

Physics

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(Chapter 12) (Kinetic Theory) (Exercises)
(Class 11)

Question 12.1:

Estimate the fraction of molecular volume to the actual volume occupied by oxygen gas at STP. Take the diameter of an oxygen molecule to be $3 \text{ \AA}$.

Answer 12.1:

Diameter of an oxygen molecule, $d = 3 \text{ \AA}$

Radius, $r = \frac{d}{2} = \frac{3}{2} \text{ \AA} = 1.5 \text{ \AA} = 1.5 \times 10^{-8} \text{ cm}$

Actual volume occupied by 1 mole of oxygen gas at STP = 22400 cm^3

Molecular volume of oxygen gas, $V = \frac{4}{3} \pi r^3 N$

Where, N is Avogadro's number = 6.023×10^{23} molecules/mole

$$\therefore V = \frac{4}{3} \times 3.14 \times (1.5 \times 10^{-8})^3 \times 6.023 \times 10^{23} = 8.51 \text{ cm}^3$$

$$\text{Ratio of the molecular volume to the actual volume of oxygen} = \frac{8.51}{22400} = 3.8 \times 10^{-4}$$

Question 12.2:

Molar volume is the volume occupied by 1 mol of any (ideal) gas at standard temperature and pressure (STP: 1 atmospheric pressure, 0°C). Show that it is 22.4 litres.

Answer 12.2:

The ideal gas equation relating pressure (P), volume (V), and absolute temperature (T) is given as:

$$PV = nRT$$

Where,

R is the universal gas constant = $8.314 \text{ J mol}^{-1} \text{ K}^{-1}$

n = Number of moles = 1

T = Standard temperature = 273 K

P = Standard pressure = $1 \text{ atm} = 1.013 \times 10^5 \text{ Nm}^{-2}$

$$\therefore V = \frac{nRT}{P} = \frac{1 \times 8.314 \times 273}{1.013 \times 10^5}$$

$$= 0.0224 \text{ m}^3 = 22.4 \text{ litres}$$

Hence, the molar volume of a gas at STP is 22.4 litres.

Question 12.3:

Figure 12.8 shows plot of PV/T versus P for $1.00 \times 10^{-3} \text{ kg}$ of oxygen gas at two different temperatures.

(a) What does the dotted plot signify?

(b) Which is true: $T_1 > T_2$ or $T_1 < T_2$?

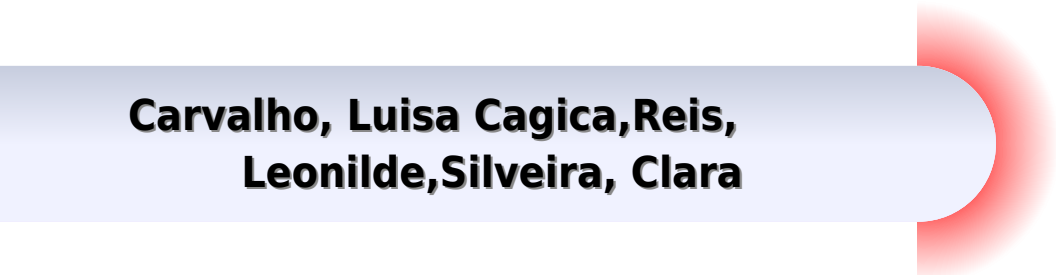
(c) What is the value of PV/T where the curves meet on the y-axis?

(d) If we obtained similar plots for $1.00 \times 10^{-3} \text{ kg}$ of hydrogen, would we get the same value of PV/T at the point where the curves meet on the y-axis? If not, what mass of hydrogen yields the same value of PV/T (for low pressure high temperature region of the plot)?
(Molecular mass of $\text{H}_2 = 2.02 \text{ u}$, of $\text{O}_2 = 32.0 \text{ u}$, $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$.)



