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Functional Equations A Problem Solving Approach

Functional Equations in Mathematical Olympiads (2017 - 2018)

Problems and Solutions

Functional equations, which are a branch of algebraic problems used in mathematical competitions, appear in recent olympiads very frequently. The current book is the first volume in a series of books on collections of solved problems in functional equations. This volume contains 175 problems on the subject, including those used in latest mathematical olympiads (2017 - 2018) around the world. The basic concepts of functional equations and techniques of problem solving have been briefly discussed in the preamble of the book.

Putnam and Beyond

Springer *This book takes the reader on a journey through the world of college mathematics, focusing on some of the most important concepts and results in the theories of polynomials, linear algebra, real analysis, differential equations, coordinate geometry, trigonometry, elementary number theory, combinatorics, and probability. Preliminary material provides an overview of common methods of proof: argument by contradiction, mathematical induction, pigeonhole principle, ordered sets, and invariants. Each chapter systematically presents a single subject within which problems are clustered in each section according to the specific topic. The exposition is driven by nearly 1300 problems and examples chosen from numerous sources from around the world; many original contributions come from the authors. The source, author, and historical background are cited whenever possible. Complete solutions to all problems are given at the end of the book. This second edition includes new sections on quad ratic polynomials, curves in the plane, quadratic fields, combinatorics of numbers, and graph theory, and added problems or theoretical expansion of sections on polynomials, matrices, abstract algebra, limits of sequences and functions, derivatives and their applications, Stokes' theorem, analytical geometry, combinatorial geometry, and counting strategies. Using the W.L. Putnam Mathematical Competition for undergraduates as an inspiring symbol to build an appropriate math background for graduate studies in pure or applied mathematics, the reader is eased into transitioning from problem-solving at the high school level to the university and beyond, that is, to mathematical research. This work may be used as a study guide for the Putnam exam, as a text for many different problem-solving courses, and as a source of problems for standard courses in undergraduate mathematics. Putnam and Beyond is organized for independent study by undergraduate and gradu ate students, as well as teachers and researchers in the physical sciences who wish to expand their mathematical horizons.*

Functional Equations and How to Solve Them

Springer Science & Business Media *Many books have been written on the theory of functional equations, but very few help readers solve functional equations in mathematics competitions and mathematical problem solving. This book fills that gap. Each chapter includes a list of problems associated with the covered material. These vary in difficulty, with the easiest being accessible to any high school student who has read the chapter carefully. The most difficult will challenge students studying for the International Mathematical Olympiad or the Putnam Competition. An appendix provides a*

springboard for further investigation of the concepts of limits, infinite series and continuity.

Introduction to Functional Equations

Theory and Problem-solving Strategies for Mathematical Competitions and Beyond

American Mathematical Soc. *Functions and their properties have been part of the rigorous precollege curriculum for decades. And functional equations have been a favorite topic of the leading national and international mathematical competitions. Yet the subject has not received equal attention by authors at an introductory level. The majority of the books on the topic remain unreachable to the curious and intelligent precollege student. The present book is an attempt to eliminate this disparity. The book opens with a review chapter on functions, which collects the relevant foundational information on functions, plus some material potentially new to the reader. The next chapter presents a working definition of functional equations and explains the difficulties in trying to systematize the theory. With each new chapter, the author presents methods for the solution of a particular group of equations. Each chapter is complemented with many solved examples, the majority of which are taken from mathematical competitions and professional journals. The book ends with a chapter of unsolved problems and some other auxiliary material. The book is an invaluable resource for precollege and college students who want to deepen their knowledge of functions and their properties, for teachers and instructors who wish to enrich their curricula, and for any lover of mathematical problem-solving techniques. In the interest of fostering a greater awareness and appreciation of mathematics and its connections to other disciplines and everyday life, MSRI and the AMS are publishing books in the Mathematical Circles Library series as a service to young people, their parents and teachers, and the mathematics profession.*

