

dimensional analysis book

The Ultimate Guide to Dimensional Analysis Books: Mastering Units & Problem Solving

Are you struggling with unit conversions? Do complex physics or engineering problems leave you feeling lost? Mastering dimensional analysis is the key to unlocking clarity and confidence in your scientific and engineering endeavors. This comprehensive guide will explore the world of dimensional analysis books, helping you choose the perfect resource to elevate your problem-solving skills. We'll delve into what makes a great dimensional analysis book, provide recommendations, and equip you with the knowledge to tackle any unit-related challenge head-on. Get ready to conquer the world of units!

Understanding the Importance of Dimensional Analysis Books

Dimensional analysis is a powerful tool that uses the dimensions of physical quantities (like length, mass, and time) to check the validity of equations and to derive relationships between different physical quantities. It's not just a theoretical concept; it's an essential skill for anyone working in science, engineering, or any field involving quantitative analysis. A well-written dimensional analysis book can be the difference between struggling through complex problems and confidently solving them with ease.

What to Look for in a Good Dimensional Analysis Book

Choosing the right book depends on your existing knowledge and learning style. Here are key features to consider:

Clear Explanations: The book should explain the fundamental concepts of dimensional analysis in a straightforward and easy-to-understand manner. Avoid overly technical jargon unless it's properly defined and explained.

Abundant Examples: Numerous worked examples are crucial. These examples should progress in complexity, allowing you to gradually build your understanding. The examples should cover a wide range of applications relevant to your field.

Practice Problems: A good book will include plenty of practice problems with varying levels of difficulty. Solutions to these problems are essential for reinforcing your learning.

Real-World Applications: Connecting dimensional analysis to real-world scenarios makes the learning more engaging and memorable. Look for examples that illustrate the practical uses of dimensional analysis in different

fields.

Targeted Audience: Consider the book's intended audience. Is it suitable for beginners, or does it cater to advanced students or professionals? Choose a book that matches your level.

Recommended Dimensional Analysis Book: "Dimensions and Units in Physics"

This guide focuses on a hypothetical book, "Dimensions and Units in Physics," to illustrate the ideal structure and content.

Bullet Point Outline:

Introduction: Explains the fundamental concepts of dimensional analysis, including base units, derived units, and the importance of dimensional consistency.

Chapter 1: Basic Concepts of Dimensions and Units: Covers SI units, dimensional homogeneity, and the process of dimensional analysis. Includes numerous examples of unit conversions and dimensional checks.

Chapter 2: Advanced Dimensional Analysis Techniques: Explores Buckingham Pi theorem, and its application in deriving dimensionless groups. Demonstrates how to use dimensional analysis to simplify complex equations and solve problems.

Chapter 3: Applications in Physics: Illustrates the use of dimensional analysis in various branches of physics, including mechanics, thermodynamics, and electromagnetism. Provides real-world examples and case studies.

Chapter 4: Applications in Engineering: Shows the importance of dimensional analysis in engineering disciplines like fluid mechanics, heat transfer, and structural analysis. Includes practical examples and problem-solving strategies.

Chapter 5: Troubleshooting Common Errors: Addresses common mistakes in applying dimensional analysis and offers techniques to avoid them. Provides tips for effective problem-solving.

Conclusion: Summarizes the key concepts of dimensional analysis and emphasizes its importance as a problem-solving tool. Encourages readers to continue practicing and applying dimensional analysis in their studies and work.

Detailed Explanation of the "Dimensions and Units in Physics" Book Outline

Introduction: This section sets the stage, defining dimensional analysis and its significance. It establishes the importance of dimensional consistency in equations and lays the groundwork for the subsequent chapters. The introduction aims to grab the reader's attention and clearly outline the book's scope.

Chapter 1: Basic Concepts of Dimensions and Units: This chapter focuses on

the fundamentals. It explains the International System of Units (SI) and provides a thorough understanding of base units and derived units. This section emphasizes dimensional homogeneity, the principle that equations must have consistent dimensions on both sides. This chapter is built upon numerous solved examples that demonstrate unit conversions and dimensional checks, ensuring the reader fully grasps the basics.

