

# Practice problems for the Math Olympiad

## <Problem #7>

Prove that there are infinitely many positive integers which are not representable as a sum of cubes of two other positive integers.

**Proof:** Let us fix a positive integer  $n$  and let  $1 \leq x \leq n^3$ . Let us assume the positive number  $x$  can be represented as a sum of two cubes of two positive integers, i.e.  $x = a^3 + b^3$ . Then it is clear that

$$1 \leq a \leq n \text{ and } 1 \leq b \leq n$$

So there are  $n$  distinct  $a$  for  $1 \leq a \leq n$  and there are  $n$  distinct  $b$  for  $1 \leq b \leq n$ . Therefore, there are no more than  $n^2$  such pairs of  $a, b$  for which  $x = a^3 + b^3 \leq n^3$ . And there are  $n^3$  distinct  $x$  such that  $1 \leq x \leq n^3$ . So there are at least  $n^3 - n^2$  integers not representable as a sum of cubes of two positive integers. Since  $n^3 - n^2$  is a polynomial of positive degree with a leading coefficient 1, it can be made arbitrary large by making  $n$  sufficiently large. This proves the theorem.

## <Problem #8>

Show that a positive integer is divisible by 9 if and only if the sum of its digits is divisible by nine.

**Proof:** The  $n$ -digit positive integer

$$\overline{a_n a_{n-1} \dots a_2 a_1 a_0} = a_n \times 10^n + a_{n-1} \times 10^{n-1} + \dots + a_2 \times 10^2 + a_1 \times 10 + a_0, \quad (8.1)$$

where  $a_0, a_1, a_2, \dots, a_{n-1}, a_n$  are digits (meaning integers from 0 to 9) and  $a_n \neq 0$ .

Rewriting (8.1) by using  $10^i = 10 \cdot 0 = 9 \cdot 9 + 1$ , we get

$$\begin{aligned} & \overline{a_n a_{n-1} \dots a_2 a_1 a_0} \\ &= a_n \times \left( \underset{9}{9} \cdot \underset{9}{9} + 1 \right) + a_{n-1} \times \left( \underset{9}{9} \cdot \underset{9}{9} + 1 \right) + \dots + a_2 \times (99 + 1) + a_1 \times (9 + 1) + a_0 \\ &= a_n \times \underset{9}{9} + a_{n-1} \times \underset{9}{9} + \dots + a_2 \times 99 + a_1 \times 9 + (a_n + a_{n-1} + \dots + a_2 + a_1 + a_0) \end{aligned}$$

# Math Olympiad Practice Problems

**Dr. Manoj Kale**



## **Math Olympiad Practice Problems:**

*Math Olympiad Contest Problems for Elementary and Middle Schools* George Lenchner,2008     [Mathematical Olympiad Problems](#) Jagat Narain Kapur,1993     *Math Olympiad Contest Problems, Volume 2 (REVISED)* Richard Kalman,2008-01-01

**Articles and Excerpts, Volume 1** AoPS Incorporated,2006     *Mathematical Circle Diaries, Year 2* Anna Burago,2018-07-03 Mathematical circles with their question driven approach and emphasis on problem solving expose students to the type of mathematics that stimulates the development of logical thinking creativity analytical abilities and mathematical reasoning These skills while scarcely introduced at school are in high demand in the modern world This book a sequel to *Mathematical Circle Diaries Year 1* teaches how to think and solve problems in mathematics The material distributed among twenty nine weekly lessons includes detailed lectures and discussions sets of problems with solutions and contests and games In addition the book shares some of the know how of running a mathematical circle The book covers a broad range of problem solving strategies and proofing techniques as well as some more advanced topics that go beyond the limits of a school curriculum The topics include invariants proofs by contradiction the Pigeonhole principle proofs by coloring double counting combinatorics binary numbers graph theory divisibility and remainders logic and many others When students take science and computing classes in high school and college they will be better prepared for both the foundations and advanced material The book contains everything that is needed to run a successful mathematical circle for a full year This book written by an author actively involved in teaching mathematical circles for fifteen years is intended for teachers math coaches parents and math enthusiasts who are interested in teaching math that promotes critical thinking Motivated students can work through this book on their own 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