University Physics Chapter 12 Solutions

**Carvalho, Luisa Cagica, Reis,
Leonilde, Silveira, Clara**



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Multidimensional NMR Methods for the Solution State Gareth A. Morris, James W. Emsley, 2012-12-19 The content of this volume has been added to eMagRes formerly Encyclopedia of Magnetic Resonance the ultimate online resource for NMR and MRI The literature of multidimensional NMR began with the publication of three papers in 1975 then nine in 1976 and fifteen in 1977 and now contains many tens of thousands of papers Any attempt to survey the field must therefore necessarily be very selective not to say partial In assembling this handbook the Editors have sought to provide both the new researcher and the established scientist with a solid foundation for the understanding of multidimensional NMR a representative if inevitably limited survey of its applications an authoritative account of classic techniques such as COSY NOESY and TOSCY and an account of the latest progress in the development of multidimensional techniques This handbook is structured in four parts The first opens with an historical introduction to and a brief account of the practicalities and applications of multidimensional NMR methods followed by a definitive survey of their conceptual basis and a series of articles setting out the generic principles of methods for acquiring and processing multidimensional NMR data In the second part the main families of multidimensional techniques arranged in approximate order of increasing complexity are described in detail from simple J resolved spectroscopy through to the powerful heteronuclear 3D and 4D methods that now dominate the study of structural biology in solution The third part offers an illustrative selection from the very wide range of applications of multidimensional NMR methods including some of the most recent developments in protein NMR Finally the fourth part introduces the idea of multidimensional spectra containing non frequency dimensions in which properties such as diffusion and relaxation are correlated About EMR Handbooks eMagRes Handbooks The Encyclopedia of Magnetic Resonance up to 2012 and eMagRes from 2013 onward publish a wide range of online articles on all aspects of magnetic resonance in physics chemistry biology and medicine The existence of this large number of articles written by experts in various fields is enabling the publication of a series of EMR Handbooks eMagRes Handbooks on specific areas of NMR and MRI The chapters of each of these handbooks will comprise a carefully chosen selection of articles from eMagRes In consultation with the eMagRes Editorial Board the EMR Handbooks eMagRes Handbooks are coherently planned in advance by specially selected Editors and new articles are written together with updates of some already existing articles to give appropriate complete coverage The handbooks are intended to be of value and interest to research students postdoctoral fellows and other researchers learning about the scientific area in question and undertaking relevant experiments whether in academia or industry Have the content of this Handbook and the complete content of eMagRes at your fingertips Visit www.wileyonlinelibrary.com/ref/eMagRes View other eMagRes publications here

The Padé Approximant in Theoretical Physics, 1971-02-27 In this book we study theoretical and practical aspects of computing methods for mathematical modelling of nonlinear systems A number of computing techniques are considered such as methods of operator

approximation with any given accuracy operator interpolation techniques including a non Lagrange interpolation methods of system representation subject to constraints associated with concepts of causality memory and stationarity methods of system representation with an accuracy that is the best within a given class of models methods of covariance matrix estimation methods for low rank matrix approximations hybrid methods based on a combination of iterative procedures and best operator approximation and methods for information compression and filtering under condition that a filter model should satisfy restrictions associated with causality and different types of memory As a result the book represents a blend of new methods in general computational analysis and specific but also generic techniques for study of systems theory and its particular branches such as optimal filtering and information compression Best operator approximation Non Lagrange interpolation Generic Karhunen Loeve transform Generalised low rank matrix approximation Optimal data compression Optimal nonlinear filtering

University Physics: Australian edition Hugh D Young, Roger A Freedman, Ragbir Bhathal, 2010-08-04 This book is the product of more than half a century of leadership and innovation in physics education When the first edition of University Physics by Francis W Sears and Mark W Zemansky was published in 1949 it was revolutionary among calculus based physics textbooks in its emphasis on the fundamental principles of physics and how to apply them The success of University Physics with generations of several million students and educators around the world is a testament to the merits of this approach and to the many innovations it has introduced subsequently In preparing this First Australian SI edition our aim was to create a text that is the future of Physics Education in Australia We have further enhanced and developed University Physics to assimilate the best ideas from education research with enhanced problem solving instruction pioneering visual and conceptual pedagogy the first systematically enhanced problems and the most pedagogically proven and widely used online homework and tutorial system in the world Mastering Physics

