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Regional math olympiad

RMO or Regional Math Olympiad is the second stage of the mathematics talent search examination that is conducted in India. The exam is conducted by Regional Coordinator under the guidance of Homi Bhabha Centre for Science Education (HBCSE), Mumbai. The regional coordinator is in charge of conducting evaluations of the answer sheets. After checking the answers of the students, the results are sent to HBCSE where it is declared online. Please Note: This page will be updated soon The exam is a descriptive test where students have to solve a total of six questions in three hours. Students are given an answer sheet and rough papers to solve the questions. However, they have to submit the answer sheet and the rough sheets at the end of the exam. The question paper can be taken. RMO Overview 3 hours written test with 6 questions. Conducted by Regional Coordinators under the guidance of HBCSE. 30 top students from Classes VIII, IX, X, XI and top 6 students from Class XII + 5 girl students are selected for the next stage through this exam. Results are declared centrally by HBCSE on the official website. Students who qualify PRMO will be eligible for RMO. Important Dates The dates of the RMO 2021-22 are not finalised due to the ongoing pandemic. ➤ RMO Application Form ➤ RMO Syllabus Admit Card for RMO The admit card for the olympiad examination should be downloaded from the official website of HBCSE. Students should provide details like the roll number and date of birth. Once they login they can download the admit card and the letter of selection. It is mandatory to carry the admit card, along with the school id card to the examination centre. How to check the RMO Result 2021-22? The results can be checked in the official page of HBCSE by clicking on the link provided. The students will be redirected to the individual result page. To break ties for the closing ranks, the PRMO score shall be applied by the regional coordinator. In case ties cannot be broken by PRMO scores, the final list will include all candidates in the tied position. General Syllabus for Mathematics Olympiad The mathematics syllabus for all the olympiad examinations is based on Class IX to Class XII mathematics. The topics covered in the syllabus are number systems, quadratic equations and expressions, arithmetic integers, coordinate geometry, trigonometry, geometry, factorisation of polynomials, permutations and combinations, inequalities, systems of linear equations, probability theory, elementary combinatorics, complex numbers, infinite series, elementary graph theory and number theory. Though the syllabus is roughly spread over Class IX to Class XII level, the questions are exceptionally high in difficulty level. What is Olympiad? Olympiad is a talent search examination conducted by Homi Bhabha Centre for Science Education (HBCSE). The examination is conducted in science and mathematics. The mathematics olympiad is a six-stage process. The first stage, known as PRMO (Pre-Regional Mathematical Olympiad), is conducted by the Mathematics Teachers' Association (India). The remaining five stages of the examination are organised by Homi Bhabha Centre for Science Education (HBCSE). Stages of Mathematical Olympiad The Mathematical Olympiad Program in India is conducted by the HBCSE on behalf of National Board for Higher Mathematics. The students who perform well will participate in the International Mathematical Olympiad. Stage 1 – Pre-Regional Mathematics Olympiad (PRMO) The Pre-Regional Mathematics Olympiad (PRMO) is conducted for a duration of three hours. There will be 30 questions asked in the examination and the answer to each question is a single-digit number or a two-digit number. The question paper will be in English/Hindi. Know more details on PRMO by visiting the given link. Stage 2 – Regional Mathematical Olympiad (RMO) This examination is conducted in a small number of centres in the region. The duration of the examination is 3 hours with 6 questions. The examination is conducted in English/Hindi or sometimes in other regional languages. Stage 3 – Indian National Mathematical Olympiad (INMO) The best performers from the RMO are selected for the Indian National Mathematical Olympiad. Approximately 900 students get selected for this examination. Stage 4 – International Mathematical Olympiad Training Camp (IMOTC) The toppers from INMO (approximately 35) are invited to HBCSE for the International Mathematical Olympiad Training Camp (IMOTC). Several tests are conducted during this camp. The best 6 performers are selected for the next stage. Stage 5 – Pre Departure Camp The selected students will undergo an extensive training programme for 8-10 days at HBCSE