

Syllabus Scope & Purpose: The Group F syllabus introduces formal algebraic methods, Euclidean geometry, modular arithmetic, and combinatorial counting. Contestants should choose fluently between arithmetic reasoning and algebraic equations.

1 Numbers and Operations

- ▶ Order of operations with nested brackets, whole numbers, signed integers, and decimals.
- ▶ Evaluating custom-defined mathematical operations and binary functions (e.g. $a \oplus b$).
- ▶ Squares and square roots of whole numbers.

2 Number Theory and Digits

- ▶ Divisibility rules for 3 and 4, and combining rules to test divisibility for composite numbers.
- ▶ Systematically counting the divisors of a composite number.
- ▶ Prime factorization into canonical prime power representation.
- ▶ Highest Common Factor (HCF/GCD) and Lowest Common Multiple (LCM), including fraction pairs.

3 Fractions, Ratio, Proportion and Percentages

- ▶ Fraction of a quantity, fraction of a remainder, and reconstructing the whole from a part.
- ▶ Setting up equations relating fractions of two distinct quantities.
- ▶ Sharing in a ratio, including tracking adjustments after individual shares change.
- ▶ Successive percentage changes: percentage decrease followed by percentage increase to restore original value.
- ▶ Mixtures: solution concentration percentages and price-per-kilogram of coffee or grain blends.

4 Word Problems and Algebraic Reasoning

- ▶ Formulating and solving linear equations in one unknown from practical scenarios.
- ▶ Combining two given totals to deduce a third related total.
- ▶ Working backwards through a multi-link chain of mathematical operations.
- ▶ Reuse, remainder, and leftover inventory problems.

5 Rates and Work

- ▶ Inlet and outlet rate problems: filling and emptying reservoirs simultaneously.
- ▶ Comparing and synthesizing work rates across different agents and tasks.

6 Measurement and Time

- ▶ Converting compound units of length, area, volume, and speed.
- ▶ Clock face angles: angular displacement of hour and minute hands in a given time interval.

7 Geometry

- ▶ Angle sum theorems for triangles and quadrilaterals; interior angles in given ratios.
- ▶ Isosceles triangles, angle bisectors, and altitudes (especially from right angles).
- ▶ The 30° – 60° – 90° right triangle: shortest side equals half the hypotenuse.
- ▶ Pythagorean theorem and calculating Euclidean distance between coordinate grid points.
- ▶ Trapezoid midline (median) properties and segments formed by intersecting diagonals.
- ▶ Areas of triangles and rectangles: equal areas yielding equal base-height products.
- ▶ Perimeter changes when geometric sections are excised.
- ▶ Systematic geometric counting: enumerating triangles and quadrilaterals within complex figures.

8 Counting, Probability and Sets

- ▶ Ordered permutations, including constrained arrangements (keeping two specific individuals together).
- ▶ Combinations and selections where order does not matter.
- ▶ Theoretical probability of single and compound events with dice, spinners, and probability bounds.
- ▶ Two-set Venn diagrams with set operations (union, intersection, complement).

9 Logic and Patterns

- ▶ Solving multi-variable logic grids from deductive clues.
- ▶ Evaluating compound statements (e.g. exactly two true statements and one false).
- ▶ Repeating decimals and cyclic decimal periods: identifying the digit at arbitrary decimal positions.

PROBLEM-SOLVING STRATEGIES & MATHEMATICAL HABITS

Group F contestants should choose between arithmetic reasoning and a simple equation. These eight strategies appear repeatedly across the papers: Forming an Equation, Invariant Analysis, Working Backwards, Pigeonhole Principle, Case Exhaustion, Proportional Scaling, Geometric Dissection, and Parity Testing.