

## Fisicoquímica.

### Problemario 1/3

- For steam at 500°C and 10 MPa, using the Mollier diagram,
  - Compute the Joule-Thomson coefficient  $\mu_{JT} = \left(\frac{\partial T}{\partial P}\right)_H$
  - Compute the coefficient  $\kappa_s = \left(\frac{\partial T}{\partial P}\right)_s$
- Evaluate the difference  $\left(\frac{\partial U}{\partial T}\right)_P - \left(\frac{\partial U}{\partial T}\right)_V$  for the ideal and van der Waals gases, and for a gas that obeys the virial equation of state.
- One hundred cubic meters of carbon dioxide initially at 150°C and 50 bar is to be isothermally compressed in a frictionless piston-and-cylinder device to a final pressure of 300 bar. Calculate
  - The volume of the compressed gas
  - The work done to compress the gas
  - The heat flow on compressionassuming carbon dioxide a. is an ideal gas, b. Obeys the principle of corresponding states, c. Obeys the Peng-Robinson equation of state.
- Ethylene at 30 bar and 100°C passes through a heater-expander and emerges at 20 bar and 150°C. There is no flow of work into or out of the heater-expander, but heat is supplied. Assuming that ethylene obeys the Peng-Robinson equation of state, compute the flow of heat into the heater-expander per mole of ethylene.



- Calculate  $\Delta A$  and  $\Delta G$  when a mole of water vapor initially at 200°C and 1 bar undergoes a cyclic process for which  $W = 145$  J.
- a) Use the equations  $C_p = \left(\frac{\partial H}{\partial T}\right)_P$ ,  $\frac{\partial}{\partial T} \left(\frac{\partial H}{\partial P}\right) = \frac{\partial}{\partial P} \left(\frac{\partial H}{\partial T}\right)$ , and  $\left(\frac{\partial H}{\partial P}\right)_T = -T \left(\frac{\partial V}{\partial T}\right)_P + V = -TV\alpha + V$  to show that  $\left(\frac{\partial C_p}{\partial P}\right)_T = -T \left(\frac{\partial^2 V}{\partial T^2}\right)_P$ . The volumes of substances increase approximately linearly with T, so  $\frac{\partial^2 V}{\partial T^2}$  is usually quite small. Consequently, the pressure dependence of  $C_p$  can usually be neglected unless one is dealing with high pressures.  
  
The volume of Hg in the temperature range 0°C to 100°C at 1 atm is given by  $V = V_0(1 + \alpha t + bt^2)$ , where  $\alpha = 0.18182 \times 10^{-3} \text{ } ^\circ\text{C}^{-1}$ ,  $b = 0.78 \times 10^{-8} \text{ } ^\circ\text{C}^{-2}$ ,  $V_0$  is the volume at 0°C, and t is the Celsius temperature. The density of mercury at 1 atm and 0°C is 13.596 g/cm<sup>3</sup>. b) Calculate  $\left(\frac{\partial C_p}{\partial P}\right)_T$  for Hg at 25°C and 1 atm. c) Given  $C_{p,m} = 6.66 \text{ cal mol}^{-1} \text{ K}^{-1}$  for Hg at 1 atm and 25°C, estimate  $C_{p,m}$  of Hg at 25°C and 10<sup>4</sup> atm.
- Calculate  $\Delta G$  for the isothermal compression of 30.0 g of water from 1.0 atm to 100.0 atm at 25°C; neglect the variation of V with P.
- Suppose 1.00 mol of water initially at 27°C and 1 atm undergoes a process whose final state is 100°C and 50 atm. Calculate  $\Delta H$ ,  $\Delta U$ , and  $\Delta S$  considering that the temperature and pressure variations of  $\alpha$ ,  $\kappa$ , and  $C_p$  can be neglected.

# Advanced Physical Chemistry Problems V

## Thermodynamics

**Marc J. Assael, Geoffrey C.  
Maitland, Thomas Maskow, Urs von  
Stockar, William A. Wakeham, Stefan  
Will**

## **Advanced Physical Chemistry Problems V Thermodynamics:**

**Commonly Asked Questions in Thermodynamics** Marc J. Assael, Geoffrey C. Maitland, Thomas Maskow, Urs von Stockar, William A. Wakeham, Stefan Will, 2022-08-05 CRC Press is pleased to introduce the new edition of Commonly Asked Questions in Thermodynamics an indispensable resource for those in modern science and engineering disciplines from molecular science engineering and biotechnology to astrophysics Fully updated throughout this edition features two new chapters focused on energy utilization and biological systems This edition begins by setting out the fundamentals of thermodynamics including its basic laws and overarching principles It provides explanations of those principles in an organized manner using questions that arise frequently from undergraduates in the classroom as the stimulus These early chapters explore the language of thermodynamics the first and second laws statistical mechanical theory measurement of thermodynamic quantities and their relationships phase behavior in single and multicomponent systems electrochemistry and chemical and biochemical reaction equilibria The later chapters explore applications of these fundamentals to a diverse set of subjects including power generation with and without fossil fuels for transport industrial and domestic use heating decarbonization technologies energy storage refrigeration environmental pollution and biotechnology Data sources for the properties needed to complete thermodynamic evaluations of many processes are included The text is designed for readers to dip into to find an answer to a specific question where thermodynamics can provide some if not all of the answers whether in the context of an undergraduate course or not Thus its readership extends beyond conventional technical undergraduates to practicing engineers and also to the interested lay person who seeks to understand the discourse that surrounds the choice of particular technological solutions to current and future energy and material production problems *Small Systems and Fundamentals of Thermodynamics* Yu. K. Tovbin, 2018-07-17 Small systems are a very active area of research and development due to improved instrumentation that allows for spatial resolution in the range of sizes from one to 100 nm In this size range many physical and chemical properties change which opens up new approaches to the study of substances and their practical application This affects both traditional fields of knowledge and many other new fields including physics chemistry biology etc This book highlights new developments in statistical thermodynamics that answer the most important questions about the specifics of small systems when one cannot apply equations or traditional thermodynamic models *A System of Physical Chemistry* William Cudmore McCullagh Lewis, 1921 **A System of Physical Chemistry: Thermodynamics** William Cudmore McCullagh Lewis, 1922 **Molecular Driving Forces, third edition** Ken Dill, Sarina Bromberg, Charles D Kocher, Gabor Balazsi, 2026-03-31 The comprehensively updated third edition of a popular introductory statistical thermodynamics text that describes the principles and forces that drive chemical and biological processes This widely used comprehensively updated introductory text on statistical thermodynamics describes the principles and forces that drive chemical and biological processes It explains how a few simple physical principles cause the complex behaviors of