Wireless Multi-Access Environments and Quality of Service Provisioning: Solutions and Application Muntean, Gabriel-Miro, Trestian, Ramona, 2012-01-31 This book serves as a vital resource for practitioners to learn about the latest research and methodology within the field of wireless technology covering important aspects of emerging technologies in the heterogeneous next generation network environment with a focus on wireless communications and their quality Provided by publisher

An Introduction to Statistical Thermodynamics Terrell L. Hill, 2012-06-08 Four part treatment covers principles of quantum statistical mechanics systems composed of independent molecules or other independent subsystems and systems of interacting molecules concluding with a consideration of quantum statistics

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Some Musings on Theta, Eta, and Zeta Floyd L. Williams,2023-11-02 This book continues the applications of mathematics more specifically of theta eta and zeta functions and modular forms to various areas of theoretical physics It is a follow up and extension in some sense of the author s earlier book entitled A window into zeta and modular physics Some of the main topics are 1 A new approach to logarithmic corrections to black hole entropy 2 My recent work that provides for an explicit cold plasma black hole connection 3 Generalization of work of physicists on certain

asymptotic problems relating to string theory for example by way of the general theory of modular forms of non positive weight 4 A construction of the E8 root lattice its theta function and its relevance for heterotic string theory 5 Applications of elliptic functions to KdV nonlinear Schr dinger and Duffing equations for example including a discussion of Lax pairs and the Miura transformation 6 Finite temperature zeta functions and partition functions for quantum fields in thermal equilibrium on various curved background spacetimes 7 Exact solutions of the Einstein gravitational field equations for Lemaitre and inhomogeneous cosmological models with a special focus on the Szekeres Szafron exact solutions by way of the Weierstrass elliptic function 8 Elementary particles and my zeta function formula for higher spin fermionic particles this covers in particular the gravitino particle of spin $3/2$ and bosons with integral spin $s = 2, 3, 4, 5$ These are some sample topics Others include the continuous Heisenberg model reaction diffusion systems Dirichlet and Hecke L functions the modular j invariant the computation of the one loop effective potential for non compact symmetric spaces the BTZ black hole Jacobi inversion formulas etc Thus there is a very large range of material with the first 9 chapters of preliminary expository background for mathematicians and physicists

Handbook of Research on Entrepreneurship, Innovation, Sustainability, and ICTs in the Post-COVID-19 Era Carvalho, Luisa Cagica, Reis, Leonilde, Silveira, Clara, 2021-04-30 ICT has had a huge impact on businesses and organizations in general with new business models new marketing channels and new markets being reached using these technologies ICT can promote new strategies and enhancers to optimize various aspects of business but this technology also provides important tools that can empower social entrepreneurship initiatives to develop fund and implement new and innovative solutions to social cultural and environmental problems With the upheaval caused by the COVID 19 pandemic and its subsequent impact on the economy the methods and tools used within this field will be forever impacted ICTs and the digital economy are huge trends that will affect organizations in several dimensions such as how to communicate and improve performance Thus new perspectives and research are needed to identify the trends emerging in these fields The Handbook of Research on Entrepreneurship Innovation Sustainability and ICTs in the Post COVID 19 Era broadens the exploitation of entrepreneurship innovation and ICTs in a global approach to draw attention to multidisciplinary perspectives of these contexts and their influence in modern organizations In addition the book explores and discusses through innovative studies case studies systematic literature reviews and reports the key developments in digital entrepreneurship circular economy and digitalization digital business models digital market and internationalization digital economy trends and challenges for organizations digital entrepreneurial ecosystems IS ICT in organizations social aspects of information systems and more This book is ideally intended for business managers industry professionals entrepreneurs practitioners stakeholders researchers academicians and students looking for how business and organizations are going to shift and advance in the post COVID 19 era