before they leave for the IMO. Stage 6 – International Mathematical Olympiad (IMO) The best 6 students from India will participate in the International Mathematical Olympiad. The full form of RMO is Regional Mathematics Olympiad. It is the second stage of the International Mathematical Olympiad (IMO).The Regional Mathematical Exam is the second stage of the Olympiad, and it qualifies a candidate to represent India internationally. It is a fantastic chance for young brains who are passionate about mathematics, and wish to further their education in this field.RMO is hosted in 15 places between November and December, with each area hosting the event. Around 30 students from each location are eligible.The solution keys for the Pre-Regional Mathematics Olympiads will be accessible on the official website within a few days following the tests. The answer key is incredibly helpful in evaluating students' performance on the Pre-Regional Mathematics Olympiads test. National Olympiad, Olympiads Abhinav Moghe 11 months ago Regional Mathematics Olympiad (RMO) 2025 is an acronym of RMO. RMO leads to the participation of Indian students in the International Mathematics Olympiad (IMO). It is organized by Homi Bhabha Centre for Science Education (HBCSE) on behalf of the National Board for Higher Mathematics (NBHM). RMO aims to spot mathematical talent among pre-university students in the country. Latest Update: As per previous year record RMO exam will be conducted in October 2025. Timing – 1 pm to 4 pm . RMO is conducted in 25 regions all over the country every year in the month of October. In this article, we are going to provide you detailed information on RMO 2025 Eligibility, registration, syllabus, exam pattern, selection procedure, schedule, result and previous year papers. If you want to know the exam dates of the India National Mathematical Olympiad (INMO) then Click Here. Note: It's exam time, so students can download the 10th Time Table & 12th Time Table from the given links. Download RMO Admit Card || RMO Syllabus RMO 2025 Registration RMO registration must be completed by October 2025 and all eligible candidates will have to register for RMO 2025, exam. RMO is conducted in 25 regions all over the country. It is quite obvious that your school will be an exam centre for Regional Mathematics Olympiad (RMO) but if not so, there are three Regional Coordinators (RCs) assigned to handle such requests. The three RCs are the Central Board of Secondary Education (CBSE), Navodaya Vidyalaya Samiti (NVS) and Kendriya Vidyalaya Sangathan (KVS). Pre-RMO Registration 2025 can be done by following these simple steps. RMO Sample Papers || RMO Previous Papers How To Fill RMO 2025 Registration Form Open this to complete the registration process. Click on the "Student Registration Form (In PDF)" link to download the registration form. Take a print of the registration form and fill in all the mandatory details with care. Now, visit the nearest NSE Centre to you and submit the registration form. It must be noted that the last date to fill the form is July 2025. RMO 2025 Apply Online: Click Here RMO Eligibility Criteria The RMO eligibility criteria are simple to understand. The eligibility criteria to appear in Regional Mathematics Olympiad are given below: Candidates born on or after August 1, 2003 and studying in Class 8, 9, 10, 11 or 12 are eligible to write PRMO 2025. Further, the candidates must be Indian citizens. Provisionally, students with OCI cards are eligible to write the PRMO. As per the orders of Madras High Court, students with OCI status will not be eligible for selection to the Indian team in the International Mathematical Olympiad. However, such students are provisionally eligible for selection at ALL prior stages, up to and including the IMOTC provided they fulfill all other criteria. This policy is subject to revision without prior notice depending on any further orders issued by the courts, or by a competent Government authority. Note: Students studying in class XII are not eligible for the Regional Mathematics Olympiad 2025. RMO 2025 Syllabus The syllabus for the Regional Mathematics Olympiad 2025 is pre-degree college mathematics. The RMO Syllabus is in a sense spread over class XI and XII levels, but the problems under each topic involve a high level of difficulty and sophistication. The topics covered are given below: • Arithmetic of Integers • Inequalities • Geometry • Elementary Combinatorics • Quadratic Equations & Expressions • Probability Theory • Trigonometry • Number Theory • Co-ordinate Geometry • Finite Series & Complex Numbers • System of Linear Equations • Elementary Graph Theory • Permutations & Combinations • Factorization of Polynomial NOTE: The major areas from which problems will