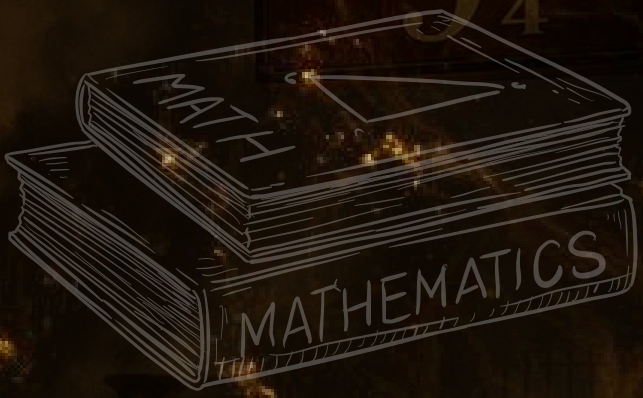


PTΦLΣMY'S PUZZLΣ

$V = \frac{4}{3}\pi r^3$

STUDY GUIDE

This guide is designed to help you prepare for the competition by outlining the key concepts, formulas, and skills you should master for each topic. Consistent practice with problems is the most effective way to succeed.

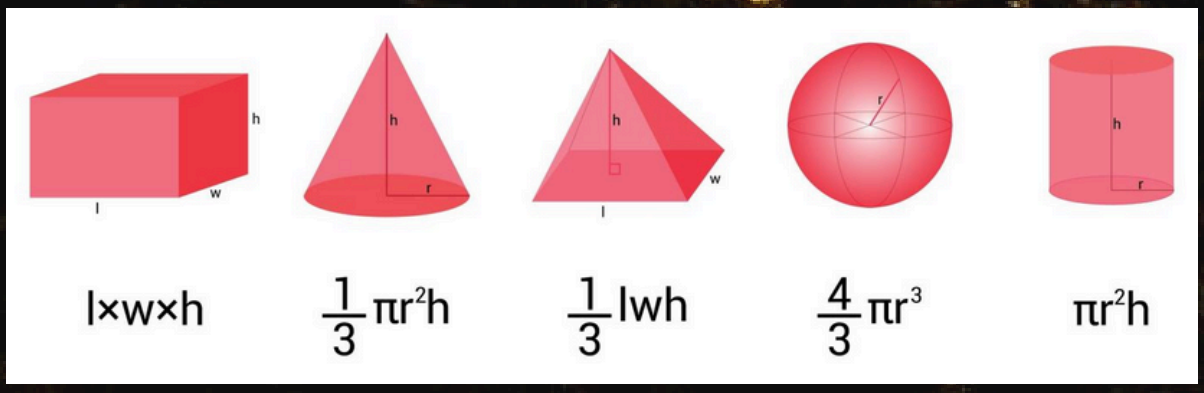
1. Algebra:

Focus on manipulating expressions and solving equations across various forms.

- **Polynomials**: Factoring (including cubic and quartic forms), remainder theorem, polynomial long division.
- **Equations & Inequalities:** Solving linear, quadratic, rational, radical, and absolute value equations/inequalities.
- **Functions:** Domain, range, inverse functions, composite functions, and graphing common functions (e.g., linear, quadratic, exponential, logarithmic).
- **Logarithms & Exponentials:** Change of base formula, solving exponential and logarithmic equations.
- **Sequences and Series:** Arithmetic and geometric progressions, sums of finite and infinite series.

2. Geometry:

Be prepared for both synthetic (Euclidean) and analytic (coordinate) geometry problems.



- **Triangles:** Similarity, congruence, Pythagorean theorem, trigonometric ratios (Sine Rule, Cosine Rule), area formulas.
- **Circles:** Properties of chords, tangents, and secants; arc length and sector area; circle theorems.
- **Polygons:** Sum of interior/exterior angles, properties of quadrilaterals (parallelogram, trapezoid, etc.).
- **Coordinate Geometry:** Distance formula, midpoint formula, equations of lines, circles.

3. Number theory and Discrete Math:

- Topics include divisibility rules, prime numbers, factorisation, HCF and LCM, Euclidean algorithm, modular arithmetic, remainders, and cyclic patterns.
- Discrete mathematics elements include sequences and series, arithmetic and geometric progressions, pigeonhole principle, basic graph theory concepts, logical statements,and elementary proofs.

- Problems may require systematic counting, pattern recognition, or constructing logical arguments.

4. Time Series:

This is a topic focused on data collected over time.

- Basic Concepts: Understanding what a time series is, components (trend, seasonality, cycle, residual/irregular), and stationarity.
- Moving Averages: Calculating and interpreting simple moving averages for smoothing data.
- Forecasting Models: Basic extrapolation and simple regression for time series (e.g., linear trend fitting).
- Interpreting Data: Analyzing graphs and tables of time series data to identify patterns and anomalies.

5. Binomial:

The focus is likely on the Binomial Expansion and the Binomial Distribution.

- **Binomial Expansion:** Using the Binomial Theorem to expand (a+b)^n.
- **Binomial Theorem:**

$$(a+b)^n = \sum_{k=0}^{n} \left(\frac{n}{k}\right) a^{n-k} b^k$$

- **Binomial Coefficients:** Properties of (n/k), Pascal's triangle.

7. 2D Vectors

Extending vector concepts into three dimensions.

- **Vector Basics:** Position vectors,express the magnitude of a vector v=xy as |v| =x2+y2 .
- **Vector Operations:** Addition, subtraction, scalar multiplication.
- **Dot Product (Scalar Product):** $u \cdot v = uv\cos\theta$ and its use for finding the angle between vectors or testing for perpendicularity.
- **Equation of a Line:** Representing lines and planes in the 2D plane using vector, parametric, and Cartesian forms.

8. Probability:

- **Counting Techniques:** Factorials, permutations and combinations, including arrangements with restrictions, repeated elements, and circular arrangements.
- **Combinations & Permutations in Context:** Applying counting methods to real problems such as selections, arrangements, probability spaces, and multi-stage experiments.
- **Probability Fundamentals:** Sample spaces, events, complementary events, mutually exclusive and independent events, and use of probability laws.
- **Tree Diagrams:** Construction and analysis of tree diagrams for sequential events, including conditional probabilities and dependent trials.

- **Conditional Probability:** Use of conditional probability formulas, interpreting information from trees and tables.
- **Combined Probability Problems:** Multi-step problems integrating counting methods with probability, requiring logical breakdown rather than brute force.

Note: Participants are expected to have a solid understanding of the complete O Level Mathematics syllabus.