International Math Olympiad Handbook – Grade 12

This handbook covers topics for Grade 12 students (Age 17–18).

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Introduction

Grade 12 students focus on advanced mathematics concepts suitable for pre-university and international Olympiad preparation. Topics include advanced algebra, calculus, coordinate geometry, trigonometry, probability, sequences, and challenging problem-solving.

Curriculum Topics

- Algebra: quadratic and cubic equations, inequalities, matrices & determinants, binomial expansion, exponential and logarithmic functions
- Calculus: limits, derivatives, integrals, optimization, area under curves
- Functions: linear, quadratic, polynomial, exponential, logarithmic, inverse, composite
- Trigonometry: identities, equations, laws of sine & cosine
- Coordinate Geometry: lines, circles, parabolas, ellipses, hyperbolas, distance, slope, intersection
- Probability & Statistics: conditional probability, discrete and continuous distributions, expected value, variance

- Sequences & Series: arithmetic, geometric, series, binomial theorem
- Word Problems & Olympiad Challenges: multi-step reasoning, logic, and application problems

Examples & Explanations

- **Algebra / Quadratic:** Solve x2−7x+10=0x^2 - 7x + 10 = 0x2−7x+10=0 → x = 2, 5
- **Functions:** f(x) = 2x³ - 3x² + x, f(2) = 6
- **Calculus:** Derivative of f(x) = x² sin x → f'(x) = 2x sin x + x² cos x
- **Trigonometry:** Solve sin 2x = √3/2 → x = π/6 + kπ or x = π/3 + kπ
- **Probability:** Draw 2 aces from 52 cards → P = 1/221
- **Coordinate Geometry:** Line through (1,2) perpendicular to y = 3x +1 → y = -1/3 x + 7/3
- **Sequences:** Arithmetic sequence a_1=2, d=5 → 10th term = 47

Practice Problems

1. Solve x³ - 6x² + 11x - 6 = 0
2. f(x) = x² e^x, find f'(1)
3. Compute ∫ (2x +1) dx
4. Solve cos 2x = 1/2, 0 ≤ x ≤ 2π
5. Probability: draw 3 hearts from deck
6. Line through (2,3) parallel to 4x - y = 5 → equation?
7. Find 7th term of geometric sequence a_1=3, r=2