be given are Algebra, Combinatorics, Geometry and Number Theory. For a detailed syllabus Click Here Exam Pattern: Regional Mathematics Olympiad is a three hour written test. The RMO 2025 will have only six problems. These six questions will be descriptive in nature. RMO Schedule 2025 Events Dates Registration of Centers June 2025 Registration of Candidates July 2025 Download Admit Card Available Soon Date of Examination October 2025 INMO Examination January 2025 Top Indian Schools Entrance Exams || Indian National Olympiad RMO 2025 Selection Procedure Regional Mathematics Olympiad is the first level of examination if you want to appear in International Mathematics Olympiad. Top 30 students from each region will qualify for the second level i.e. India National Mathematics Olympiad (INMO). Certificate of Merit/Participation will be given to the Top 50 students of each region in their respective schools. In addition to the quota of 30 selected students, 5 girl students are also selected from each region. RMO Previous Year Question Papers To give you an estimation of the RMO paper, we are here providing you with various sets from last year's Regional Mathematics Olympiad. The links for RMO previous year papers are given below in the table: Year Links 2016 Set-A Set-B Set-C Set-D RMO 2025 Exam Result The RMO Result is published online every year at the official website for the Mathematics Olympiad Programme. The top 30 students from each region are selected with an addition of 5 girl students. The result for RMO 2025 has not been published yet. We will be updating the details here so make sure you check this page time to time. The result for Regional Mathematics Olympiad 2025 will be declared in the month of December 2025. RMO Registration 2025 FAQ How To I register For RMO 2025? All interested students can fill online application for rmo @ secure.hbcse.tifr.res.in. What Is Eligibility Criteria For RMO? All interested aspirants of the Regional Mathematics Olympiad can check eligibility at our website. Is RMO 2025 Form Released? No, It is not yet released. Prev Article Next Article It is the second stage of the mathematics talent exam conducted in India, and this exam is organized by the Homi Bhabha center for science and educational research. This exam contains descriptive-type questions requiring students to solve six questions in 3 hours. The school provides answer sheets and rough papers for every participant, and the students must submit them after the exam. In this exam, the top 30 students are selected from classes 8th, 9th, 10th, and 11th, and a maximum of 6 students from class 12th. The organization declares the official website of the Homi Bhabha center for science and educational research. In addition, the student who clears the PRMO exam becomes eligible to participate in the RMO exam. Only Indian citizens can apply for this examination, and the participants must be born on or before 1st August 2020. However, according to the orders of the madras high court, overseas citizens of India are also eligible for this exam. The students of classes 9th to 12th are eligible to participate in this exam, and the regional coordinators allow the students of class 7th to participate in the RMO exam. However, it is the student's responsibility to check the eligibility criteria; if any student fails to meet the requirements, they are not allowed to appear in the Olympiad. Registration for the RMO exam can be done on its official website. The candidate must click on the link and enter their PRMO roll number and date of birth. Only those students who clear their first stage (PRMO) are eligible for the RMO exam. RMO is a very challenging exam. The syllabus of the RMO exam contains the topics of class 9th to class 12th Mathematics syllabus which are listed below in the table: Number Theory Algebra Combinatorics Geometry Divisibility Polynomials Permutation and Combination Lines and Curves Euclidean and Division algorithm Quadratic Equations Sts Solution of a triangle Modular arithmetic Graphical method of solving the equation Balls and Bar questions Menelaus Theorem Diophantine equation Root co-efficient Graph theory, etc. Ptolemy's theorem Problem-solving strategies, etc. Relationship, etc Ceva's theorem, etc. For a better understanding of the RMO examination, the structure is given below : Chapter-wise weightage explanation Chapters weightage No of question Number theory 21 7 Algebra 20 6 Trigonometry 3 1 Combinatorics 31 7 Geometry 27 9 RMO exam SPECIFICATION Time duration 3 HOURS Number of questions 6 Registration The student can register at the official website of HBSCE Marking scheme This paper contains 6 subjective-type questions for 17 Marks, and the marks are divided between the equation and logical