Chapter 2: Advanced Dimensional Analysis Techniques: Here, the book delves into more sophisticated techniques, such as the Buckingham Pi theorem. This theorem is explained clearly, with step-by-step examples demonstrating how to identify dimensionless groups. This section also shows how dimensional analysis can significantly simplify complex equations and provide insightful relationships between variables.

Chapter 3: Applications in Physics: This chapter showcases the versatility of dimensional analysis across diverse physics branches. Worked examples highlight its use in mechanics (analyzing forces and motion), thermodynamics (understanding energy transfer), and electromagnetism (analyzing electric and magnetic fields). Real-world applications reinforce the practical relevance of the concepts.

Chapter 4: Applications in Engineering: Similar to Chapter 3, but with a focus on engineering applications. This section demonstrates the use of dimensional analysis in fluid mechanics (solving problems related to fluid flow), heat transfer (analyzing temperature distributions), and structural analysis (designing stable structures). Practical examples and problem-solving strategies are included.

Chapter 5: Troubleshooting Common Errors: This crucial chapter addresses common pitfalls students encounter. It highlights frequent mistakes in applying dimensional analysis and provides practical solutions to avoid these errors. This section also offers advice on effective problem-solving strategies, reinforcing good habits.

Conclusion: The conclusion summarizes the key takeaways from the book, reinforcing the significance of dimensional analysis as a powerful problem-solving tool. It encourages readers to continue practicing and applying the learned techniques in their academic and professional endeavors. It might even suggest further reading or resources for continued learning.

Frequently Asked Questions (FAQs)

1. What is the difference between dimensional analysis and unit conversion? Dimensional analysis checks the consistency of units in an equation, while unit conversion changes units within a single quantity.

1. Can dimensional analysis determine the exact value of a physical quantity? No, it only provides information about the relationship between variables, not their numerical values.

1. Is dimensional analysis only useful in physics and engineering? No, it's applicable in any field involving quantitative relationships, including chemistry, biology, and economics.

1. How can I improve my skills in dimensional analysis? Practice is key! Work through numerous problems with varying levels of difficulty.

1. Are there online resources to help me learn dimensional analysis? Yes, many websites, videos, and online courses offer tutorials and practice problems.

1. What are some common mistakes to avoid when using dimensional analysis? Forgetting to include all relevant variables, incorrectly applying the Buckingham Pi theorem, and misinterpreting the results.

1. Can dimensional analysis be used to verify experimental results? Yes, it can help check the consistency of units and identify potential errors in experimental data.

1. Are there different types of dimensional analysis techniques? Yes, besides the Buckingham Pi theorem, there are other approaches depending on the complexity of the problem.

1. Where can I find more advanced topics in dimensional analysis? Consult specialized textbooks and research papers focusing on advanced techniques and applications.

Related Articles:

1. Introduction to Dimensional Analysis: A beginner-friendly overview of the fundamental concepts.
1. The Buckingham Pi Theorem Explained: A detailed explanation of this powerful theorem with worked examples.
1. Dimensional Analysis in Fluid Mechanics: Applications of dimensional analysis in fluid flow problems.
1. Dimensional Analysis in Heat Transfer: Analyzing temperature distributions and energy transfer using dimensional analysis.
1. Dimensional Analysis in Structural Analysis: Applications in designing stable and efficient structures.
1. Dimensional Analysis and Model Building: How dimensional analysis helps in creating accurate physical models.
1. Common Errors in Dimensional Analysis: Avoiding common mistakes and developing good problem-solving techniques.
1. Advanced Dimensional Analysis Techniques: Exploring more sophisticated methods and applications.
1. Dimensional Analysis Software and Tools: Exploring available software that can assist in dimensional analysis calculations.

dimensional analysis book: Dimensional Analysis J.C. Gibbings, 2011-02-11 For experiments, dimensional analysis enables the design, checks the validity, orders the procedure and synthesises the data. Additionally it can provide relationships between variables where standard analysis is not available. This widely valuable analysis for engineers and scientists is here presented to the student, the teacher and the researcher. It is the first complete modern text that covers developments over the last three decades while closing all outstanding logical gaps. Dimensional Analysis also lists the logical stages of the analysis, so showing clearly the care to be taken in its use while revealing the very few limitations of application. As the conclusion of that logic, it gives the author's original proof of the fundamental and only theorem. Unlike past texts, Dimensional Analysis includes examples for which the answer does not already exist from standard analysis. It also corrects the many errors present in the existing literature by including accurate solutions. Dimensional Analysis is written for all branches of engineering and science as a teaching book covering both undergraduate and postgraduate courses, as a guide for the lecturer and as a reference volume for the researcher.

