamics text this work retains the thorough coverage and excellent organization that made the first edition so popular Now incorporates industrially relevant microcomputer programs with which readers can perform sophisticated thermodynamic calculations including calculations of the type they will encounter in the lab and in industry Also provides a unified treatment of phase equilibria Emphasis is on analysis and prediction of liquid liquid and vapor liquid equilibria solubility of gases and solids in liquids solubility of liquids and solids in gases and supercritical fluids freezing point depressions and osmotic equilibria as well as traditional vapor liquid and chemical reaction equilibria Contains many new illustrations and exercises **Introduction to Chemical Engineering Thermodynamics** H. C. Van Ness, 1987 Introduction to Chemical Engineering Thermodynamics 6 e presents comprehensive coverage of the subject of thermodynamics from a chemical engineering viewpoint The text provides a thorough exposition of the principles of thermodynamics and details their application to chemical processes The chapters are written in a clear logically organized manner and contain an abundance of realistic problems examples and illustrations to help students understand complex concepts New ideas terms and symbols constantly challenge the readers to think and encourage them to apply this fundamental body of knowledge to the solution of practical problems The comprehensive nature of this book makes it a useful reference both in graduate courses and for professional practice The sixth edition continues to be an excellent tool for teaching the subject of chemical engineering thermodynamics to undergraduate students

**Chemical, Biochemical, and Engineering Thermodynamics** Stanley I. Sandler, 2017-04-24 In this newly revised 5th Edition of Chemical and Engineering Thermodynamics Sandler presents a modern applied approach to chemical thermodynamics and provides sufficient detail to develop a solid understanding of the key principles in the field The text confronts current information on environmental and safety issues and how chemical engineering principles apply in biochemical engineering bio technology polymers and solid state processing This book is appropriate for the undergraduate and graduate level courses **A Text Book of Engineering Thermodynamics** John Joseph Flather, 1915 **Introductory Chemical Engineering Thermodynamics** J. Richard Elliott, Carl T. Lira, 2011-11 A Practical Up to Date Introduction to

Applied Thermodynamics Including Coverage of Process Simulation Models and an Introduction to Biological Systems  
Introductory Chemical Engineering Thermodynamics Second Edition helps readers master the fundamentals of applied thermodynamics as practiced today with extensive development of molecular perspectives that enables adaptation to fields including biological systems environmental applications and nanotechnology This text is distinctive in making molecular perspectives accessible at the introductory level and connecting properties with practical implications Features of the second edition include Hierarchical instruction with increasing levels of detail Content requiring deeper levels of theory is clearly delineated in separate sections and chapters Early introduction to the overall perspective of composite systems like distillation columns reactive processes and biological systems Learning objectives problem solving strategies for energy balances and phase equilibria chapter summaries and important equations for every chapter Extensive practical examples especially coverage of non ideal mixtures which include water contamination via hydrocarbons polymer blending recycling oxygenated fuels hydrogen bonding osmotic pressure electrolyte solutions zwitterions and biological molecules and other contemporary issues Supporting software in formats for both MATLAB and spreadsheets Online supplemental sections and resources including instructor slides ConcepTests coursecast videos and other useful resources

**Answers to Problems, Introduction to Chemical Engineering Thermodynamics, Second Edition** Joe Mauk Smith, H. C. Van Ness, 1959

Chemical Engineering Thermodynamics Barnett Fred Dodge, 1944 *Introduction to Chemical Engineering*

*Thermodynamics* Joseph Mauk Smith, Hendrick C. Van Ness, Michael M. Abbott, 2001 Presents comprehensive coverage of the subject of thermodynamics from a chemical engineering viewpoint This text provides an exposition of the principles of thermodynamics and details their application to chemical processes It contains problems examples and illustrations to help students understand complex concepts

**Catalogue for the Academic Year** Naval Postgraduate School (U.S.), 1958

FUNDAMENTALS OF CHEMISTRY - Volume II Sergio Carrà, 2009-05-05 Fundamentals of Chemistry theme in two volumes is a component of Encyclopedia of Chemical Sciences Engineering and Technology Resources in the global Encyclopedia of Life Support Systems EOLSS which is an integrated compendium of twenty one Encyclopedias The Theme is organized into six different topics which represent the main scientific areas History and Fundamentals of Chemistry Chemical Experimentation and Instrumentation Theoretical Approach to Chemistry Chemical Thermodynamics Rates of Chemical Reactions Chemical Synthesis of Substances These two volumes are aimed at the following five major target audiences University and College students Educators Professional practitioners Research personnel and Policy analysts managers and decision makers and NGOs

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*Chemical Engineering Thermodynamics* Stephen A. Newman,1983      **Problems in Chemical Thermodynamics with Solutions** Maka Aleksishvili,Shota Sidamonidze,2002 The methods of chemical thermodynamics are effectively used in many fields of science and technology Mastering these methods and their use in practice requires profound comprehension of the theoretical questions and acquisition of certain calculating skills This book is useful to undergraduate and graduate students in chemistry as well as chemical thermal and refrigerating technology it will also benefit specialists in all other fields who are interested in using these powerful methods in their practical activities      Introductory Chemical Engineering Thermodynamics J. Richard Elliott,Carl T. Lira,2012-02-06 A Practical Up to Date Introduction to Applied Thermodynamics Including Coverage of Process Simulation Models and an Introduction to Biological Systems Introductory Chemical Engineering Thermodynamics Second Edition helps readers master the fundamentals of applied thermodynamics as practiced today with extensive development of molecular perspectives that enables adaptation to fields including biological systems environmental applications and nanotechnology This text is distinctive in making molecular perspectives accessible at the introductory level and connecting properties with practical implications Features of the second edition include Hierarchical instruction with increasing levels of detail Content requiring deeper levels of theory is clearly delineated in separate sections and chapters Early introduction to the overall perspective of composite systems like distillation columns reactive processes and biological systems Learning objectives problem solving strategies for energy balances and phase equilibria chapter summaries and important equations for every chapter Extensive practical examples especially coverage of non ideal mixtures which include water contamination via hydrocarbons polymer blending recycling oxygenated fuels

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