



## Syllabus for AMC 10/12 Training Course

### (AMC 10/12 培训课教学大纲)<sup>1</sup>

PROFESSOR CHEN EDUCATION PALACE (陈教授教育学院)

#### WHY CHOOSING US (为什么选择我们)

1. Many of our alumni have received great achievements in math Olympiads (such as qualifying for USAMO and MOP) and have been admitted by top-tier universities (such as Harvard, MIT, Princeton, Stanford, and Yale).

(我们很多学员在数学竞赛中取得了优异成绩, 例如进入USAMO甚至MOP, 并且被顶级大学录取, 例如哈佛, MIT, 普林斯顿, 斯坦福, 耶鲁)

2. We have summarized a series of general and effective problem-solving skills that allow students to solve most AMC and AIME problems.

(我们总结出了一系列具有普适性和高效性的解决大多数AMC和AIME题目的方法)

3. We have been invited to contribute our solutions to many AMC and AIME problems in the Art of Problem Solving (AoPS) forum.

我们应邀在AoPS平台贡献了很多我们给AMC和AIME题目的解答。

#### OBJECTIVES (教学目标)

We expect students to achieve the following objectives after taking this course:

(学生通过我们的课程培训可以实现以下目标)

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1. Master most problem-solving skills to analyze the greatest number of AMC 12 problems.  
(掌握用于解答绝大部分AMC 12题目的解题技巧)
2. Advance to AIME.  
(晋级AIME)
3. Receive competition awards, such as Distinction or Distinguished Honor Roll.  
(获得竞赛奖励, 例如Distinction, Distinguished Honor Roll)
4. Build up solid foundation for AIME and be ready to answer the greatest number of problems in AIME.  
(为进一步参加 AIME, 解答好 AIME 的绝大多数题目打下扎实的基础)
5. Be prepared to take other sister math Olympiad contests, such as Berkeley Math Tournament (BmMT), Harvard-MIT Math Tournament (HMMT), Princeton University Mathematics Competition (PUMaC), Stanford Math Tournament (SMT).  
(准备好参加其他数学比赛, 例如 BmMT, HMMT, PUMaC, SMT)
6. Build a solid math foundation for contests in other STEM fields, such as physics, USACO, and AI.  
(为参加其他竞赛, 例如物理, USACO, AI 等, 打下扎实的数学基础)

## **DURATION (总课时)**

30 Hours (30小时).

## **TEXTBOOKS (教材)**

We use our developed course packet (我们用自己编写的教材).

## **COURSE CONTENTS (教学内容)**

### **Module 1: Algebra (第一模块: 代数)**

1. Skills to manipulate math expressions (数学表达式的处理技巧)



- (a) Factorization (分解因式)
- (b) Manipulation on the expressions with fractions (分数表达式的处理技巧)
- (c) Manipulation on the expressions with factorials (阶乘表达式的处理技巧)
2. Skills to solve problems with exponents and logarithms (分析指数和对数问题的技巧)
  - (a) Skill to convert an exponential problem to a logarithmic problem (把指数问题转化为对数问题的技巧)
  - (b) Universal skills to solve all logarithmic problems (解决所有对数问题的普适技巧)
3. Skills to solve special equations (求解特殊方程的技巧)
  - (a) Skills to solve radical equations (解含有根号的方程的技巧)
  - (b) Skills to solve the systems of equations with special structures (解含有特殊结构的方程组的技巧)
4. Skills to solve inequalities with structures (解含有特殊结构的不等式)
5. Number bases (进制数)
6. Skills of using sum-notation (求和符号的使用技巧)
7. Skills of analyzing arithmetic sequences (等差数列的分析技巧)
8. Skills of analyzing geometric sequences (等比数列的分析技巧)
9. Skills of using the recursive equations method to analyze general sequences (递归方程方法分析数列的技巧)
10. Functions (函数)
  - (a) Skills of analyzing composite functions (分析复合函数的技巧)
  - (b) Skills of solving functional equations (求解函数方程的技巧)
  - (c) Skills of analyzing Gaussian (floor) functions (分析向下取整函数的技巧)
11. Trigonometry (三角函数)
  - (a) Skills of trigonometric function and angle transformation (三角函数方程种类和角度变换技巧)
  - (b) Skills of using trigonometric function identities (三角函数恒等变换的使用技巧)



## 12. Complex numbers (复数)

- (a) Skills of using the rectangular form of a complex number to analyze complex number problems (使用复数的直角坐标形式分析复数问题的技巧)
- (b) Skills of using the exponential form of a complex number to analyze complex number problems (使用复数的指数形式分析复数问题的技巧)
- (c) Skills of using the complex number method to analyze trigonometric problems (使用复数方法分析三角函数问题的技巧)

## 13. Polynomial functions (多项式函数)

- (a) Skills of factoring a polynomial expression and exploiting its properties (因式分解多项式表达式和利用相关性质解题的技巧)
- (b) Skills of using the relationship of polynomial function coefficients and zeros (利用多项式系数和零点的关系解决问题的技巧)
- (c) Skills of using conjugate zeros to solve problems (利用共轭零点解题的技巧)
- (d) Skills of finding rational zeros (寻找有理数零点的技巧)

## Module 2: Geometry (第二模块：几何)

### 1. Triangles, quadrilaterals, polygons (三角形，四边形，多边形)

- (a) Law of cosines (余弦定理)
- (b) Law of sines (正弦定理)
- (c) Skills of using the law of cosines and the law of sines without adding auxiliary lines (不添加辅助线，完全使用余弦定理和正弦定理求解几何问题的技巧)