explanation. Date of result declaration The regional coordinators are responsible for the declaration of exam results. Exam mode Online Important documents Admit card and identity card Stage 1 – pre regional mathematics Olympiad –It is the first exam stage; this exam contains six steps. First, the mathematics teacher association organized the PRMO exam, and the other remaining rounds were introduced as the Homi Bhabha center for science education. Stage 2- regional mathematics Olympiad – It is the second stage of the mathematics Olympiad and is organized under the guidance of HBCSE. This exam contained multiple-choice type questions, and the duration was 3 hours. This is a pen-paper-based test, and the students are provided the exam streets and rough paper for the rough work. After the exam t, the examiners collect these papers. Stage 3 – Indian national mathematics Olympiad – It is the 3rd stage of the mathematics Olympiad. Only the Top 30 students are selected for this stage. Stage 4 – Indian mathematic Olympiad training camp – After qualifying for the Indian national mathematic Olympiad, the selected students are invited for orientation. Stage 5- pre-departure camp – The selected students went to another camp where they underwent advanced training for 8-10 days, and the HBCSE organized this camp. Stage 6- International mathematic Olympiad – Top 6 students get the selection to represent India in the international mathematic Olympiad. Aspect Details Awards in RMO - Certificates of Merit: For best performers based on performance - Cash Prizes for IMO Medalists: - Gold Medal: ₹5,000 - Silver Medal: ₹4,000 - Bronze Medal: ₹3,000 RMO Regions 25 regions across India Qualification for IMO - Category A: Top 30 students - Category B: Top 6 students INMO Certificate of Merit Awarded to the top 45 students NBHM Nurture Programme - Eligibility: INMO awardees pursuing undergraduate engineering studies - Benefits: - Cash awards - Summer workshop participation - Contact with mathematical institutions Que. What is the RMO exam? Ans. It is the second round of the mathematics Olympiad. First, the students who qualify for the PRMO are eligible to appear in RMO. After that, the candidate who clears the RMO exam will be suitable for participating in the INMO exam. Que. What is the Full form of the RMO exam? Ans. The Full form of the RMO exam is the Regional mathematics Olympiad Que. In how many regions does RMO is carried out? Ans. The RMO exam is organized in 15 regions, and 30 students from each region participate in this competition. Regional Mathematics Olympiad (RMO) is the second stage of the International Mathematical Olympiad. The regional coordinators of HBCSE conduct RMO under the observation of HBCSE, Mumbai. The HBCSE regional coordinators evaluate RMO answer papers, and the results are sent to HBCSE. Latest Updates The IOQM 2024-25 revised date is now announced. Table of Contents What is RMO? The Regional Mathematical Olympiad, RMO Olympiad, is a three-hour written test conducted by the HBCSE regional coordinators with six problems. Based on the student performance in RMO, up to 30 students from classes 8 to 11 and nearly six students from class 12 will be selected for INMO (stage 3 of IMO) from each region. For a special case, up to 5 students studying in KV schools outside India may be selected to appear directly for the INMO examination. KVS will make the selection of these students. Further, up to five girls may be selected only from students studying in classes 8, 9, 10, and 11, apart from the general quota of 30 students for each region. The provision is independent of the number of girls who may be part of 30 students from the region. Girl students studying in class 12 are not eligible for the additional girls' quota. Below are the important details of PRMO 2024-25. Highlights of RMO Particulars About Name of Exam RMO Olympiad RMO Full Form Regional Mathematics Olympiad HBCSE IMO Stage 2 RMO Exam Date 2024-25 TBA RMO Eligibility Students Clearing PRMO IOQM Exam Date 2024 TBA INMO Exam Date 2024 TBA Classes Eligibility 8 to 12 Note: In case of a tie, the regional coordinator's PRMO score will be final. Even after the PRMO scores, the final list will include all candidates in the tied position in case of a tie. RMO 2024 Eligibility Criteria Students in the top 300 list from classes 8, 9, 10, and 11 can participate in RMO. Besides, the top 60 students from class 12 are chosen to participate in RMO in each region. Students from KV and JNV schools are regarded as separate regions. A maximum of the top 5% of participants from classes 8 to 11 and 1% of students from class 12 will be selected to participate in the RMO Olympiad. RMO 2024 Registration The best student performer from the RMO qualifies