Topics in Algebra and Analysis

Preparing for the Mathematical Olympiad

Birkhäuser *The techniques presented here are useful for solving mathematical contest problems in algebra and analysis. Most of the examples and exercises that appear in the book originate from mathematical Olympiad competitions around the world. In the first four chapters the authors cover material for competitions at high school level. The level advances with the chapters. The topics explored include polynomials, functional equations, sequences and an elementary treatment of complex numbers. The final chapters provide a comprehensive list of problems posed at national and international contests in recent years, and solutions to all exercises and problems presented in the book. It helps students in preparing for national and international mathematical contests form high school level to more advanced competitions and will also be useful for their first year of mathematical studies at the university. It will be of interest to teachers in college and university level, and trainers of the mathematical Olympiads.*

Inequalities

An Approach Through Problems

Springer *This book discusses about the basic topics on inequalities and their applications. These include the arithmetic mean–geometric mean inequality, Cauchy–Schwarz inequality, Chebyshev inequality, rearrangement inequality, convex and concave functions and Muirhead's theorem. The book contains over 400 problems with their solutions. A chapter on geometric inequalities is a special feature of this book. Most of these problems are from International Mathematical Olympiads and from many national mathematical Olympiads. The book is intended to help students who are preparing for various mathematical competitions. It is also a good source book for graduate students who are consolidating their knowledge of inequalities and their applications.*

Problem-Solving Strategies

Springer Science & Business Media *A unique collection of competition problems from over twenty major national and international mathematical competitions for high school students. Written for trainers and participants of contests of all levels up to the highest level, this will appeal to high school teachers conducting a mathematics club who need a range of simple to complex problems and to those instructors wishing to pose a "problem of the week", thus bringing a creative atmosphere into the classrooms. Equally, this is a must-have for individuals interested in solving difficult and challenging problems. Each chapter starts with typical examples illustrating the central concepts and is followed by a number of carefully selected problems and their solutions. Most of the solutions are complete, but some merely point to the road leading to the final solution. In addition to being a valuable resource of mathematical problems and solution strategies, this is the most complete training book on the market.*

Challenge and Thrill of Pre-College Mathematics

New Age International *Challenge And Thrill Of Pre-College Mathematics Is An Unusual Enrichment Text For Mathematics Of Classes 9, 10, 11 And 12 For Use By Students And Teachers Who Are Not Content With The Average Level That Routine Text Dare Not Transcend In View Of Their Mass Clientele. It Covers Geometry, Algebra And Trigonometry Plus A Little Of Combinatorics. Number Theory And Probability. It Is Written Specifically For The Top Half Whose Ambition Is To Excel And Rise To The Peak Without Finding The Journey A Forced Uphill Task.The Undercurrent Of The Book Is To Motivate The Student To Enjoy The Pleasures Of A Mathematical Pursuit And Of Problem Solving. More Than 300 Worked Out Problems (Several Of Them From National And International Olympiads) Share With The Student The Strategy, The Excitement, Motivation, Modeling, Manipulation, Abstraction, Notation And Ingenuity That Together Make Mathematics. This Would Be The Starting Point For The Student, Of A Life-Long Friendship With A Sound Mathematical Way Of Thinking.There Are Two Reasons Why The Book Should Be In The Hands Of Every School Or College Student, (Whether He Belongs To A Mathematics Stream Or Not) One, If He Likes Mathematics And, Two, If He Does Not Like Mathematics- The Former, So That The Cramped Robot-Type Treatment In The Classroom Does Not Make Him Into The Latter; And The Latter So That By The Time He Is Halfway Through The Book, He Will Invite Himself Into The Former.*

Topics in Functional Equations

Third Edition

Partial Differential Equations

New Age International *This book provides a basic introductory course in partial differential equations, in which theory and applications are interrelated and developed side by side. Emphasis is on proofs, which are not only mathematically rigorous, but also constructive, where the structure and properties of the solution are investigated in detail. The authors feel that it is no longer necessary to follow the tradition of introducing the subject by deriving various partial differential equations of continuum mechanics and theoretical physics. Therefore, the subject has been introduced by mathematical analysis of the simplest, yet one of the most useful (from the point of view of applications), class of partial differential equations, namely the equations of first order, for which existence, uniqueness and stability of the solution of the relevant problem (Cauchy problem) is easy to discuss. Throughout the book, attempt has been made to introduce the important ideas from relatively simple cases, some times by referring to physical processes, and then extending them to more general systems.*