Group Theory & General Relativity Moshe Carmeli, 2000-11-15 This is the only book on the subject of group theory and Einstein's theory of gravitation It contains an extensive discussion on general

relativity from the viewpoint of group theory and gauge fields It also puts together in one volume many scattered original works on the use of group theory in general relativity theory There are twelve chapters in the book The first six are devoted to rotation and Lorentz groups and their representations They include the spinor representation as well as the infinite dimensional representations The other six chapters deal with the application of groups particularly the Lorentz and the $SL(2, \mathbb{C})$ groups to the theory of general relativity Each chapter is concluded with a set of problems The topics covered range from the fundamentals of general relativity theory its formulation as an $SL(2, \mathbb{C})$ gauge theory to exact solutions of the Einstein gravitational field equations The important Bondi Metzner Sachs group and its representations conclude the book The entire book is self contained in both group theory and general relativity theory and no prior knowledge of either is assumed The subject of this book constitutes a relevant link between field theoreticians and general relativity theoreticians who usually work rather independently of each other The treatise is highly topical and of real interest to theoretical physicists general relativists and applied mathematicians It is invaluable to graduate students and research workers in quantum field theory general relativity and elementary particle theory *Advanced Engineering Mathematics with MATLAB®* Dean G.

Duffy, 2025-08-19 In the five previous editions of *Advanced Engineering Mathematics with MATLAB* the author presented a text firmly grounded in mathematics that engineers and scientists must understand and know how to use Tapping into decades of teaching at the US Navy Academy and the US Military Academy and serving for twenty five years at NASA Goddard Space Flight he combines teaching and practical experience that is rare among authors of advanced engineering mathematics books This edition continues to refine a smaller easier to read and useful version of this classic textbook While competing textbooks continue to grow the book presents a slimmer more practical option to align with the expectations of today's students The new edition of the author's classic textbook continues on a path to creating the best possible learning resource for instructors and students alike Through extensive class testing over five previous editions including the author's current course at the US Naval Academy the book has been steadily improved The primary mission of this edition is to dramatically increase the quality and quantity of examples and problems especially in the chapters on differential equations and Laplace transforms The chapters on differential equations linear algebra Fourier series and Laplace transforms have seen the greatest changes Of course this edition continues to offer a wealth of examples and applications from scientific and engineering literature a highlight of previous editions MATLAB remains central to the presentation and is employed to reinforce the concepts that are taught Worked solutions are given in the back of the book An Instructor's Solutions Manual is also available **Heat Conduction** Yaman Yener, Sadik Kakac, 2018-05-04 Nearly thirty years since its first publication the highly anticipated fourth edition of *Heat Conduction* upholds its reputation as an instrumental textbook and reference for graduate students and practicing engineers in mechanical engineering and thermal sciences Written to suit a one semester graduate course the text begins with fundamental concepts introducing the governing equation of heat conduction as derived

from the First law of Thermodynamics Solutions for one dimensional conduction follow then orthogonal functions Fourier series and transforms and multi dimensional problems Later sections focus on a series of specialized techniques including integral equations Laplace transforms finite difference numerical methods and variational formulations Two new chapters 9 and 11 have been added to cover heat conduction with local heat sources and heat conduction involving phase change Applications of Fourier transforms in the semi infinite and infinite regions have been added to Chapter 7 and Chapter 10 has been expanded to include solutions by the similarity method Also new to the fourth edition are additional problems at the end of each chapter

Self-Assembly Ramanathan Nagarajan, 2019-01-07 An introduction to the state of the art of the diverse self assembly systems Self Assembly From Surfactants to Nanoparticles provides an effective entry for new researchers into this exciting field while also giving the state of the art assessment of the diverse self assembling systems for those already engaged in this research Over the last twenty years self assembly has emerged as a distinct science technology field going well beyond the classical surfactant and block copolymer molecules and encompassing much larger and complex molecular biomolecular and nanoparticle systems Within its ten chapters each contributed by pioneers of the respective research topics the book Discusses the fundamental physical chemical principles that govern the formation and properties of self assembled systems Describes important experimental techniques to characterize the properties of self assembled systems particularly the nature of molecular organization and structure at the nano meso or micro scales Provides the first exhaustive accounting of self assembly derived from various kinds of biomolecules including peptides DNA and proteins Outlines methods of synthesis and functionalization of self assembled nanoparticles and the further self assembly of the nanoparticles into one two or three dimensional materials Explores numerous potential applications of self assembled structures including nanomedicine applications of drug delivery imaging molecular diagnostics and theranostics and design of materials to specification such as smart responsive materials and self healing materials Highlights the unifying as well as contrasting features of self assembly as we move from surfactant molecules to nanoparticles Written for students and academic and industrial scientists and engineers by pioneers of the research field Self Assembly From Surfactants to Nanoparticles is a comprehensive resource on diverse self assembly systems that is simultaneously introductory as well as the state of the art

