Problem Set 1: Number Theory

Dakahlia Math Club

Week 1

Problems

1. The first two numbers that are both squares and triangles are 1 and 36. Find the next one and, if possible, the one after that. Can you figure out an efficient way to find triangular–square numbers? Do you think that there are infinitely many?

2. Try adding up the first few odd numbers and see if the numbers you get satisfy some sort of pattern. Once you find the pattern, express it as a formula. Give a geometric verification that your formula is correct.

3. The consecutive odd numbers 3, 5, and 7 are all primes. Are there infinitely many such "prime triplets"? That is, are there infinitely many prime numbers p such that $p + 2$ and $p + 4$ are also primes?

4. It is generally believed that infinitely many primes have the form $N^2 + 1$, although no one knows for sure.

   (a) Do you think that there are infinitely many primes of the form $N^2 - 1$?
   (b) Do you think that there are infinitely many primes of the form $N^2 - 2$?
   (c) How about of the form $N^2 - 3$? How about $N^2 - 4$?
   (d) Which values of a do you think give infinitely many primes of the form $N^2 - a$?

5. The following two lines indicate another way to derive the formula for the sum of the first n integers by rearranging the terms in the sum. Fill in the details.

$$1 + 2 + 3 + \cdots + n = (1 + n) + (2 + (n - 1)) + (3 + (n - 2)) + \cdots$$
$$= (1 + n) + (1 + n) + (1 + n) + \cdots .$$

How many copies of $n + 1$ are in the second line? You may need to consider the cases of odd n and even n separately. If that's not clear, first try writing it out explicitly for $n = 6$ and $n = 7$.

Problems In Elementary Number Theory Problem Solving

Calvin L. Petroselli

Problems In Elementary Number Theory Problem Solving:

   Number Theory Titu Andreescu,Dorin Andrica,2009-06-12 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   Problems in Number Theory Adam J Wick,2024-02-11 Welcome to the fascinating world of elementary number theory a branch of mathematics that deals with the properties and relationships of numbers especially the integers This book is designed to introduce readers to the beauty and utility of number theory through a collection of problems and their solutions Whether you are a student educator or enthusiast this book aims to enhance your understanding of number theory in an engaging and accessible manner Number theory is often considered the queen of mathematics due to its ancient origins and pure nature It is a field that has captivated mathematicians for centuries from the early discoveries of Euclid and Diophantus to the groundbreaking work of Fermat Euler Gauss and beyond The allure of number theory lies not only in its rich history but also in its applicability to modern day cryptography computer science and problem solving This book is structured to cater to a wide audience from beginners to those with some background in number theory The problems presented range from simple exercises that reinforce basic concepts to more challenging questions that stimulate deeper thinking and exploration Each problem is carefully selected and crafted to illustrate a particular aspect of number theory with solutions provided to guide the reader through the thought process and techniques involved The journey through this book begins with the fundamentals of divisibility primes and the Euclidean algorithm gradually progressing to more complex topics such as congruences and Diophantine equations Along the way readers will encounter famous theorems and conjectures that have shaped the field including the Fundamental Theorem of Arithmetic Fermat s Little Theorem and Wilson s theorem Our goal is not only to solve problems but also to cultivate a deeper appreciation for the elegance of mathematical concepts We encourage readers to actively engage with the material to explore beyond the solutions provided and to discover the joy of uncovering truths for themselves In preparing this book we have drawn upon a wealth of sources including classic texts and contemporary research to ensure a comprehensive and enriching experience We are grateful to the many mathematicians whose work has inspired and informed these pages and we hope to pass on a fraction of their passion for number theory to our readers Whether you are embarking on this journey out of curiosity academic interest or the pursuit of mathematical beauty we welcome you May this book serve as a valuable resource and companion as you explore the intriguing world of elementary number theory   **Problem Solving in Mathematics** Thomas Butts,1973   **Problems of Number Theory in Mathematical Competitions** Hong-Bing Yu,2010