Euclidean Geometry in Mathematical Olympiads

American Mathematical Soc. *This is a challenging problem-solving book in Euclidean geometry, assuming nothing of the reader other than a good deal of courage. Topics covered included cyclic quadrilaterals, power of a point, homothety, triangle centers; along the way the reader will meet such classical gems as the nine-point circle, the Simson line, the symmedian and the mixtilinear incircle, as well as the theorems of Euler, Ceva, Menelaus, and Pascal. Another part is dedicated to the use of complex numbers and barycentric coordinates, granting the reader both a traditional and computational viewpoint of the material. The final part consists of some more advanced topics, such as inversion in the plane, the cross ratio and projective transformations, and the theory of the complete quadrilateral.*

The exposition is friendly and relaxed, and accompanied by over 300 beautifully drawn figures. The emphasis of this book is placed squarely on the problems. Each chapter contains carefully chosen worked examples, which explain not only the solutions to the problems but also describe in close detail how one would invent the solution to begin with. The text contains a selection of 300 practice problems of varying difficulty from contests around the world, with extensive hints and selected solutions. This book is especially suitable for students preparing for national or international mathematical olympiads or for teachers looking for a text for an honor class.

Principles and Techniques in Combinatorics

World Scientific *A textbook suitable for undergraduate courses. The materials are presented very explicitly so that students will find it very easy to read. A wide range of examples, about 500 combinatorial problems taken from various mathematical competitions and exercises are also included.*

Mathematical Olympiad Challenges

Springer Science & Business Media *Mathematical Olympiad Challenges is a rich collection of problems put together by two experienced and well-known professors and coaches of the U.S. International Mathematical Olympiad Team. Hundreds of beautiful, challenging, and instructive problems from algebra, geometry, trigonometry, combinatorics, and number theory were selected from numerous mathematical competitions and journals. An important feature of the work is the comprehensive background material provided with each grouping of problems. The problems are clustered by topic into self-contained sections with solutions provided separately. All sections start with an essay discussing basic facts and one or two representative examples. A list of carefully chosen problems follows and the reader is invited to take them on. Additionally, historical insights and asides are presented to stimulate further inquiry. The emphasis throughout is on encouraging readers to move away from routine exercises and memorized algorithms toward creative solutions to open-ended problems. Aimed at motivated high school and beginning college students and instructors, this work can be used as a text for advanced problem- solving courses, for self-study, or as a resource for teachers and students training for mathematical competitions and for teacher professional development, seminars, and workshops.*

The IMO Compendium

A Collection of Problems Suggested for The International Mathematical Olympiads: 1959-2009 Second Edition

Springer Science & Business Media *"The IMO Compendium" is the ultimate collection of challenging high-school-level mathematics problems and is an invaluable resource not only for high-school students preparing for mathematics competitions, but for anyone who loves and appreciates mathematics. The International Mathematical Olympiad (IMO), nearing its 50th anniversary, has become the most popular and prestigious competition for high-school students interested in mathematics. Only six students from each participating country are given the honor of participating in this competition every year. The IMO represents not only a great opportunity to tackle interesting and challenging mathematics problems, it also offers a way for high school students to measure up with students from the rest of the world. Until the first edition of this book appearing in 2006, it has been almost impossible to obtain a complete collection of the problems proposed at the IMO in book form. "The IMO Compendium" is the result of a collaboration between four former IMO participants from Yugoslavia, now Serbia and Montenegro, to rescue these problems from old and scattered manuscripts, and produce the ultimate source of IMO practice problems. This book attempts to gather all the problems and solutions appearing on the IMO through 2009. This second edition contains 143 new problems, picking up where the 1959-2004 edition has left off.*