for the third stage of IMO, i.e., the Indian National Mathematical Olympiad (INMO). Approximately 900 students are qualified for the INMO exam, which will be conducted in 28 centers. The RMO exam is a descriptive test where the students are provided with an answer sheet and rough papers to solve them. After the exams, students must return their answer sheets and the rough sheets, both used and unused. Highlights of RMO registration are as follows, At the end of IMOTC, the six-member team will represent their country at IMO, International Mathematical Olympiad. The eligibility criteria at IMO are age limits, medical fitness, and personal consent confirmation. As for special cases, exceptionally talented students from class 8 can be allowed to participate in the regional coordinator's knowledge. RMO2024 Admit Card HBCSE RMO admit card can be downloaded from the HBCSE website by entering student details such as roll number and date of birth. After the login, students can download both the admit card as well as their letter of selection. Note: Students must bring their RMO admit card and school id card to the examination hall for verification. Read More: RMO Admit Card RMO 2024 Syllabus There is a prescribed RMO syllabus but no standard pattern. But it is strongly suggested that students must have a very strong knowledge of the topics involved, without relying on any book or teacher. However, developing a clear concept and understanding the difficulty level help clear the exam. Focus on getting the concepts and acquiring the necessary skills needed to solve problems and prove theorems. Solve more RMO sample papers and work on the basic concepts. Read More: RMO Syllabus RMO 2024 Results The RMO results for all regions will be declared centrally by HBCSE. The regional coordinators are responsible for sending the final results to HBCSE by November. The procedure to check the result online is given below. Go to the HBCSE website. Select RMO results on the top right corner. Students will be redirected to the individual results page. Click on the link RMO result. Enter your roll number, and the result details will be available in the pdf. Read More: RMO Results RMO 2024 Preparation Tips The RMO will be held in all the regions by October between 1 pm and 4 pm. If the PRMO cannot be held due to unavoidable external circumstances, an alternative date may be announced for specific regions/centers as an exception. Given below are the RMO preparation tips that help students prepare for the exam. Focusing on strong and weak points: While solving different problems, try to focus on the topics that you are weak in. As from the exam pattern, students should focus on combinatorics, geometry, and number theory. Solve sample paper and past year question papers: This will help students get familiar with the test's exam pattern and structure and provide them with an idea of the standard required. Refer to such papers as practice materials rather than a complete question bank. Understand the theorems and the results: RMO is a concept-based test. Having the proper understanding of significant theorems and their results will help students save time and reduce effort. Read the question carefully: Read the questions carefully. Sometimes a problem appears too easy, but it's a sign to be alert and read more carefully. Read More: RMO Preparation Other Stages of IMO International Mathematical Olympiad is divided into multiple stages, and students have to clear each stage to go to the next. The stages are: Note: The Olympiad exams are objective and subjective, but it always tests students' concept, logical approach, and understanding of the subjects/topics. Past Papers of RMO (Regional Math Olympiad India) Let ABC be a right angled triangle with $angle B=90^\circ$. Let I be the incentre of $\triangle ABC$. Suppose AI is extended to meet BC at F . The perpendicular on AI at I is extended to meet AC at E . Prove that $IE = IF$. Let ABC be a right angled triangle with $\angle B=90^\circ$. Let I be the incentre of $\triangle ABC$. Suppose AI is extended to meet BC at F . The perpendicular on AI at I is extended to meet AC at E . Prove that $IE = IF$. Let a,b,c be positive real numbers such that $\frac{a}{1+a}+\frac{b}{1+b}+\frac{c}{1+c}=1$.Prove that $abc\leq\frac{1}{8}$. For any natural number n, expressed in base 10, let $S(n)E$ denote the sum of all digits of n. Find all positive integers n such that n^3 = $8Sn^3$+$6Sn(n+1)$. Find all 6 digit natural numbers, which consist of only the digits $1,2$ and 3, in which 3 occurs exactly twice and the number is divisible by 9. Let ABC be a right angled triangle with $\angle B=90^\circ$. Let AD be the bisector of angle A with D on BC . Let the circumcircle of $\triangle ACD$ intersect AB