**THE CHINESE-AMERICAN METHOD** Linda Hu; John X. Wang,2013-01-24 Raising a child is challenging for many parents especially for a new immigrant family For those parents they not only have to face the challenges of integrating themselves into a new environment but they also need to handle the conflicts coming from two cultural backgrounds Like many Chinese Americans the authors inherited the traditional Chinese culture Yet they also opened their minds and embraced their new culture Through the collisions of these two cultures they developed a unique parenting strategy a combination of the best of both worlds to educate their children This approach offered them a cutting edge in developing their children to be among the most competitive As they raised their children they held parties to build their children s social groups used teamwork to create a harmonious family strengthening the family bonds helped their children excel in academic competitions taught their children how to be rigorous and strive for perfection inspired their children to explore innovative strategies to overcome obstacles developed their children s creativity leadership and initiative encouraged their children to

be involved in the community and gave their children freedom to develop their individual personalities and discover their full potentials The authors believe that their story will be beneficial to other parents and also provide a new perspective of Chinese American families for mainstream Americans Developing Math Talent Susan G. Assouline, Ann Lupkowski-Shoplak, 2021-09-03 Build student success in math with the only comprehensive guide for developing math talent among advanced learners The authors nationally recognized math education experts offer a focused look at educating gifted and talented students for success in math More than just a guidebook for educators this book offers a comprehensive approach to mathematics education for gifted students of elementary or middle school age The authors provide concrete suggestions for identifying mathematically talented students tools for instructional planning and specific programming approaches Developing Math Talent features topics such as strategies for identifying mathematically gifted learners strategies for advocating for gifted children with math talent how to design a systematic math education program for gifted students specific curricula and materials that support success and teaching strategies and approaches that encourage and challenge gifted learners **Maths Olympiad Contest Problems** Australasian Problem Solving Mathematical Olympiads (APSMO) Inc., 2018-04 Past papers from the Australian and USA Maths Olympiads from 2014 to 2017 **Foundations of Greatness** Dr. Manoj Kale, 2025-02-12 Introduction In the ever changing world we live in the foundation of a good life is built not on wealth or fame but on character values and the mindset we carry As parents educators and mentors we have a profound responsibility to shape the minds and hearts of the next generation Yet this task often feels overwhelming How do we nurture honesty kindness respect and resilience in a world that can sometimes seem devoid of these qualities How do we prepare our children to become not just successful individuals but responsible citizens compassionate humans and confident leaders The answer lies in stories From time immemorial stories have been the heartbeat of learning They have carried lessons across generations wrapped in the warmth of imagination and the simplicity of words Stories are more than just entertainment they are mirrors showing us who we are and windows opening up possibilities of who we can become A story can ignite a child's imagination shape their moral compass and instill values that will guide them for a lifetime This book Foundations of Greatness is a humble attempt to use the timeless power of storytelling to inspire young minds and empower parents It is a collection of 50 carefully curated stories from across India and the world each one unique and rooted in real life experiences These are not mere tales of fiction but narratives inspired by ordinary people who have achieved extraordinary things who have shown exceptional character or who have faced challenges with courage and grace Each story is a lesson in itself teaching values like honesty perseverance compassion and respect These stories will take you to a small village in India where a boy returns a priceless heirloom to its rightful owner to a refugee camp in Germany where a child dares to dream to a bustling market in Bangladesh where an ice cream vendor changes lives and to a classroom in Finland where a teacher refuses to give up on her students The stories cross borders and cultures but their messages are universal

This book is not just for children It is for parents who wish to raise thoughtful empathetic and resilient children It is for families who want to build strong bonds through meaningful conversations After each story you ll find simple takeaways and action points small steps that parents and children can take together to bring these lessons into their daily lives Why 50 stories Because life offers countless lessons and each story is a window into a new perspective Some stories will make you laugh others might bring tears to your eyes and a few will make you pause and reflect on your own life Together these stories create a tapestry of values perspectives and possibilities that can guide children as they navigate the complexities of growing up This book is more than just a collection of stories it s an invitation An invitation to parents to become storytellers and mentors An invitation to children to dream bigger think kinder and act braver And an invitation to families to sit together read and rediscover the joy of learning through shared experiences As you turn these pages I hope you ll find stories that resonate with your heart and stay with you long after you close the book I hope they spark conversations encourage curiosity and create memories that will last a lifetime Most of all I hope they inspire you to see the greatness that lies in every child and the infinite potential in every moment of life So let s begin this journey together Let s explore the lives of unsung heroes extraordinary children and everyday champions Let s build a foundation of greatness for the next generation one story at a time