The Light of Knowledge

Literacy Activism and the Politics of Writing in South India

Cornell University Press *Since the early 1990s hundreds of thousands of Tamil villagers in southern India have participated in literacy lessons, science demonstrations, and other events designed to transform them into active citizens with access to state power. These efforts to spread enlightenment among the oppressed are part of a movement known as the Arivoli Iyakkam (the Enlightenment Movement), considered to be among the most successful mass literacy movements in recent history. In The Light of Knowledge, Francis Cody's ethnography of the Arivoli Iyakkam highlights the paradoxes inherent in such movements that seek to emancipate people through literacy when literacy is a power-laden social practice in its own right. The Light of Knowledge is set primarily in the rural district of Pudukkottai in Tamil Nadu, and it is about activism among laboring women from marginalized castes who have been particularly active as learners and volunteers in the movement. In their endeavors to remake the Tamil countryside through literacy activism, workers in the movement found that their own understanding of the politics of writing and Enlightenment was often transformed as they encountered vastly different notions of language and imaginations of social order. Indeed, while activists of the movement successfully mobilized large numbers of rural women, they did so through logics that often pushed against the very Enlightenment rationality they hoped to foster. Offering a rare behind-the-scenes look at an increasingly important area of social and political activism, The Light of Knowledge brings tools of linguistic anthropology to engage with critical social theories of the postcolonial state.*

Topics in Functional Analysis and Applications

Key Features:Basic knowledge in functional analysis is a pre-requisite. Illustrations via partial differential equations of physics provided. Exercises given in each chapter to augment concepts and theorems.About the Book:The book, written to give a fairly comprehensive treatment of the techniques from Functional Analysis used in the modern theory of Partial Differential Equations, is now in its third edition. The original structure of the book has been retained but each chapter has been revamped. Proofs of several theorems have been either simplified or elaborated in order to achieve greater clarity. It is hoped that this version is even more user-friendly than before. In the chapter on Distributions, some additional results, with proof, have been presented. The section on Convolution of Functions has been rewritten. In the chapter on Sobolev Spaces, the section containing Stampacchia's theorem on composition of functions has been reorganized. Some additional results on Eigenvalue problems are presented. The material in the text is supplemented by four appendices and updated bibliography at the end.

Climate Change and Island and Coastal Vulnerability

Springer Science & Business Media "*Climate Change and Island and Coastal Vulnerability" is the outcome of a selection of peer reviewed edited papers presented at the International Workshop on Climate Change and Island Vulnerability (IWCCI) held at Kadmat Island, Lakshadweep, India in October 2010. Marine and coastal biodiversity, sea level rise vulnerability, fisheries, climate change impact on livelihood options, water and sanitation in island ecosystem and mitigation, adaptation and governance are the focal themes. The basic concept conveyed in the book is that biodiversity of islands is to be protected as a natural mechanism to mitigate climate change. Probability recurrence of mass coral bleaching and the management of coral reefs and their future protection are discussed in this book. Marine productivity and climate change for the last ten thousand years in the Arabian Sea have been examined with core records. Green technology is suggested as an important tool for mitigation and adaptation programmes in climate change. Measures taken to project biomass utilisation of islands as an energy source is delineated. Climate change may pose a potential threat on human health. Improved sanitation packages and models that are cost effective and environment-friendly for islands are uniquely presented in this book.*

Methods of Solving Number Theory Problems

Birkhäuser *Through its engaging and unusual problems, this book demonstrates methods of reasoning necessary for learning number theory. Every technique is followed by problems (as well as detailed hints and solutions) that apply theorems immediately, so readers can solve a variety of abstract problems in a systematic, creative manner. New solutions often require the ingenious use of earlier mathematical concepts - not the memorization of formulas and facts. Questions also often permit experimental numeric validation or visual interpretation to encourage the combined use of deductive and intuitive thinking. The first chapter starts with simple topics like even and odd numbers, divisibility, and prime numbers and helps the reader to solve quite complex, Olympiad-type problems right away. It also covers properties of the perfect, amicable, and figurate numbers and introduces congruence. The next chapter begins with the Euclidean algorithm, explores the representations of integer numbers in different bases, and examines continued fractions, quadratic irrationalities, and the Lagrange Theorem. The last section of Chapter Two is an exploration of different methods of proofs. The third chapter is dedicated to solving Diophantine linear and nonlinear equations and includes different methods of solving Fermat's (Pell's) equations. It also covers Fermat's factorization techniques and methods of solving challenging problems involving exponent and factorials. Chapter Four reviews the Pythagorean triple and quadruple and emphasizes their connection with geometry, trigonometry, algebraic*