again at E; and let the circumcircle of $\triangle ABD$ intersect AC again at F . Let K be the reflection of E in the line BC . Prove that $FK = BC$. Show that the infinite arithmetic progression {$1,4,7,10 \cdots$} has infinitely many 3 -term sub sequences in harmonic progression such that for any two such triples {a_1, a_2 , a_3 } and {b_1, b_2 ,b_3} in harmonic progression , one has $$\frac{a_1} {b_1} eq \frac {a_2}{b_2}$$ All Papers Let ABC be a triangle and D be the mid-point of BC. Suppose the angle bisector of $\angle ADC$ is tangent to the circumcircle of triangle ABD at D. Prove that $\angle A=90^{\circ}$. Let ABC be a triangle and D be the mid-point of BC. Suppose the angle bisector of $\angle ADC$ is tangent to the circumcircle of $\triangle ABD$ at D. Prove that $\angle A=90^{\circ}$. Let a,b,c be three distinct positive real numbers such that $abc=1$. Prove that $$\frac{a^3}{(a-b)(a-c)}+\frac{b^3}{(b-c)(b-a)}+\frac{c^3}{(c-a)(c-b)} \geq 3$$ Let a,b,c,d,e,d,e,f be positive integers such that $\frac a b 45^{\circ}$. Let a,b,c be three natural numbers such that ($a\leq b\leq c$) and ($gcd(c-a,c-b)=1$). Suppose that there exits an integer d such that $a+d,b+d,c+d$ form the sides of a right-angled triangle. Prove that there exist integers l,m such that $c+d=l^2+m^2$. Find all pairs (a,b) of real numbers such that whenever α is a root $x^2+ax+b=0$, α^2-1 is also a root of the equation. How many 6-digits numbers are there such that: (a) the digits of all the numbers are from the set { $1,2,3,.... $}; (b) any digits that appears in the number appears twice? (Example: 225252 is an admissible number, while 222133 is not.) A trapezium $ABCD$, in which AB is parallel to CD, is inscribed in a circle with centre O. Suppose the diagonal AC and BD of the trapezium intersect at M and $OM=2$. (a) If $\angle AMB$ is determine with proof the difference between the length between the parallel sides. (b) If $\angle AMD$ is find the difference between the parallel sides. Prove that: (a) $5 < 5^{\frac{1}{2}}+5^{\frac{1}{3}}+5^{\frac{1}{4}}$; (b) $8 < 8^{\frac{1}{2}}+8^{\frac{1}{3}}+8^{\frac{1}{4}}$; (c) $n < n^{\frac{1}{2}}+n^{\frac{1}{3}}+n^{\frac{1}{4}} $ for all integers greater than or equal to 9. All Papers Let ABC be an acute-angled triangle and let D, E, F be the feet of perpendiculars from A,B,C respectively to BC,CA,AB. Let the perpendiculars from F to CB, CA, AD, BE meet them in P, Q,M,N respectively. Prove that P, Q,M,N are collinear. Find the least possible value of $a + b$, where a, b are positive integers such that 11 divides $a + 13b$ and 13 divides $a + 11b$. If a, b, c are three positive real numbers, prove that $\frac{a^2+1}{b+c}+\frac{b^2+1}{c+a}+\frac{c^2+1}{a+b} \geq 3 $. A $6×6$ square is dissected into 9 rectangles by lines parallel to its sides such that all these rectangles have only integer sides. Prove that there are always two congruent rectangles. Let $ABCD$ be a quadrilateral in which AB is parallel to CD and perpendicular to AD; $AB = 3CD$; and the area of the quadrilateral is 4. If a circle can be drawn touching all the sides of the quadrilateral, find its radius. Prove that there are infinitely many positive integers n such that $n(n+ 1)$ can be expressed as a sum of two positive squares in at least two different ways. (Here a^2+b^2 and b^2+a^2 are considered as the same representation.) Let X be the set of all positive integers greater than or equal to 8 and let $f:X \mapsto X $ be a function such that $f(x + y) = f(xy)$ for all $x \geq 4 $, $y \geq 4 $. If $f(8) = 9$, determine $f(9)$. All Papers Let $ABCD$ be a convex quadrilateral; P, Q,R, S be the midpoints of AB,BC,CD,DA respectively such that $\triangle AQR$ and $\triangle CSP$ are equilateral. Prove that $ABCD$ is a rhombus. Determine its angles. If x, y are integers and 17 divides both the expressions $x^2-2xy-y^2-5x+7y$ and $x^2-3xy+2y^2+x-y$,then prove that 17 divides $xy − 12x + 15y$. If a, b, c are three real numbers such that $|a-b| \geq c,|b-c| \geq a,|c-a| \geq b $, then prove that one of a, b, c is the sum of the other two. Find the number of all 5-digit numbers (in base 10) each of which contains the block 15 and is divisible by 15. (For example, 31545, 34155 are two such numbers.) In $\triangle ABC$, let D be the midpoint of BC. If $\angle ADB = 45^{\circ} $ and $\angle ACD = 30^{\circ} $, determine $\angle BAD $. Determine all triples (a, b, c) of positive integers such that $a \leq b \leq c $ and $a + b + c + ab + bc + ca = abc + 1$. Let a, b, c be three positive real numbers such that $a + b + c = 1$.Let $\gamma=min{ $a^3+a^2bc,b^3+ab^2c,c^3+abc^2$}.Prove that the roots of the equation $x^2+x+4 \gamma$ are real. All Papers Consider in the plane a circle Γ with center O and a line l not intersecting circle