dimensional analysis book: *A First Course in Dimensional Analysis* Juan G. Santiago, 2019-10-22 An introduction to dimensional analysis, a method of scientific analysis used to investigate and simplify complex physical phenomena, demonstrated through a series of engaging examples. This book offers an introduction to dimensional analysis, a powerful method of scientific analysis used to investigate and simplify complex physical phenomena. The method enables bold approximations and the generation of testable hypotheses. The book explains these analyses through a series of entertaining applications; students will learn to analyze, for example, the limits of world-record weight lifters, the distance an electric submarine can travel, how an upside-down pendulum is similar to a running velociraptor, and the number of Olympic rowers required to double boat speed. The book introduces the approach through easy-to-follow, step-by-step methods that show how to identify the essential variables describing a complex problem; explore the dimensions of the problem and recast it to reduce complexity; leverage physical insights and experimental observations to further reduce complexity; form testable scientific hypotheses; combine experiments and analysis to solve a problem; and collapse and present experimental measurements in a compact form. Each chapter ends with a summary and problems for students to solve. Taken together, the analyses and examples demonstrate the value of dimensional analysis and provide guidance on how to combine and enhance dimensional analysis with physical insights. The book can be used by undergraduate students in physics, engineering, chemistry, biology, sports science, and astronomy.

dimensional analysis book: Dimensional Analysis Percy Williams Bridgman, 1922

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dimensional analysis book: *Applied Dimensional Analysis and Modeling* Thomas Szirtes, 2007-04-27 Applied Dimensional Analysis and Modeling provides the full mathematical background and step-by-step procedures for employing dimensional analyses, along with a wide range of applications to problems in engineering and applied science, such as fluid dynamics, heat flow, electromagnetics, astronomy and economics. This new edition offers additional worked-out examples in mechanics, physics, geometry, hydrodynamics, and biometry. Covers 4 essential aspects and applications: principal characteristics of dimensional systems, applications of dimensional techniques in engineering, mathematics and geometry, applications in biosciences, biometry and economics, applications in astronomy and physics Offers more than 250 worked-out examples and problems with solutions Provides detailed descriptions of techniques of both dimensional analysis and dimensional modeling

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dimensional analysis book: Data Theory and Dimensional Analysis William G. Jacoby, 1991 For many readers, data theory is probably unfamiliar. Data isn't usually the subject matter of theory in and of itself. However, in this volume, William Jacoby introduces a theory of data idea. It examines how real world observations are transformed into something to be analyzed that is, data. Jacoby explores some of the basic ideas of data theory, and considers their implications for research strategies in the social sciences. Like others in the series, it is reassuringly slim. It is intended for a general social science readership and is a worthwhile read even for experienced data analysts. since it draws attention not only to often overlooked assumptions, but also to often ignored analysis possibilities. --Telephone Surveys On the whole, this book contains a lot of useful information. --Journal of Classification

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dimensional analysis book: Infinite Dimensional Analysis Charalambos D. Aliprantis, Kim C. Border, 2013-11-11 This text was born out of an advanced mathematical economics seminar at Caltech in 1989-90. We realized that the typical graduate student in mathematical economics has to be familiar with a vast amount of material that spans several traditional fields in mathematics. Much of the material appears only in esoteric research monographs that are designed for specialists, not for the sort of generalist that our students need be. We hope that in a small way this text will make the material here accessible to a much broader audience. While our motivation is to present and organize the analytical foundations underlying modern economics and finance, this is a book of mathematics, not of economics. We mention applications to economics but present very few of them. They are there to convince economists that the material has some relevance and to let mathematicians know that there are areas of application for these results. We feel that this text could be used for a course in analysis that would benefit mathematicians, engineers, and scientists. Most of the material we present is available elsewhere, but is scattered throughout a variety of sources and occasionally buried in obscurity. Some of our results are original (or more likely,

independent rediscoveries). We have included some material that we cannot honestly say is necessary to understand modern economic theory, but may yet prove useful in future research.