geometry, and stereographic projection. A special case of Waring's problem as a representation of a number by the sum of the squares or cubes of other numbers is covered, as well as quadratic residuals, Legendre and Jacobi symbols, and interesting word problems related to the properties of numbers. Appendices provide a historic overview of number theory and its main developments from the ancient cultures in Greece, Babylon, and Egypt to the modern day. Drawing from cases collected by an accomplished female mathematician, Methods in Solving Number Theory Problems is designed as a self-study guide or supplementary textbook for a one-semester course in introductory number theory. It can also be used to prepare for mathematical Olympiads. Elementary algebra, arithmetic and some calculus knowledge are the only prerequisites. Number theory gives precise proofs and theorems of an irreproachable rigor and sharpens analytical thinking, which makes this book perfect for anyone looking to build their mathematical confidence.

A First Step to Mathematical Olympiad Problems

World Scientific Publishing Company *See also A SECOND STEP TO MATHEMATICAL OLYMPIAD PROBLEMS The International Mathematical Olympiad (IMO) is an annual international mathematics competition held for pre-collegiate students. It is also the oldest of the international science olympiads, and competition for places is particularly fierce. This book is an amalgamation of the first 8 of 15 booklets originally produced to guide students intending to contend for placement on their country's IMO team. The material contained in this book provides an introduction to the main mathematical topics covered in the IMO, which are: Combinatorics, Geometry and Number Theory. In addition, there is a special emphasis on how to approach unseen questions in Mathematics, and model the writing of proofs. Full answers are given to all questions. Though A First Step to Mathematical Olympiad Problems is written from the perspective of a mathematician, it is written in a way that makes it easily comprehensible to adolescents. This book is also a must-read for coaches and instructors of mathematical competitions.*

Berkeley Problems in Mathematics

Springer Science & Business Media *This book collects approximately nine hundred problems that have appeared on the preliminary exams in Berkeley over the last twenty years. It is an invaluable source of problems and solutions. Readers who work through this book will develop problem solving skills in such areas as real analysis, multivariable calculus, differential equations, metric spaces, complex analysis, algebra, and linear algebra.*

Chemical Engineering Fluid Mechanics, Third Edition

CRC Press *This book provides readers with the most current, accurate, and practical fluid mechanics related applications that the practicing BS level engineer needs today in the chemical and related industries, in addition to a fundamental understanding of these applications based upon sound fundamental basic scientific principles. The emphasis remains on problem solving, and the new edition includes many more examples.*

Advanced Euclidean Geometry

Courier Corporation *This classic text explores the geometry of the triangle and the circle, concentrating on extensions of Euclidean theory, and examining in detail many relatively recent theorems. 1929 edition.*

The Phobia of the Modern World: Nomophobia

"Conceptualization of Nomophobia and Investigation of Associated Psychological

Constructs"