### 2. Circles (圆)

- (a) Skills of analyzing problems with tangents (求解跟圆相切问题的技巧)
- (b) Skills of using the power of a point (圆幂定理)
- (c) Skills of analyzing problems with circles without drawing any circle (分析含有圆的问题但是不画圆的技巧)



- (d) Skills of analyzing cyclic quadrilateral problems (分析四点共圆的技巧)
- 3. Analytic geometry (解析几何)
  - (a) Skills of using various forms of equations of lines (使用不同种类直线方程的技巧)
  - (b) Skills of analyzing the problems about the relationship between a point and a line (分析点和线关系问题的解题技巧)
  - (c) Skills of analyzing the problems about the relationship between two lines (分析线和线关系问题的解题技巧)
  - (d) Skills of analyzing transformation problems (分析涉及变换操作问题的技巧)
  - (e) Skills of analyzing non-linear graphs (分析非线性图形的技巧)
  - (f) Skills of using analytic geometry method to solve Euclidean geometry problems (使用解析几何方法求解平面几何问题的解题技巧)
- 4. Triangular centers (三角形的各种心)
  - (a) Skills of analyzing problems with centroids (分析含有三角形重心问题的技巧)
  - (b) Skills of analyzing problems with incenters (分析含有三角形内心问题的技巧)
  - (c) Skills of analyzing problems with circumcenters (分析含有三角形外心问题的技巧)
  - (d) Skills of analyzing problems with orthocenters (分析含有三角形垂心问题的技巧)
  - (e) Skills of using various forms of a triangle's area (利用多种类型三角形面积公式解决问题的技巧)
- 5. Solid geometry (立体几何)
  - (a) Properties of special-shaped solids: Spheres, prisms and cylinders, pyramids and cones, parallelepipeds, cubes (特殊形状体的性质, 例如球, 棱柱, 圆柱, 锥体, 平行六面体, 正方体)
  - (b) Skills of analyzing the 3-d perpendicular and parallel problems (分析三维垂直和平行问题的技巧)
  - (c) Skills of analyzing problems with tangents to spheres (分析跟球相切问题的技巧)
  - (d) Skills of using analytic geometry method to solve solid geometry problems (使用解析几何分析立体几何的方法)



## Module 3: Counting and probability (第三模块：排列组合和概率)

1. Set operations (集合运算)
  - (a) Venn diagram (文恩图)
  - (b) Rule of sum (加法原理, 分类讨论)
  - (c) Complement (补集计数方法)
  - (d) Principle of inclusion-exclusion (容斥原理)
  - (e) Rule of product (乘法原理, 分步计数)
2. Permutations (排列计数)
3. Combinations (组合计数)
  - (a) Canonical models (经典组合模型)
  - (b) Skills of counting in the resource allocation models (资源分配计数问题的解题技巧)
  - (c) Skills of counting the number of travel paths on graphs (图上路径计数问题的解题技巧)
  - (d) Skills of proving and using the combinatorial identities (组合恒等式的证明和使用技巧)
  - (e) Skills of using the binomial theorem (二项式定理的使用技巧)
  - (f) Skills of using the multinomial theorem (多项式定理的使用技巧)
4. Classical probability models (古典概率模型)
5. Geometric models of uniform distribution (均匀分布的几何概率模型)
6. Skills to analyze conditional probability problems (分析条件概率的技巧)
7. Skills of using the law of total probability (利用全概率公式解题的技巧)
8. Counting and probability problems with symmetry (含有对称性的排列组合和概率问题)
  - (a) Skills of analyzing counting problems with symmetry (分析含有对称性的排列组合问题的技巧)
  - (b) Skills of analyzing probability problems with symmetry (分析含有对称性的概率问题的技巧)



9. Recursive equations method in counting and probability (递归方程方法在排列组合和概率问题中的应用)
  - (a) Skills of using the recursive equations method to solve counting problems (利用递归方程求解排列组合问题的技巧)
  - (b) Skills of using the recursive equations method to solve probability problems (利用递归方程求解概率问题的技巧)

#### **Module 4: Number theory (第四模块：数论)**

1. Skills of using the parity properties (奇偶性质的使用技巧)
2. Properties of primes, composites (质数和合数的性质)
3. Skills of prime factorization (分解质因数的技巧)
4. Skills of analyzing problems with greatest common divisors and least common multiples (分析含有最大公约数和最小公倍数问题的技巧)
5. Statistics of divisors (因数统计问题)
  - (a) Skills of analyzing problems about counting the number of divisors (统计因数个数的解题技巧)
  - (b) Skills of analyzing problems about the sum of divisors (统计因数之和的解题技巧)
6. Skills of analyzing problems with divisibility (解决整除问题的技巧)
7. Modular arithmetic (同余运算)
  - (a) Properties of modular arithmetic with addition, subtraction, multiplication, exponentiation (同余的加法, 减法, 乘法, 指数运算)
  - (b) Properties of modular arithmetic with division (同余的除法运算)
  - (c) Skills of using the Fermat's little theorem and the Euler's theorem to compute remainders (利用费马小定理和欧拉定理计算余数的技巧)
  - (d) Skills of using the binomial theorem to compute remainders (利用二项式定理计算余数的技巧)
  - (e) Skills of using the properties of special moduli (特殊模数性质的使用技巧)



- (f) Skills of solving a single linear modular equation (求解单一线性同余方程的技巧)
- (g) Skills of solving a system of linear modular equations (求解线性同余方程组的技巧)
- (h) Skills of using the Chinese Remainder Theorem to analyze problems with large moduli (利用中国余数定理分析很大模数的问题)
- (i) Skills of solving Diophantine equations (求解丢番图方程的技巧)

