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# Chapter 1

## Fundamentals

### 1.1 Equations

one variable several variables

### 1.2 Inequalities

three variables

### 1.3 Sequences

invariants pigeonhole floor and archimedian principle asymptotics

## Chapter 2

# Geometry

### 2.1 Basic topics

length computation triangles and quadrilaterals angle chasing rigid motions for auxiliary points

### 2.2 Advanced topics

five centers conics inversive and projective tangent circles

### 2.3 Coordinates

algebraic curves vector method complex method solid geometry: length computation projections regular polytopes

## Chapter 3

# Combinatorics

### 3.1 Counting

combinatorial identities discrete geometry

### 3.2 Graphs

double counting

### 3.3 Probability

conditional prob probabilistic method

## Chapter 4

# Algebra

### 4.1

prime factors quadratic residue

### 4.2 Matrices

conjugacy class, commutation two-by-two in particular algebraic condition and spectrum

### 4.3

# Chapter 5

## Analysis

### 5.1

indefinite and definite integrals

### 5.2 Differential inequities

mean value type taylor type gronwall type

- 5.1. (a) Let  $f \in C^3(\mathbb{R})$ . If  $0 < f'(x)$ ,  $0 < f''(x)$ ,  $0 < f'''(x) \leq f(x)$ , then  $f'(x) \leq 2f(x)$ .  
(b) Let  $f \in C^2(\mathbb{R})$ . If  $f''(x) \geq f(x)$ , then  $f(x) \geq f(0) \cosh x + f'(0) \sinh x$ .

### 5.3 Integral inequalities

Holder, minkowski interpolation fourier transform, divide and conquer