Γ. Prove that there is a point Q on the perpendicular drawn from O to the line l, such that for any point P on the line l, PQ represents the length of the tangent from P to the circle Γ. Positive integers are written on all the faces of a cube, one on each. At each corner (vertex) of the cube, the product of the numbers written at all the corners is 2004. If T denotes the sum of the numbers on all the faces, find all the possible values of T. Let α and β be the roots of the quadratic equation x^2+mx-1.where m is an odd integer. Let $\gamma_m = \alpha^n + \beta^n$,for $n \geq 0$. Prove that for $n \geq 0$, (a) is an integer and (b) $gcd(\gamma_n, \gamma_{n+1})=1$. Prove that the number of triples (A,B,C) where A,B,C are subsets of {$1, 2, · · · , n$} such that $A \cap B \cap C = \phi$, $A \cap B eq \phi$, $B \cap C = \phi$ is $7^n+2.6^n+5^n$. Let $ABCD$ be a quadrilateral ; X and Y be the midpoints of AC and BD respectively ; and the lines through X and Y respectively parallel to BD,AC meet in O. Let P, Q,R, S be the midpoints of AB,BC,CD,DA respectively. Prove that (a) quadrilaterals $APOS$ and $APXS$ have the same area ; (b) the areas of the quadrilaterals $APOS,BQOP,CROQ,DSOR$ are all equal . Let $(p_1p_2p_3.....p_n....)$ be a sequence of primes defined by $p_1=2$ and for $n \geq 1$, p_{n+1} is the largest prime factor of $p_1p_2p_3.....p_n+1$ (Thus $p_2=3,p_3=7$). Prove that $p_n eq 5$ for any n. Let x and y be positive real numbers such that $y^3+y \leq x-x^3$.Prove that (a) $y < x < 1$; and (b). $x^2+y^2 \leq 1$. All Papers Let ABC be a triangle in which $AB = AC$ and $\angle CAB = 90^{\circ}$. Suppose M and N are points on the hypotenuse BC such that $BM^2 +CN^2= MN^2$. Prove that $\angle MAN = 45^{\circ}$. If n is an integer greater than 7, prove that (${n} \choose {7}$ - l floor $\frac{n}{7}$ r floor) is divisible by 7. [Here $\frac{n}{7}$ denotes the number of ways of choosing 7 objects from among n objects; also for any real number x, $[x]$ denotes the greatest integer not exceeding x. Let a, b, c be three positive real numbers such that $a + b + c = 1$. Prove that among the three numbers $a − ab, b − bc, c − ca$ there is one which is at most $\frac{1}{4}$ and there is one which is at least $\frac{2}{9}$. Find the number of ordered triples (x, y, z) of nonnegative integers satisfying the conditions: (i) $x \leq y \leq z$, (ii) $x+y+z \leq 100$. Suppose P is an interior point of a $\triangle ABC$ such that the ratios $d(A,BC)$ $\frac{d(A,BC)}{d(P,BC)} , \frac{d(B,CA)}{d(P,CA)},\frac{d(C,AB)}{d(P,AB)}$ are all equal. Find the common value of these ratios. [Here $d(X, Y Z)$ denotes the perpendicular distance from a point X to the line $Y Z$.]. Find all real numbers a for which the equation $x^2+(a-1)x+1=3|x|$ has exactly three distinct real solutions in x. Consider the set $X = {1, 2, 3, · · · , 9, 10}$. Find two disjoint nonempty subsets A and B of X such that. (a) $A \cup B = X $; (b) $\prod(A)$ is divisible by $\prod(B)$, where for any finite set of numbers C, $\prod(C)$ denotes the product of all numbers in C; (c)the quotient $\prod(A)/ \prod(B)$ is as small as possible. All Papers In an acute $\triangle ABC$, points $D;E; F$ are located on the sides $BC;CA;AB$ respectively such that $\frac{CD}{CE}=\frac{CA}{CB},\frac{AE}{AF}=\frac{AB}{AC},\frac{BF}{BD}=\frac{BC}{BA}$ Prove that $AD;BE;CF$ are the altitudes of ABC. Solve the following equation for real x: $(x^2+x-2)^3+(2x^2-x-1)^3=27(x^2-1)^3$. Let $a; b; c$ be positive integers such that a divides b^2, b divides c^2 and c divides a^2. Prove that abc divides $la(a+b+c) $. Suppose the integers $1; 2; 3;...; 10$ are split into two disjoint collections $a_1a_2a_3a_4a_5$ and $b_1b_2b_3b_4b_5$ such that $a_1 < a_2 < a_3 < a_4, b_2 > b_3 > b_4 > b_5 $ (i) Show that the larger number in any pair { a_i, $b_j $}, $1 \leq j \leq 5$ is at least 6. (ii) Show that $|a_1-b_1|+|a_2-b_2|+|a_3-b_3|+|a_4-b_4|+|a_5-b_5|=25$ for every such partition. The circumference of a circle is divided into eight arcs by a convex quadrilateral $ABCD$, with four arcs lying inside the quadrilateral and the remaining four lying outside it. The lengths of the arcs lying inside the quadrilateral are denoted by p, q, r, s in counter-clockwise direction starting from some arc. Suppose $p + r = q + s$. Prove that $ABCD$ is a cyclic quadrilateral. For any natural number $n> 1$, prove the inequality: $\frac{1}{2} \leq \frac{1}{1+n^2} + \frac{2}{2+n^2} + \frac{3}{3+n^2} +.....