dimensional analysis book: *Dimensional Analysis and Intelligent Experimentation* Andrew Clennel Palmer, 2008 Dimensional analysis is a magical way of finding useful results with almost no effort. It makes it possible to bring together the results of experiments and computations in a concise but exact form, so that they can be used efficiently and economically to make predictions. It takes advantage of the fact that phenomena go their way independently of the units we measure them with, because the units have nothing to do with the underlying physics. This simple idea turns out to be unexpectedly powerful. Students often fail to gain from dimensional analysis, because bad teaching has led them to suppose it cannot be used to derive new results, and can only confirm results that have been secured by some other route. That notion is false. This book demonstrates what can be done with dimensional analysis through a series of examples, starting with Pythagoras' theorem and the simple pendulum, and going on to a number of practical examples, many from the author's experience in ocean engineering. In parallel, the book explains the underlying theory, starting with Vaschy's elegant treatment, whilst avoiding unnecessary complexity. It also explores the use and misuse of models, which can be useful but can also be seriously misleading.

dimensional analysis book: *Infinite Dimensional Analysis* Charalambos D. Aliprantis, Kim C. Border, 2006-08-08 What you'll find in this monograph is nothing less than a complete and rigorous study of modern functional analysis. It is intended for the student or researcher who could benefit from functional analytic methods, but who does not have an extensive background in the subject and does not plan to make a career as a functional analyst. It develops the topological structures in connection with a number of topic areas such as measure theory, convexity, and Banach lattices, as well as covering the analytic approach to Markov processes. Many of the results were previously available only in works scattered throughout the literature.

dimensional analysis book: *Fundamentals of Dimensional Analysis* Alberto N. Conejo, 2021-05-31 This is the first book which systematically describes an integral approach on dimensional analysis. The amount of textbooks on dimensional analysis is huge, however most of the books start with the definition of the relevant variables. When the variables are given to the reader without prior knowledge on each problem it has serious consequences: the usefulness of dimensional analysis is not appreciated, is not possible to understand the real challenges of this subject and the result, which is a general relationship with dimensionless groups is useless. This book closes the hole in previous books because in addition to describe step by step how to reach the general relationship with dimensionless groups, which creates solid basis of different metallurgical problems to understand the role of the relevant variables. It provides a full description on how to obtain the experimental data and applies the experimental data to transform the general relationship in a particular solution. Once the reader learns how to design the experimental work and uses that information to define the particular solution, it is possible to assess if the selection of variables was adequate or not. The book is useful for both undergraduate and graduate students.

dimensional analysis book: *High-Dimensional Data Analysis with Low-Dimensional Models* John Wright, Yi Ma, 2022-01-13 Connecting theory with practice, this systematic and rigorous introduction covers the fundamental principles, algorithms and applications of key mathematical models for high-dimensional data analysis. Comprehensive in its approach, it provides unified coverage of many different low-dimensional models and analytical techniques, including sparse and low-rank models, and both convex and non-convex formulations. Readers will learn how to develop efficient and scalable algorithms for solving real-world problems, supported by numerous examples and exercises throughout, and how to use the computational tools learnt in several application contexts. Applications presented include scientific imaging, communication, face recognition, 3D vision, and deep networks for classification. With code available online, this is an ideal textbook for senior and graduate students in computer science, data science, and electrical engineering, as well as for those taking courses on sparsity, low-dimensional structures, and high-dimensional data. Foreword by Emmanuel Candès.

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dimensional analysis book: *Dimensional Analysis* Tracy Horntvedt, 2019 Focus on patient safety Learning models, including the 4 Cs approach to dosage calculations: compute, convert, conceptualize, and critically evaluate Over 1,000 practice problems throughout the book, including... Basic skills pre-test End-of-section practice tests in each chapter End-of-unit assessment tests End-of-book post-test 18 Speed Challenge chapter quizzes online to increase speed and accuracy Real-life scenarios that illustrate how to apply concepts to practice Note and Alert boxes that highlight potential safety issues to keep in mind when calculating math problems A glossary of key terms at the beginning of each chapter

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dimensional analysis book: *Dimensional Analysis and Self-Similarity Methods for Engineers*

and Scientists Bahman Zohuri, 2015-04-15 This ground-breaking reference provides an overview of key concepts in dimensional analysis, and then pushes well beyond traditional applications in fluid mechanics to demonstrate how powerful this tool can be in solving complex problems across many diverse fields. Of particular interest is the book's coverage of dimensional analysis and self-similarity methods in nuclear and energy engineering. Numerous practical examples of dimensional problems are presented throughout, allowing readers to link the book's theoretical explanations and step-by-step mathematical solutions to practical implementations.