Transport Equations for Semiconductors Ansgar Jüngel, 2009-04-20 Semiconductor devices are ubiquitous in the modern computer and telecommunications industry A precise knowledge of the transport equations for electron flow in semiconductors when a voltage is applied is therefore of paramount importance for further technological breakthroughs In the present work the author tackles their derivation in a systematic and rigorous way depending on certain key parameters such as the number of free electrons in the device the mean free path of the carriers the device dimensions and the ambient temperature Accordingly a hierarchy of models is examined which is reflected in the structure of the book first the microscopic and macroscopic semi classical approaches followed by their quantum mechanical counterparts

Thermal

Computations for Electronics Gordon N. Ellison, 2020-05-13 The first edition of Thermal Computations for Electronics Conductive Radiative and Convective Air Cooling was based on the author's lecture notes that he developed over the course of nearly 40 years of thermal design and analysis activity the last 15 years of which included teaching a university course at the senior undergraduate and graduate levels The subject material was developed from publications of respected researchers and includes topics and methods original to this author Numerous students have contributed to both the first and second editions the latter corrected sections rewritten e g radiation spatial effects Green's function properties for thermal spreading 1 D FEA theory and application and some new material added The flavor and organization of the first edition have been retained whereby the reader is guided through the analysis process for systems and then components Important new material has been added regarding altitude effects on forced and buoyancy driven airflow and heat transfer The first 20% of the book is devoted to the prediction of airflow and well mixed air temperatures in systems circuit board channels and heat sinks followed by convective PCB mounted components included radiative and conductive heat transfer and the resultant temperatures in electronic equipment Detailed application examples illustrate a variety of problems Downloads from the CRC website include MathcadTM text examples exercise solutions adopting professors only plus PDF lecture aids professors only and a tutorial Chapter 14 using free FEA software to solve a thermal spreading problem This book is a valuable professional resource for self study and is ideal for use in a course on electronics cooling It is well suited for a first course in heat transfer where applications are as important as theory

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Topological Polymer Chemistry Yasuyuki Tezuka, 2013 There are examples aplenty in the macroscopic world that demonstrate the form of objects directing their functions and properties On

the other hand the fabrication of extremely small objects having precisely defined structures has only recently become an attractive challenge which is now opening the door to nanoscience and nanotechnology In the field of synthetic polymer chemistry a number of critical breakthroughs have been achieved during the first decade of this century to produce an important class of polymers having a variety of cyclic and multicyclic topologies These developments now offer unique opportunities in polymer materials design to create unprecedented properties and functions simply based on the form i e topology of polymer molecules In this book on topological polymer chemistry the important developments in this growing area will be collected for the first time with particular emphasis on new conceptual insights for polymer chemistry and polymer materials The book will systematically review topological polymer chemistry from basic aspects to practice and give a broad overview of cyclic polymers covering new synthesis structure characterization basic properties functions and the eventual applications

Masters of the Universe Helge Kragh, 2014-11-20 How did our modern picture of the universe come into being Masters of the Universe tells this fascinating story in an unusual format that blends factual and fictional elements It is based on a series of interviews that a fictional person conducted with leading astronomers and physicists between 1913 and 1965 Among the interviewed scientists are giants such as Albert Einstein Edwin Hubble and George Gamow but also scientists who are less well known today or not primarily known as cosmologists such as Karl Schwarzschild Paul Dirac and Svante Arrhenius By following the interviews the reader gets a lively and almost authentic impression of the problems that faced this early generation of cosmologists Although the interviews are purely fictional a product of the author s imagination they could have taken place in just the way that is described They are solidly based on historical facts and moreover supplemented with careful annotations and references to the literature In this way the book bridges the gap between scholarly and popular history of science

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