eKitap Projesi & Cheapest Books *In the modern world, the mobile phone has become an indispensable part of modern life. On the one hand, the mobile phone allows maintaining interpersonal contacts and fulfilling work or school duties regardless of time and location. It enables individuals to plan their daily routines and their free times. On the other hand, a mobile phone is a tool that can cause several psychological and physical problems. Nomophobia, which is considered the phobia of the modern era, is only one of these problems. In the simplest terms, nomophobia is the fear of being without a mobile phone and the intense anxiety and distress experienced in the absence of a mobile phone. Although technological addictions such as smartphone addiction and internet addiction have been studied extensively in the psychology literature, it is striking that nomophobia is a neglected psychological problem. However, nomophobia is emerging as a common phenomenon among young adults, as most young adults use the mobile phone for about 5 hours a day. Some users define the mobile phone as a friend and the meaning of life. More importantly, prevalence studies have revealed that about half of young adults suffer from nomophobia. Since nomophobia causes many serious consequences such as physical pain, social problems and a decrease in academic achievement, nomophobia studies are important and beneficial especially for the younger generation. This book has been written to emphasize the importance of nomophobia and to provide detailed information about the diagnosis, treatment, prevalence, predictors and symptoms of nomophobia. In addition, this book aimed to conceptualize nomophobia theoretically. Also, based on the theoretical conceptualization, psychological structures that can cause nomophobia have been identified. The theoretical conceptualization has been tested and validated using scientific methods. This book, which contains a comprehensive literature review and scientific research, can shed light on researchers for future nomophobia studies. I also believe that this book will make valuable contributions to the clinical field by providing a better understanding of the factors that should be considered in prevention programs and treatment interventions developed for nomophobia. I hope that scholars, clinicians, and students from a variety of disciplines will find my efforts helpful. Lastly, I would like to express my deepest gratitude to my supervisor Prof. Dr. Özden Yalçınkaya Alkar for her constant support, advice, and understanding during my doctoral process. Dr. Özge ENEZ ABOUT AUTHOR: Özge Enez, PhD, graduated from Istanbul University, Department of Psychology in 2009. Özge completed her master's degree in clinical psychology at Queen Mary, University of London in 2013 and her doctorate in psychology at Ankara Yıldırım Beyazıt University in 2021. Since 2014, she is a faculty member at the Department of Guidance and Psychological Counselling, Giresun University, Turkey. Özge has extensive experience in teaching at the university. Since 2014, she has been teaching undergraduate courses such as Child Psychology, Interpersonal Communication, Developmental Psychology, Psychological Counseling Skills. Her research area is Clinical Psychology and her research interests are smartphone addiction, nomophobia, grief, death, psychopathology, and emotions.*

Problems from the Book

Amer Mathematical Society

Differential and Integral Inequalities

Springer *Theories, methods and problems in approximation theory and analytic inequalities with a focus on differential and integral inequalities are analyzed in this book. Fundamental and recent developments are presented on the inequalities of Abel, Agarwal, Beckenbach, Bessel, Cauchy–Hadamard, Chebychev, Markov, Euler's constant, Grothendieck, Hilbert, Hardy, Carleman, Landau–Kolmogorov, Carlson, Bernstein–Mordell, Gronwall, Wirtinger, as well as inequalities of functions with their integrals and derivatives. Each inequality is discussed with proven results, examples and various applications. Graduate students and advanced research scientists in mathematical analysis will find this reference essential to their understanding of differential and integral inequalities. Engineers, economists, and physicists will find the highly applicable inequalities practical and useful to their research.*

Tectonics and Structural Geology: Indian Context

Springer *This book presents a compilation of findings, review and original works, on the tectonic evolution and structural detail of several terrains in India. It captures the tectonic diversity of the Indian terrain, including tectonics of India's coastal areas, the tectonic evolution of Gondwana and Proterozoic (Purana) basins. It also describes the research results of the Indian craton's geo-history, Tertiary Bengal basin, and also the Himalayan collisional zone. Thus the book covers the deformation history of Indian terrain involving strike slip, compressional and extensional tectonics, and ductile and brittle shear deformations.*

The Emergence of Modern Hinduism

Religion on the Margins of Colonialism

University of California Press *The Emergence of Modern Hinduism argues for the importance of regional, vernacular innovation in processes of Hindu modernization. Scholars usually trace the emergence of modern Hinduism to cosmopolitan reform movements, producing accounts that overemphasize the centrality of elite religion and the influence of Western ideas and models. In this study, the author considers religious change on the margins of colonialism by looking at an important local figure, the Tamil Shaiva poet and mystic Ramalinga Swami (1823–1874). Weiss narrates a history of Hindu modernization that demonstrates the transformative role of Hindu ideas, models, and institutions, making this text essential for scholarly audiences of South Asian history, religious studies, Hindu studies, and South Asian studies. Learn more at www.luminosoa.org.*

Mathematical Circles

Universities Press *These two books are the first volumes of articales published from 1970 to 1990 in the Russian journal, Kvant. The influence of the this magazine on mathematics and physics education in Russia is unmatched. Articles selected for these two volumes are written by leading Russian mathematicians and expositors.*