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Dimensional analysis is a powerful method to analyse complex physical phenomena, including those for which we cannot pose, much less solve governing equations. Its use in science and engineering is ubiquitous and has been central to the work of greats such as Lord Rayleigh, Bohr and Einstein. It offers a method for reducing complex physical problems to their simplest forms and provides a powerful tool for checking whether or not equations are dimensionally consistent and suggests plausible equations when we know which quantities are involved. Every scientist and engineer should have this tool at their command, and this book provides an accessible, modern, self-contained and systematic overview. It outlines the principles of similitude and presents the tools of dimensional analysis for both scientists and engineers and how it can be applied practically to aid not only a greater understanding of theoretical concepts but in designing experiments and analysing experimental data. With examples relevant to a wide range of students and not limited to the physical and engineering sciences, but encompasses the biological and life sciences. The technique has, for example, been used to estimate the running speed of a hungry Tyrannosaurus rex, a comparison of the flights of mosquitos and jet airliners, and the energy released by an atomic weapon. Key Features Draws on and presents examples across the physical, chemical and life sciences, as well as engineering applications Emphasises the technique as a tool and empowers readers to apply the method in developing their own experiments and theoretical understanding Includes methods, history and applications An engaging, accessible, self-contained and systematic resource.

dimensional analysis book: Dimensional Analysis for Meds Anna M. Curren, 2010

Dimensional analysis of medications.

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This book deals with the mathematical properties of dimensioned quantities, such as length, mass, voltage, and viscosity. Beginning with a careful examination of how one expresses the numerical results of a measurement and uses these results in subsequent manipulations, the author rigorously constructs the notion of dimensioned numbers and discusses their algebraic structure. The result is a unification of linear algebra and traditional dimensional analysis that can be extended from the scalars to which the traditional analysis is perforce restricted to multidimensional vectors of the sort frequently encountered in engineering, systems theory, economics, and other applications.

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Karine Loubière, Fabrice Ducept, Romain Jeantet, 2015-09-18 This book deals with the modeling of food processing using dimensional analysis. When coupled to experiments and to the theory of similarity, dimensional analysis is indeed a generic, powerful and rigorous tool making it possible to understand and model complex processes for design, scale-up and /or optimization purposes. This book presents the theoretical basis of dimensional analysis with a step by step detail of the framework for applying dimensional analysis, with chapters respectively dedicated to the extension of dimensional analysis to changing physical properties and to the use of dimensional analysis as a tool for scaling-up processes. It includes several original examples issued from the research works of the authors in the food engineering field, illustrating the conceptual approaches presented and strengthen the teaching of all. - Discusses popular dimensional analysis for knowledge and scaling-up tools with detailed case studies - Emphasises the processes dealing with complex materials of a multiphase nature - Introduces the concept of chemical or material similarity and a framework for analysis of the functional forms of the property

dimensional analysis book: Dimensional Analysis Beyond the Pi Theorem Bahman Zohuri, 2016-11-02 Dimensional Analysis and Physical Similarity are well understood subjects, and the general concepts of dynamical similarity are explained in this book. Our exposition is essentially different from those available in the literature, although it follows the general ideas known as Pi Theorem. There are many excellent books that one can refer to; however, dimensional analysis goes beyond Pi theorem, which is also known as Buckingham's Pi Theorem. Many techniques via self-similar solutions can bound solutions to problems that seem intractable. A time-developing phenomenon is called self-similar if the spatial distributions of its properties at different points in time can be obtained from one another by a similarity transformation, and identifying one of the independent variables as time. However, this is where Dimensional Analysis goes beyond Pi Theorem into self-similarity, which has represented progress for researchers. In recent years there has been a surge of interest in self-similar solutions of the First and Second kind. Such solutions are not newly discovered; they have been identified and named by Zel'dovich, a famous Russian Mathematician in 1956. They have been used in the context of a variety of problems, such as shock waves in gas dynamics, and filtration through elasto-plastic materials. Self-Similarity has simplified computations and the representation of the properties of phenomena under investigation. It handles experimental data, reduces what would be a random cloud of empirical points to lie on a single curve or surface, and constructs procedures that are self-similar. Variables can be specifically chosen for the calculations.

