



## Math Contest Preparation- Senior Level (G10 & above)

**Course Description:** This contest preparation is for the Senior Math Contests (Caley/Galois/Fermat/Hypatia but strong emphasis on Euclid/CSMC/COMC), and is meant for older students who already have some experience with math contests. The topics in this section exceed curriculum courses and are aimed for the intermediate/hard questions in the senior level contests.

### Topics Covered:

- **Lesson 1:** Introduction + Quadratics/Higher power
  - About contests: How to mock contests + score/time breakdown expectations for certificate/honor roll
  - Common techniques: Casework, Patience, Clear proof solutions, Proof by contradiction, Link question parts together
  - Diagnostic assessment
  - Quadratics: Complete the square  $\rightarrow$  vertex form, Vieta's, The discriminant
  - Higher Power: Sum/Difference of cubes
- **Algebra**
  - **Lesson 2:** Logarithms and Trig
    - Learn how to use them while mixing in other topics
  - **Lesson 3:** Functions & polynomials: Even/odd, Function composition, Inverse, Remainder/Factor theorem, A touch on inequalities, Trivial inq, AM-GM
- **Number Theory**
  - **Lesson 4:** Sequences and Series
    - Arithmetic: Sum, nth term
    - Geometric: Sum, nth term; Infinite case
    - Telescoping series
  - **Lesson 5:** Divisibility rules extended, prime factorization extension
    - Div. rule increase to include 11, 12, 13
    - # of integer divisors given prime factorization
  - **Lesson 6:** Number Properties & Flex room for previous lessons
    - Modular Arithmetic, the fancy way
    - Fibonacci Numbers



- More practice

- **Geometry**

- **Lesson 7:** Review of basic geo, and extension formulas
  - Triangle, Area of equilateral, Heron's formula, Pythagorean triple reviews, Congruence/Similarity
  - Interior, sum of angles in polygons
  - Parallel lines
- **Lesson 8:** Circle
  - Area of sector
  - Inscribed angle: Special 90 deg case; Same chord = same insc. Angle
  - Tangents
  - Power of a point
- **Lesson 9:** Analytic (coordinate) Geometry — when Euclidean geometry is too hard
  - Area of the triangle
  - Midpoint, distance, circle
  - Line properties (parallel/perpendicular)
  - Chuck problems (2d, 3d) into coordinate plane

- **Combinatorics**

- **Lesson 10:** Counting Review + enrichment
  - PIE
  - Stars and bars
- **Lesson 11:** Combinations, in a different way
  - Pascal's triangle
  - Binomial Theorem
  - Hockey Stick Identity
  - A few other combination identities
- **Lesson 12:** Probability
  - Review
  - Geometric Probability
  - Game theory intro
  - Course review