An Introduction to the Theory of Functional Equations and Inequalities

Cauchy's Equation and Jensen's Inequality

Springer Science & Business Media *Marek Kuczma was born in 1935 in Katowice, Poland, and died there in 1991. After finishing high school in his home town, he studied at the Jagiellonian University in Kraków. He defended his doctoral dissertation under the supervision of Stanislaw Golab. In the year of his habilitation, in 1963, he obtained a position at the Katowice branch of the Jagiellonian University (now University of Silesia, Katowice), and worked there till his death. Besides his several administrative positions and his outstanding teaching activity, he accomplished excellent and rich scientific work publishing three monographs and 180 scientific papers. He is considered to be the founder of the celebrated Polish school of functional equations and inequalities. "The second half of the title of this book describes its contents adequately. Probably even the most devoted specialist would not have thought that about 300 pages can be written just about the Cauchy equation (and on some closely related equations and inequalities). And the book is by no means chatty, and does not even claim completeness. Part I lists the required preliminary knowledge in set and measure theory, topology and algebra. Part II gives details on solutions of the Cauchy equation and of the Jensen inequality [...], in particular on continuous convex functions, Hamel bases, on inequalities following from the Jensen inequality [...]. Part III deals with related equations and inequalities (in particular, Pexider, Hosszú, and conditional equations, derivations, convex functions of higher order, subadditive functions and stability theorems). It concludes with an excursion into the field of extensions of homomorphisms in general." (Janos Aczel, Mathematical Reviews) "This book is a real holiday for all the mathematicians independently of their strict speciality. One can imagine what deliciousness represents this book for functional equationists." (B. Crstici, Zentralblatt für Mathematik)*

Problems in Real and Complex Analysis

Springer Science & Business Media *This text covers many principal topics in the theory of functions of a complex variable. These include, in real analysis, set algebra, measure and topology, real- and complex-valued functions, and topological vector spaces. In complex analysis, they include polynomials and power series, functions holomorphic in a region, entire functions, analytic continuation, singularities, harmonic functions, families of functions, and convexity theorems.*

The Universe in Zero Words

The Story of Mathematics as Told through Equations

Princeton University Press *Most popular books about science, and even about mathematics, tiptoe around equations as if they were something to be hidden from the reader's tender eyes. Dana Mackenzie starts from the opposite premise: He celebrates equations. No history of art would be complete without pictures. Why, then, should a history of mathematics--the universal language of science--keep the masterpieces of the subject hidden behind a veil? The Universe in Zero Words tells the history of twenty-four great and beautiful equations that have shaped mathematics, science, and society--from the elementary (1+1=2) to the sophisticated (the Black-Scholes formula for financial derivatives), and from the famous (E=mc2) to the arcane (Hamilton's quaternion equations). Mackenzie, who has been called "a popular-science ace" by Booklist magazine, lucidly explains what each equation means, who discovered it (and how), and how it has affected our lives. Illustrated in color throughout, the book tells the human and often-surprising stories behind the invention or discovery of the equations, from how a bad cigar changed the course of quantum mechanics to why whales (if they could communicate with us) would teach us a totally different concept of geometry. At the same time, the book shows why these equations have something timeless to say about the universe, and how they do it with an economy (zero words) that no other form of human expression can match. The Universe in Zero Words is the ultimate introduction and guide to equations that have changed the world.*

Mathematical Olympiad Challenges

Springer Science & Business Media *A collection of problems put together by coaches of the U.S. International Mathematical Olympiad Team.*

A Path to Combinatorics for Undergraduates

Counting Strategies

Springer Science & Business Media *This unique approach to combinatorics is centered around unconventional, essay-type combinatorial examples, followed by a number of carefully selected, challenging problems and extensive discussions of their solutions. Topics encompass permutations and combinations, binomial coefficients and their applications, bijections, inclusions and exclusions, and generating functions. Each chapter features fully-worked problems, including many from Olympiads and other competitions, as well as a number of problems original to the authors; at the end of each chapter are further exercises to reinforce understanding, encourage creativity, and build a repertory of problem-solving techniques. The authors' previous text, "102 Combinatorial Problems," makes a fine companion volume to the present work, which is ideal for Olympiad participants and coaches, advanced high school students, undergraduates, and college instructors. The book's unusual problems and examples will interest seasoned mathematicians as well. "A Path to Combinatorics for Undergraduates" is a lively introduction not only to combinatorics, but to mathematical ingenuity, rigor, and the joy of solving puzzles.*