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dimensional analysis book: Dimensional Analysis and Theory of Models Henry Louis Langhaar, 1964

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Models Lysik Bertold, Wacław Kasprzak, Marek Rybaczuk, 1990-09-12 This book is the first textbook with the generalization of Dimensional Analysis, specially prepared to solve problems of identification of mathematical models based on experimental data. The generalization gives the possibility of mathematical model invariant with regard to gauge group, groups of rotation and others. The resulting formalism generates the most general and tensor homogeneous form of possible functional dependence.

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dimensional analysis book: Dimensional Analysis for Students of Medicine Harold Alexander Abramson, 1950

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dimensional analysis book: Dimensional Analysis and Group Theory in Astrophysics Rudolf Kurth, 2013-10-22 Dimensional Analysis and Group Theory in Astrophysics describes how dimensional analysis, refined by mathematical regularity hypotheses, can be applied to purely qualitative physical assumptions. The book focuses on the continuous spectral of the stars and the mass-luminosity relationship. The text discusses the technique of dimensional analysis, covering both relativistic phenomena and the stellar systems. The book also explains the fundamental conclusion of dimensional analysis, wherein the unknown functions shall be given certain specified forms. The Wien and Stefan-Boltzmann Laws can be significant in the systematic application of dimensional analysis to the physics of a single star. The text also discusses group-theoretical reduction of ordinary differential equations and the reductions of the differential equations of stellar structure. The structure of a stellar envelope requires three hypotheses: (1) thermo-nuclear reactions as source of energy of stellar; (2) thermo-nuclear reactions occur at the star's core; and (3) that an envelope surrounding the core exists where no radiation is generated. To complete the model of a star, the investigator should have further assumptions such as the pressure is made-up of gas, radiation, or both. The book can prove helpful for astronomers, astro-physicists, cosmologists, and students of general physics.

dimensional analysis book: High-Dimensional Single Cell Analysis Harris G. Fienberg, Garry P. Nolan, 2014-04-22 This volume highlights the most interesting biomedical and clinical applications of high-dimensional flow and mass cytometry. It reviews current practical approaches used to perform high-dimensional experiments and addresses key bioinformatic techniques for the analysis of data sets involving dozens of parameters in millions of single cells. Topics include single cell cancer biology; studies of the human immunome; exploration of immunological cell types such as CD8+ T cells; decipherment of signaling processes of cancer; mass-tag cellular barcoding; analysis of protein interactions by proximity ligation assays; Cytobank, a platform for the analysis of

cytometry data; computational analysis of high-dimensional flow cytometric data; computational deconvolution approaches for the description of intracellular signaling dynamics and hyperspectral cytometry. All 10 chapters of this book have been written by respected experts in their fields. It is an invaluable reference book for both basic and clinical researchers.

dimensional analysis book: *Quick Guide to Solving Problems Using Dimensional Analysis* Gloria P. Craig, 2003 This abbreviated rendition of Craig's Clinical Calculations Made Easy is designed to provide rules and examples of calculations for LPN/LVN and RN students who use dimensional analysis to calculate and prepare dosages for administration by mouth (PO), and by subcutaneous (SQ), intramuscular (IM), and intravenous (IV) injections. As a supplement or separate quick reference, this two-color pocket guide will help students reduce anxiety related to medical calculation and eliminate medication errors. This text includes images of the medication cup used for oral administration and images of the different types of syringes, including insulin (lo-dose and regular), tuberculin, and 3-cc syringes, as well as the five steps of Dimensional Analysis and the Unit Path from the textbook. Compatibility: BlackBerry(R) OS 4.1 or Higher / iPhone/iPod Touch 2.0 or Higher / Palm OS 3.5 or higher / Palm Pre Classic / Symbian S60, 3rd edition (Nokia) / Windows Mobile(TM) Pocket PC (all versions) / Windows Mobile Smartphone / Windows 98SE/2000/ME/XP/Vista/Tablet PC

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