Contents

Part I

Algebra

Chapter 1

Equations

1.1 Polynomials

1.2 Simultaneous equations

1.3 Real solutions

factorization discriminant image of square(polynomial) intermediate value

1.4 Integer solutions

factorization root identity image of square(polynomial)

Chapter 2

Inequalities

2.1 Symmetry

2.2 Homogeneity

Chapter 3

Functions

3.1 Properties of functions

3.2 Functions over $\mathbb{R}$

3.3 Other domains

Part II

Combinatorics

Chapter 4

Counting

4.1 Orbits

4.2 Generating functions

Chapter 5

Algorithms

5.1 Invariants

5.2 Games

Chapter 6

Graphs

6.1 Double counting

6.2 Non-constructive existence

Pigeonhole principle, Probabilistic methods, Extremal theory

Part III

Geometry

Chapter 7

Plane geometry

7.1 Angle chasing

Cyclic quadrilaterals

7.2 Length ratios

menelous and ceva

7.3 Triangle centers

7.4 Conics

Chapter 8

Analytic methods

8.1 Trigonometry

8.2 Complex variables

8.3 Barycentric coordinates

Chapter 9

Transformations

9.1 Similarity

spiral homothety

9.2 Inversion

9.3 Projectivity

Part IV

Collegiate subjects

Chapter 10

Calculus

10.1 Asymptotics

10.2 Infinite series

10.3 Integral inequalities

Chapter 11

Linear algebra

11.1 Determinants

11.2 Spectrum

canonical forms

11.3 Commuting matrices

two by two matrices

11.4 Positive definiteness

Chapter 12

General physics

12.1 Mechanics

12.2 Waves

12.3 Thermodynamics

12.4 Electromagnetism

12.5 Optics

12.6 Atoms