

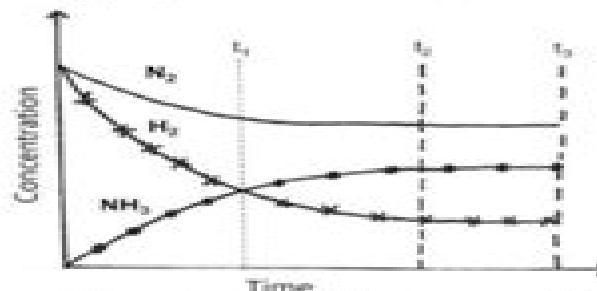
Chemical Equilibrium

The Equilibrium Condition

- The majority of chemical reactions are reversible.
- Equilibrium is the state where the **rate of the forward reaction is equal to the rate of the reverse reaction** and results in no net observable change. At equilibrium, concentrations of all reactants and products remain constant at constant temperature.
- Equilibrium is dynamic.
 - \rightleftharpoons or \rightleftharpoons indicates that the reaction is proceeding forward and in reverse.
 - Once equilibrium is established, the rate of each direction is equal.
 - This keeps the concentration of reactants constant
 - This keeps the concentration of products constant
 - This does NOT mean that concentration of products and concentration of reactants are the same or equal to each other.
- Any chemical reactions carried out in a closed vessel will reach equilibrium.
- Concept Check



H_2 gas and N_2 gas were placed in a rigid vessel and allowed to reach equilibrium in the presence of a catalyst according to the equation above. The diagram below shows how the concentrations of H_2 , N_2 , and NH_3 in this system changed over time. Based on the graph, which of these claims is most likely correct?



- The reaction reached equilibrium at t_1 , because the concentrations of H_2 and NH_3 were the same.
- The reaction reached equilibrium at t_2 , because the concentrations of N_2 , H_2 , and NH_3 stopped changing.
- The reaction reached equilibrium at t_3 , because the reaction stopped proceeding.
- The reaction did not reach equilibrium, because not all of the N_2 and H_2 was consumed at time t_3 .

Temp
Dependent

Unit 4 Chemical Equilibrium Worksheet

O. Jerry Parker, Gary L. Breneman

A red circular graphic with a gradient, appearing as a partial circle or a stylized arrow pointing to the right, located to the right of the authors' names.

Unit 4 Chemical Equilibrium Worksheet:

Symbolic Mathematics for Chemists Fred Senese, 2018-08-24 An essential guide to using Maxima a popular open source symbolic mathematics engine to solve problems build models analyze data and explore fundamental concepts Symbolic Mathematics for Chemists offers students of chemistry a guide to Maxima a popular open source symbolic mathematics engine that can be used to solve problems build models analyze data and explore fundamental chemistry concepts The author a noted expert in the field focuses on the analysis of experimental data obtained in a laboratory setting and the fitting of data and modeling experiments The text contains a wide variety of illustrative examples and applications in physical chemistry quantitative analysis and instrumental techniques Designed as a practical resource the book is organized around a series of worksheets that are provided in a companion website Each worksheet has clearly defined goals and learning objectives and a detailed abstract that provides motivation and context for the material This important resource Offers an text that shows how to use popular symbolic mathematics engines to solve problems Includes a series of worksheet that are prepared in Maxima Contains step by step instructions written in clear terms and includes illustrative examples to enhance critical thinking creative problem solving and the ability to connect concepts in chemistry Offers hints and case studies that help to master the basics while proficient users are offered more advanced avenues for exploration Written for advanced undergraduate and graduate students in chemistry and instructors looking to enhance their lecture or lab course with symbolic mathematics materials Symbolic Mathematics for Chemists A Guide for Maxima Users is an essential resource for solving and exploring quantitative problems in chemistry **ASME Technical Papers** , *Paper* , 1991

Spreadsheet Chemistry O. Jerry Parker, Gary L. Breneman, 1991 **Chemical Engineering Design** Gavin Towler, Ray Sinnott, 2008 Product Description Chemical Engineering Design is a complete course text for students of chemical engineering Written for the Senior Design Course and also suitable for introduction to chemical engineering courses it covers the basics of unit operations and the latest aspects of process design equipment selection plant and operating economics safety and loss prevention It is a textbook that students will want to keep through their undergraduate education and on into their professional lives Provides students with a text of unmatched relevance for the Senior Design Course and Introductory Chemical Engineering Courses Teaches commercial engineering tools for simulation and costing Comprehensive coverage of unit operations design and economics Strong emphasis on HS 108 realistic commercial design projects from diverse industries A rigorous pedagogy assists learning with detailed worked examples end of chapter exercises plus supporting data and Excel spreadsheet calculations plus over 150 Patent References for downloading from the companion website Extensive instructor resources include lecture slides image bank and solutions manual for adopting instructors For further information <http://textbooks.elsevier.com> Chemistry James N. Spencer, George M. Bodner, Lyman H. Rickard, 2002-02-28 The second edition of Spencer's Chemistry Structure and Dynamics has been the most successful reform project published for the

General Chemistry course The authors have revised the text by building on the recommendations of the ACS s Task Force on the General Chemistry Curriculum and suggestions from the adopters of the first edition This innovative text provides a fifteen chapter introduction to the fundamental concepts of Chemistry A collection of additional topics at the end of each chapter allow instructors to supplement and tailor their courses according to individual need Three major themes link the content of the book the process of science the relationship between molecular structure and physical chemical properties and the relationship between the microscopic and macroscopic levels **Current Index to Journals in Education** ,1985

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