molecules and how simple models provide surprisingly accurate insights into the workings of the molecular world Written in an accessible student friendly style without compromising rigor Molecular Driving Forces offers an excellent introduction to the subject for beginners and a valuable resource for experts 3rd edition highlights New chapter on the nonequilibrium dynamics of driven adaptive and evolving systems New appendix on stochastic dynamics including master equations and the Fokker Planck model New vignettes on the Bayes Theorem reverse osmosis membranes and the chemiosmotic hypothesis Comprehensively updated examples references and end of chapter questions Instructor resources available [A System of Physical Chemistry: Kinetic theory](#) William Cudmore McCullagh Lewis,1918 **Catalogue** Juniata College (Huntingdon, Pa.),1926 **Entropy and Free Energy in Structural Biology** Hagai Meirovitch,2020-08-14 Computer simulation has become the main engine of development in statistical mechanics In structural biology computer simulation constitutes the main theoretical tool for structure determination of proteins and for calculation of the free energy of binding which are important in drug design Entropy and Free Energy in Structural Biology leads the reader to the simulation technology in a systematic way The book which is structured as a course consists of four parts Part I is a short course on probability theory emphasizing 1 the distinction between the notions of experimental probability probability space and the experimental probability on a computer and 2 elaborating on the mathematical structure of product spaces These concepts are essential for solving probability problems and devising simulation methods in particular for calculating the entropy Part II starts with a short review of classical thermodynamics from which a non traditional derivation of statistical mechanics is devised Theoretical aspects of statistical mechanics are reviewed extensively Part III covers several topics in non equilibrium thermodynamics and statistical mechanics close to equilibrium such as Onsager relations the two Fick s laws and the Langevin and master equations The Monte Carlo and molecular dynamics procedures are discussed as well Part IV presents advanced simulation methods for polymers and protein systems including techniques for conformational search and for calculating the potential of mean force and the chemical potential Thermodynamic integration methods for calculating the absolute entropy and methodologies for calculating the absolute free energy of binding are evaluated Enhanced by a number of solved problems and examples this volume will be a valuable resource to advanced undergraduate and graduate students in chemistry chemical engineering biochemistry biophysics pharmacology and computational biology [Biographical Memoirs](#) National Academy of Sciences,1996-06-08 Biographic Memoirs Volume 69 contains the biographies of deceased members of the National Academy of Sciences and bibliographies of their published works Each biographical essay was written by a member of the Academy familiar with the professional career of the deceased For historical and bibliographical purposes these volumes are worth returning to time and again **Journal of the Institute of Metals** Institute of Metals,1921 *Combustion* ,1922 [Engineering and Finance](#) ,1922 **American Scientific Books** ,1965 **The Register and Catalogue for the University of Nebraska, Lincoln, Nebraska** Nebraska. University,University of

Nebraska (Lincoln campus),1884      **High Enthalpy Gas Dynamics** Ethirajan Rathakrishnan,2014-12-16 This is an introductory level textbook which explains the elements of high temperature and high speed gas dynamics written in a clear and easy to follow style the author covers all the latest developments in the field including basic thermodynamic principles compressible flow regimes and waves propagation in one volume covers theoretical modeling of High Enthalpy Flows with particular focus on problems in internal and external gas dynamic flows of interest in the fields of rockets propulsion and hypersonic aerodynamics High enthalpy gas dynamics is a compulsory course for aerospace engineering students and this book is a result of over 25 years teaching by the author accompanying website includes a Solutions Manual for exercises listed at the end of each chapter plus lecture slides      **The United States Catalog** ,1924      **Official Register** Radcliffe College,1950      Phase Equilibria in Chemical Engineering Stanley M. Walas,2013-10-22 Phase Equilibria in Chemical Engineering is devoted to the thermodynamic basis and practical aspects of the calculation of equilibrium conditions of multiple phases that are pertinent to chemical engineering processes Efforts have been made throughout the book to provide guidance to adequate theory and practice The book begins with a long chapter on equations of state since it is intimately bound up with the development of thermodynamics Following material on basic thermodynamics and nonidealities in terms of fugacities and activities individual chapters are devoted to equilibria primarily between pairs of phases A few topics that do not fit into these categories and for which the state of the art is not yet developed quantitatively have been relegated to a separate chapter The chapter on chemical equilibria is pertinent since many processes involve simultaneous chemical and phase equilibria Also included are chapters on the evaluation of enthalpy and entropy changes of nonideal substances and mixtures and on experimental methods This book is intended as a reference and self study as well as a textbook either for full courses in phase equilibria or as a supplement to related courses in the chemical engineering curriculum Practicing engineers concerned with separation technology and process design also may find the book useful      **The Cumulative Book Index** ,1914      Annual Catalogue, with Announcements University of Arizona,1967

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