Solving Problems in Geometry

Insights and Strategies

World Scientific Publishing Company *This new volume of the Mathematical Olympiad Series focuses on the topic of geometry. Basic and advanced theorems commonly seen in Mathematical Olympiad are introduced and illustrated with plenty of examples. Special techniques in solving various types of geometrical problems are also introduced, while the authors elaborate extensively on how to acquire an insight and develop strategies in tackling difficult geometrical problems. This book is suitable for any reader with elementary geometrical knowledge at the lower secondary level. Each chapter includes sufficient scaffolding and is comprehensive enough for the purpose of self-study. Readers who complete the chapters on the basic theorems and techniques would acquire a good foundation in geometry and may attempt to solve many geometrical problems in various mathematical competitions. Meanwhile, experienced contestants in Mathematical Olympiad competitions will find a large collection of*

problems pitched at competitions at the international level, with opportunities to practise and sharpen their problem-solving skills in geometry.

102 Combinatorial Problems

From the Training of the USA IMO Team

Springer Science & Business Media "*102 Combinatorial Problems*" *consists of carefully selected problems that have been used in the training and testing of the USA International Mathematical Olympiad (IMO) team. Key features: * Provides in-depth enrichment in the important areas of combinatorics by reorganizing and enhancing problem-solving tactics and strategies * Topics include: combinatorial arguments and identities, generating functions, graph theory, recursive relations, sums and products, probability, number theory, polynomials, theory of equations, complex numbers in geometry, algorithmic proofs, combinatorial and advanced geometry, functional equations and classical inequalities The book is systematically organized, gradually building combinatorial skills and techniques and broadening the student's view of mathematics. Aside from its practical use in training teachers and students engaged in mathematical competitions, it is a source of enrichment that is bound to stimulate interest in a variety of mathematical areas that are tangential to combinatorics.*

Development of Elliptic Functions According to Ramanujan

World Scientific *This unique book provides an innovative and efficient approach to elliptic functions, based on the ideas of the great Indian mathematician Srinivasa Ramanujan. The original 1988 monograph of K Venkatachaliengar has been completely revised. Many details, omitted from the original version, have been included, and the book has been made comprehensive by notes at the end of each chapter. The book is for graduate students and researchers in Number Theory and Classical Analysis, as well for scholars and aficionados of Ramanujan's work. It can be read by anyone with some undergraduate knowledge of real and complex analysis.*

Mathematical Olympiad Treasures

Springer Science & Business Media *Mathematical Olympiad Treasures aims at building a bridge between ordinary high school exercises and more sophisticated, intricate and abstract concepts in undergraduate mathematics. The book contains a stimulating collection of problems in the subjects of algebra, geometry, trigonometry, number theory and combinatorics. While it may be considered a sequel to "Mathematical Olympiad Challenges," the focus is on engaging a wider audience to apply techniques and strategies to real-world problems. Throughout the book students are encouraged to express their ideas, conjectures, and conclusions in writing. The goal is to help readers develop a host of new mathematical tools that will be useful beyond the classroom and in a number of disciplines.*

117 Polynomial Problems from the Awesomemath Summer Program

Number Theory

Structures, Examples, and Problems

Springer Science & Business Media *This introductory textbook takes a problem-solving approach to number theory, situating each concept within the framework of an example or a problem for solving. Starting with the essentials, the text covers divisibility, unique factorization, modular arithmetic and the Chinese Remainder Theorem, Diophantine equations, binomial coefficients, Fermat and Mersenne primes and other special numbers, and special sequences. Included are sections on mathematical induction and the pigeonhole principle, as well as a discussion of other number systems. By emphasizing examples and applications the authors motivate and engage readers.*