Syllabus for Pre-RMO 2012 in Mumbai region

Arithmetic of integers, plane geometry, polynomial equations and expressions, factorization of a polynomial, trigonometry, co-ordinate geometry, system of linear equations, elementary combinatorics (permutations and combinations), inequalities, number theory, sequence and series (general term and sum to n terms of A.P, G.P, H.P; infinite G.P), binomial theorem, complex numbers.

Sample questions

1. Let $x_1, x_2, \ldots, x_{100}$ be positive integers such that $x_i + x_{i+1} = k$ for all i, $1 \leq i \leq 99$, where k is a constant. If $x_{10} = 1$, what is the value of x_1?

2. A box contains 100 balls of different colours: 28 red, 17 blue, 21 green, 10 white, 12 yellow and 12 black. What is the smallest number n such that any n balls drawn from the box will contain at least 15 balls of the same colour?

3. Determine the number of integer (positive, negative or zero) solutions of $xy - 6(x + y) = 0$.

4. What is the remainder when $3^{12} + 5^{12}$ is divided by 13?

5. How many distinct positive integers can be formed using $0, 1, 2, 4$, where each integer is used at most once?

6. If α is a positive integer and the roots of the equation $6x^2 - 11x + \alpha = 0$ are rational numbers, then what is the smallest value of α?

7. In a triangle ABC, the medians AM and CN to the sides BC and AB respectively, intersect at the point O. Let P be the midpoint of AC and let MP intersect CN at Q. If the area of the triangle OMQ is s square units, what is the area of triangle ABC in terms of s?

8. What is the area of the region bounded by the curves $|x| + |y| = 1$ in the Cartesian plane?