

## Unit 6 – Thermodynamics (7-9%)

Changes in a substance's properties or change into a different substance requires an exchange of energy.

**6.1 Endothermic and Exothermic Processes:** Explain the relationship between experimental observations and energy changes associated with a chemical or physical transformation.

- Temperature changes in a system indicate energy changes.
- Energy changes in a system can be described as endothermic and exothermic processes such as the heating or cooling of a substance, phase changes, or chemical transformations.
- When a chemical reaction occurs, the energy of the system either decreases (exothermic reaction), increases (endothermic reaction), or remains the same. For exothermic reactions, the energy lost by the reacting species (system) is gained by the surroundings, as heat transfer from or work done by the system. Likewise, for endothermic reactions, the system gains energy from the surroundings by heat transfer to or work done on the system.
- The formation of a solution may be an exothermic or endothermic process, depending on the relative strengths of intermolecular/interparticle interactions before and after the dissolution process.

**6.2 Energy Diagrams:** Represent a chemical or physical transformation with an energy diagram.

- A chemical or physical process is described with an energy diagram that shows the endothermic or exothermic nature of that process.

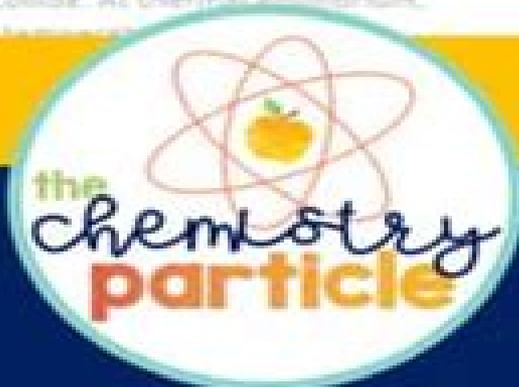
# Unit 6 Objectives

**6.3 Kinetic-Molecular Theory and Thermal Equilibrium:** Explain the relationship between molecular motion and temperature.

- The particles in a warmer body have a greater average kinetic energy than those in a cooler body.
- Collisions between particles in a warmer body and a cooler body is a process called thermal energy transfer.
- Eventually, thermal equilibrium is reached as the particles continue to collide. At thermal equilibrium, the average kinetic energy of both bodies is the same and the rate of energy transfer is zero.

AP Chemistry

REFERENCE



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**Applied Chemistry and Chemical Engineering, Volume 4** A. K. Haghi, Lionello Pogliani, Eduardo A. Castro, Devrim Balköse, Omari V. Mukbaniani, Chin Hua Chia, 2017-12-22 Applied Chemistry and Chemical Engineering Volume 4 Experimental Techniques and Methodical Developments provides a detailed yet easy to follow treatment of various techniques useful for characterizing the structure and properties of engineering materials This timely volume provides an overview of new methods and presents experimental research in applied chemistry using modern approaches Each chapter describes the principle of the respective method as well as the detailed procedures of experiments with examples of actual applications and then goes on to demonstrate the advantage and disadvantages of each physical technique Thus readers will be able to apply the concepts as described in the book to their own experiments The book is broken into several subsections Polymer Chemistry and Technology Computational Approaches Clinical Chemistry and Bioinformatics Special Topics This volume presents research and reviews and information on implementing and sustaining interdisciplinary studies in science technology engineering and mathematics

Materials Physics and Chemistry Satya Bir Singh, Alexander V. Vakhrushev, A. K. Haghi, 2020-11-02 This volume focuses on the development and application of fundamental concepts in mechanics and physics of solids as they pertain to the solution of challenging new problems in diverse areas such as materials science and micro and nanotechnology In this volume emphasis is placed on the development of fundamental concepts of mechanics and novel applications of these concepts based on theoretical experimental or computational approaches drawing upon the various branches of engineering science and the allied areas within applied mathematics materials science and applied physics Materials Physics and Chemistry Applied Mathematics and Chemo Mechanical Analysis emphasizes the basics such as design equilibrium material behavior and geometry of deformation in simple structures or machines Readers will find a thorough treatment of stress strain and the stress strain relationships Meanwhile it provides a solid foundation upon which readers can begin work in composite materials science and engineering Many chapters include theory components with the equations students need to calculate different properties

Engineering Technology and Industrial Chemistry with Applications Reza K. Haghi, Francisco Torrens, 2018-09-24 This volume Engineering Technology and Industrial Chemistry with Applications brings together innovative research new concepts and novel developments in the application of new tools for chemical and materials engineers It provides a collection of innovative chapters on new scientific and industrial research from chemists and chemical engineers at several prestigious institutions It looks at recent significant research and reports on new methodologies and important applications in the fields of chemical engineering as well as provides coverage of chemical databases bringing together theory and practical applications Highlighting theoretical foundations real world cases and future directions this authoritative reference source will be a valuable addition for researchers practitioners professionals and students of chemistry material and chemical engineering

**Multi-Objective Optimization in Chemical**

**Engineering** Gade Pandu Rangaiah,Adrian Bonilla-Petriciolet,2013-03-20 For reasons both financial and environmental there is a perpetual need to optimize the design and operating conditions of industrial process systems in order to improve their performance energy efficiency profitability safety and reliability However with most chemical engineering application problems having many variables with complex inter relationships meeting these optimization objectives can be challenging This is where Multi Objective Optimization MOO is useful to find the optimal trade offs among two or more conflicting objectives This book provides an overview of the recent developments and applications of MOO for modeling design and operation of chemical petrochemical pharmaceutical energy and related processes It then covers important theoretical and computational developments as well as specific applications such as metabolic reaction networks chromatographic systems CO2 emissions targeting for petroleum refining units ecodesign of chemical processes ethanol purification and cumene process design Multi Objective Optimization in Chemical Engineering Developments and Applications is an invaluable resource for researchers and graduate students in chemical engineering as well as industrial practitioners and engineers involved in process design modeling and optimization Planet Earth and the New Geoscience Victor Schmidt,William Harbert,2003-08 The National Guide to Educational Credit for Training Programs American Council on Education,2005 Highlights over 6 000 educational programs offered by business labor unions schools training suppliers professional and voluntary associations and government agencies Film & Video Finder ,1997 **Resources in Education** ,1976 *General Catalog* San Jose State University,1925 Annual Report University of Michigan. Bureau of Cooperation with Educational Institutions,1928 **Coal Abstracts** ,1992 *Catalog and Yearbook* University of Northern Colorado,1892 **Papers Presented at the ... Meeting** American Chemical Society. Division of Polymer Chemistry,1992 **Ceramic Abstracts** American Ceramic Society,1926 Government Reports Announcements & Index ,1996 An Introductory Guide to EC Competition Law and Practice Valentine Korah,1994 Manufacturers Record ,1925 Fusion Science and Technology ,2003 **Government Reports Announcements & Index** ,1988 *Science* John Michels (Journalist),2005

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