Number theory is an important research field of mathematics In mathematical competitions problems of elementary number theory occur frequently These problems use little knowledge and have many variations They are flexible and diverse In this book the author introduces some basic concepts and methods in elementary number theory via problems in mathematical competitions Readers are encouraged to try to solve the problems by themselves before they read the given solutions of examples Only in this way can they truly appreciate the tricks of problem solving **Elementary Number Theory** Charles Vanden Eynden,2006-02-15 This practical and versatile text evolved from the author s years of teaching experience and the input of his students Vanden Eynden strives to alleviate the anxiety that many students experience when approaching any proof oriented area of mathematics including number theory His informal yet straightforward writing style explains the ideas behind the process of proof construction showing that mathematicians develop theorems and proofs from trial and error and evolutionary improvement not spontaneous insight Furthermore the book includes more computational problems than most other number theory texts to build students familiarity and confidence with the theory behind the material The author has devised the content organization and writing style so that information is accessible students can gain self confidence with respect to mathematics and the book can be used in a wide range of courses from those that emphasize history and type A problems to those that are proof oriented **Elementary Number Theory** James S. Kraft,Lawrence C. Washington,2014-11-24 Elementary Number Theory takes an accessible approach to teaching students about the role of number theory in pure mathematics and its important applications to cryptography and other areas The first chapter of the book explains how to do proofs and includes a brief discussion of lemmas propositions theorems and corollaries The core of the text covers linear Diophantine equations unique factorization congruences Fermat s Euler s and Wilson s theorems order and primitive roots and quadratic reciprocity The authors also discuss numerous cryptographic topics such as RSA and discrete logarithms along with recent developments The book offers many pedagogical features The check your understanding problems scattered throughout the chapters assess whether students have learned essential information At the end of every chapter exercises reinforce an understanding of the material Other exercises introduce new and interesting ideas while computer exercises reflect the kinds of explorations that number theorists often carry out in their research <u>Problem Solving in School Mathematics</u> ,1980 *Exemplary Practices for Secondary Math Teachers* Alfred S. Posamentier,Daniel Jaye,2007-03-15 Every year new secondary mathematics teachers take up positions in middle and high schools The luckiest novices receive assistance from a coach or mentor a master mathematics teacher who makes constructive comments models effective approaches and illuminates other practical aspects of teaching secondary math But many new teachers don t have this advantage and must further their development on their own If you are one of these teachers this is the book you need In these pages veteran mathematics educators Alfred S Posamentier Daniel Jaye and Stephen Krulik present a treasure chest of ideas to guide new secondary math teachers through the challenging first few

months and also provide more experienced teachers with interesting alternatives to familiar methods The topics covered include The most effective instructional practices The best uses of the textbook Designing successful lessons Creating homework that promotes learning Incorporating challenge Teaching reasoning and problem solving Strategies for assessment and grading Specific innovative ideas for teaching key concepts Options for extracurricular activities Long term professional enrichment and growth It s during the first few years of a teacher s experience that he or she develops the habits methods procedures and techniques that tend to define a career Exemplary Practices for Secondary Math Teachers provides both a foundation for excellence and a touchstone for years to come Note This product listing is for the Adobe Acrobat PDF version of the book **CRC Concise Encyclopedia of Mathematics** Eric W. Weisstein,2002-12-12 Upon publication the first edition of the CRCConcise Encyclopedia of Mathematics received overwhelming accolades for its unparalleled scope readability and utility It soon took its place among the top selling books in the history of Chapman Hall CRC and its popularity continues unabated Yet also unabated has been the d Elementary Number Theory Joe Roberts,1925 Research in Collegiate Mathematics Education IV Ed Dubinsky,2000 This fourth volume of Research in Collegiate Mathematics Education RCME IV reflects the themes of student learning and calculus Included are overviews of calculus reform in France and in the U S and large scale and small scale longitudinal comparisons of students enrolled in first year reform courses and in traditional courses The work continues with detailed studies relating students understanding of calculus and associated topics Direct focus is then placed on instruction and student comprehension of courses other than calculus namely abstract algebra and number theory The volume concludes with a study of a concept that overlaps the areas of focus quantifiers The book clearly reflects the trend towards a growing community of researchers who systematically gather and distill data regarding collegiate mathematics teaching and learning This series is published in cooperation with the Mathematical Association of America The Induction Book Steven H. Weintraub,2017-05-17 Every mathematician and student of mathematics needs a familiarity with mathematical induction This volume provides advanced undergraduates and graduate students with an introduction and a thorough exposure to these proof techniques 2017 edition *Farey Sequences* Andrey O. Matveev,2017-11-07 As a first comprehensive overview on Farey sequences and subsequences this monograph is intended as a reference for anyone looking for specific material or formulas related to the subject Duality of subsequences and maps between them are discussed and explicit proofs are shown in detail From the Content Basic structural and enumerative properties of Farey sequences Collective decision making Committee methods in pattern recognition Farey duality Farey sequence Fundamental Farey subsequences Monotone bijections between Farey subsequences Discrete Mathematics with Ducks Sarah-Marie Belcastro,2018-11-15 Discrete Mathematics with Ducks Second Edition is a gentle introduction for students who find the proofs and abstractions of mathematics challenging At the same time it provides stimulating material that instructors can use for more advanced students The first edition was widely well received with its