Teaching Secondary Mathematics Alfred S. Posamentier, Beverly S. Smith, Jay Stepelman, 2006 For courses in Secondary Mathematics Methods Teaching Secondary Mathematics Techniques and Enrichment Units 7th edition has been thoroughly revised to discuss current methods of teaching mathematics considering all aspects and responsibilities of the job beginning with a brief overview of the history of mathematics education and how it has evolved over time to include standards for teaching and assessment The authors address how to craft rich and effective daily lesson plans and how to use a variety of instructional tools and strategies to reach all students in a classroom Problem solving is a key focus from its instructional underpinnings to its recreational and motivational aspects The second part of the text provides mathematics teachers with a collection of enrichment units appropriate for the entire secondary school curriculum spectrum

**What High Schools Don't Tell You (And Other Parents Don't Want You to Know)** Elizabeth Wissner-Gross, 2008-06-24 From the author of What Colleges Don t Tell You a plan to help parents of middle and early high school students prepare their kids for the best colleges In order to succeed in the fiercely competitive college admissions game you need a game plan and you have to start young In this empowering guide Elizabeth Wissner Gross a nationally sought after college packager helps parents of seventh to tenth graders create a long term plan that come senior year will allow their kids to virtually write their own ticket into their choice of schools Parents should start by helping their kids identify their academic passions then design a four year strategy based on those interests The book details hundreds of opportunities available to make kids stand out that most high school guidance counselors and teachers simply don t know about or don t think to share This indispensable guide should be required reading for any parent whose child dreams of attending one of the country s top colleges

Mathematics

Teaching in the Middle School ,2008-08

**Teaching Children Mathematics** ,1996

**Math Horizons** ,1996

**Introduction to Math Olympiad Problems** Michael A. Radin,2021-06-24 Introduction to Math Olympiad Problems aims to introduce high school students to all the necessary topics that frequently emerge in international Math Olympiad competitions In addition to introducing the topics the book will also provide several repetitive type guided problems to help develop vital techniques in solving problems correctly and efficiently The techniques employed in the book will help prepare students for the topics they will typically face in an Olympiad style event but also for future college mathematics courses in Discrete Mathematics Graph Theory Differential Equations Number Theory and Abstract Algebra Features Numerous problems designed to embed good practice in readers and build underlying reasoning analysis and problem solving skills Suitable for advanced high school students preparing for Math Olympiad competitions

Challenging Problems from Around the World Vol. 2 Richard Hammond,2019-04-25 There are many countries around the world that hold Mathematics Competitions The Competitions are extremely interesting since many professors try to create new interesting problems If you want to take part in these competitions you have to solve many problems That means you must master your problem solving skills Challenging Problems from Around the World Vol 2 is a selected problem book This book has only two chapters The first chapter of this book is a collection of problems We select many good problems from different sources Most of them used to appear in Mathematics Competitions In this part we want the readers try their best to solve the problems Remember that only a few people can solve all problems in this book So do not be up set if you cannot solve some problems Even we cannot solve problems we still gain some techniques in solving problems The readers should keep in mind that the only way in learning Mathematics is to do Mathematics The second chapter of this book was written about the solution to each problem that listed in the first chapter We try to solve the problems step by step We believe that the solutions will help the readers to understand well Reading through this part we hope the readers will learn many problem solving strategies Let this book be your close friend when you learn about Mathematics We hope the readers have a great journey in reading this book Richard S Hammond

**What High Schools Don't Tell You** Elizabeth Wissner-Gross,2007 Reveals strategies for helping today s high school students become an applicant for whom colleges will compete identifying academic credentials extracurricular programs and other achievements that will be favorably received by leading admissions committees

**Maths Olympiad Contest Problems for Primary and Middle Schools** George Lenchner,2005-01-01

**Math Olympiad Contest Problems** Richard Kalman,2016

Books in Print ,1991

## Decoding **Math Olympiad Practice Problems**: Revealing the Captivating Potential of Verbal Expression

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