whimsical writing style and numerous exercises and materials that engaged students at all levels The new expanded edition continues to facilitate effective and active learning It is designed to help students learn about discrete mathematics through problem based activities These are created to inspire students to understand mathematics by actively practicing and doing which helps students better retain what they ve learned As such each chapter contains a mixture of discovery based activities projects expository text in class exercises and homework problems The author s lively and friendly writing style is appealing to both instructors and students alike and encourages readers to learn The book s light hearted approach to the subject is a guiding principle and helps students learn mathematical abstraction Features The book s Try This sections encourage students to construct components of discussed concepts theorems and proofs Provided sets of discovery problems and illustrative examples reinforce learning Bonus sections can be used by instructors as part of their regular curriculum for projects or for further study   The Elementary Math Teacher's Book of Lists Sonia M. Helton,Stephen J. Micklo,1997 This is a unique information source and timesaver packed with 155 ready to use lists content and materials covering the entire K 6 math curriculum All of the lists patterns and worksheets are printed in a big spiral bound format ready to be photocopied as many times as needed and organized into 14 convenient sections including Standards and Methodologies Beginning Mathematics Geometry Numeration Counting Basic Operations Number Theory Fractions Decimals Measurement Probability Statistics Pre Algebra Problem Solving Technology and Ten Reproducible Patterns   **Equations and Inequalities** Jiri Herman,Radan Kucera,Jaromir Simsa,2000-03-23 A look at solving problems in three areas of classical elementary mathematics equations and systems of equations of various kinds algebraic inequalities and elementary number theory in particular divisibility and diophantine equations In each topic brief theoretical discussions are followed by carefully worked out examples of increasing difficulty and by exercises which range from routine to rather more challenging problems While it emphasizes some methods that are not usually covered in beginning university courses the book nevertheless teaches techniques and skills which are useful beyond the specific topics covered here With approximately 330 examples and 760 exercises   Steps into Analytic Number Theory Paul Pollack,Akash Singha Roy,2021-02-08 This problem book gathers together 15 problem sets on analytic number theory that can be profitably approached by anyone from advanced high school students to those pursuing graduate studies It emerged from a 5 week course taught by the first author as part of the 2019 Ross Asia Mathematics Program held from July 7 to August 9 in Zhenjiang China While it is recommended that the reader has a solid background in mathematical problem solving as from training for mathematical contests no possession of advanced subject matter knowledge is assumed Most of the solutions require nothing more than elementary number theory and a good grasp of calculus Problems touch at key topics like the value distribution of arithmetic functions the distribution of prime numbers the distribution of squares and nonsquares modulo a prime number Dirichlet s theorem on primes in arithmetic progressions and more This book is suitable for any student with a special interest in developing problem solving skills in

analytic number theory It will be an invaluable aid to lecturers and students as a supplementary text for introductory Analytic Number Theory courses at both the undergraduate and graduate level   Science Education Issues and Developments Calvin L. Petroselli,2008 Science Education Issues and Developments   Mathematical Programming and the Numerical Solution of Linear Equations Bert W. Rust,Walter R. Burrus,1972   **The American Mathematical Monthly** ,1918 Includes section Recent publications

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