+ \frac{n}{n+n^2} \leq \frac{1}{2} + \frac{1}{2n}$ Find all integers $a; b; c; d$ satisfying the following relations : (i) $1 \leq a \leq b \leq c \leq d$, (ii) $ab + cd = a + b + c + d + 3$. All Papers Let BE and CF be the altitudes of an acute $\triangle ABC$, with E on AC and F on AB. Let O be the point of intersection of BE and CF. Take any line KL through O with K on AB and L on AC. Suppose M and N are located on BE and CF respectively, such that KM is perpendicular to BE and LN is perpendicular to CF.Prove that FM is parallel to EN. Find all primes p and q such that $p^2+7pq+q^2$ is the square of an integer. Find the number of positive integers x which satisfy the condition $[\frac{x}{99}]=[\frac{x}{101}]$. (Here $[z]$ denotes, for any real z, the largest integer not exceeding z ; e. g. $[\frac{7}{4}]$. Consider an $n \times n$ array of numbers, each entry being either 1 or −1. Let $a_{ij}=a_{ji}$ for $i = 1, 2, . . . , n$ and $j = 1, 2, . . . , n$. If n is odd, prove that the numbers $a_{11},a_{22},a_{33},....,a_{nn}$ are $1, 2, . . . , n$ in some order. In a triangle ABC , D is a point on BC such that AD is the internal bisector of $\angle A$. Suppose $\angle B = 2 \angle C$ and $CD = AB$. Prove that $\angle A = 72^{\circ}$. If x, y, z are the sides of a triangle, then prove that ($|x^2(y-z)+y^2(z-x)+z^2(x-y)| \leq xyz$). Prove that the product of the first 1000 positive even integers differs from the product of the first 1000 odd integers by a multiple of 2001. All Papers Let AC be a line segment in the plane and B a point between A and C. Construct isosceles triangles PAB and QBC on one side of the segment AC such that $\angle APB = \angle BQ= 120^{\circ}$ and an isosceles $\triangle RAC$ on the other side of AC such that $\angle ARC= 120^{\circ}$. Show that PQR is an equilateral triangle. Solve the equation $y^3=x^3+8x^2-6x+8$,for positive integers x and y. Suppose $(x_1, x_2,....., x_n)$ is a sequence of positive real numbers such that ($x_1 \geq x_2 \geq x_3 \geq ... \geq x_n... $) and for all n $\frac{x_1}{1}+\frac{x_4}{2}+\frac{x_9}{3}+....+\frac{x_{n^2}}{n}\leq 1$. Show that for all k the following inequality is satisfied: $\frac{x_1}{1}+\frac{x_2}{2}+\frac{x_3}{3}+....+\frac{x_k}{k}\leq 3$. All the 7-digit numbers containing each of the digits 1, 2, 3, 4, 5, 6, 7 exactly once, and not divisible by 5, are arranged in increasing order. Find the 2000-th number in this list. The internal bisector of $\angle A$ in a $\triangle ABC$ with $AC > AB$, meets the circumcircle (Γ) of the triangle in D. Join D to the centre O of the circle (Γ) and suppose DO meets AC in E, possibly when extended. Given that BE is perpendicular to AD, show that AO is parallel to BD. (i) Consider two positive integers a and b which are such that $a^a b^b$ is divisible by 2000. What is the least possible value of the product ab? (ii) Consider two positive integers a and b which are such that $a^a b^b$ is divisible by 2000. What is the least possible value of the product ab? Find all real values of a for which the equation $x^4-2ax^2+x+a^2-a=0$ has all its root real. All Papers Prove that the inradius of a right-angled triangle with integer sides is an integer. Find the number of positive integers which divide 10^{999} but not 10^{998}. Let $ABCD$ be a square and M,N points on sides AB,BC respectably, such that $\angle MDN =45^{\circ}$. If R is the midpoint of MN show that $RP = RQ$ where P,Q are the points of intersection of AC with the lines MD, ND. If p, q, r are the roots of the cubic equation $x^3-3px^2+3q^2x-r^3=0$, show that $p=q=r$. If a, b, c are the sides of a triangle prove the following inequality: $\frac{a}{c+a-b}+\frac{b}{a+b-c}+\frac{c}{b+c-a}\geq 3 $. Find all solutions in integers m, n of the equation $(m-n)^2=\frac{4mn}{m+n-1}$. Find the number of quadratic polynomials ax^2+bx+c, which satisfy the following conditions: (a) a, b, c are distinct; (b) $a, b, c \in {1, 2, 3, . . . 1999}$ and (c) $x + 1$ divides ax^2+bx+c. All Papers Let $ABCD$ be a convex quadrilateral in which $\angle BAC = 50^{\circ} ,\angle CAD = 60^{\circ} ,\angle CBD = 30^{\circ}$,and $\angle BDC = 25^{\circ}$. If E is the point of intersection of AC and BD, find $\angle AEB$. Let n be a positive integer and $p_1p_2.....p_n$ be n prime numbers all larger than 5 such that 6 divides $p_{1}^{2}+p_{2}^{2}+p_{n}^{2}$. Prove that 6 divides n. Prove the following inequality for every natural number n: $\frac{1}{n+1}(1+\frac{1}{3}+\frac{1}{5}+.....+\frac{1}{2n-1})\geq \frac{1}{n}(\frac{1}{2}+\frac{1}{4}+\frac{1}{6}+.....+\frac{1}{2n}) $. Let ABC be a triangle with $AB = BC$ and $\angle BAC = 30^{\circ}$. Let $A^{'}$ be the reflection of A in the line BC; $B^{'}$ be the reflection of B in the line CA; $C^{'}$ be the reflection of C in the line AB. Show that $A^{'},B^{'},C^{'}$ form the vertices of an equilateral triangle. Find the minimum possible least common multiple (lcm) of twenty (not necessarily distinct) natural numbers whose sum is 801. Given the 7-element set $A = {a, b, c, d, e, f, g}$, find a collection T of 3-element subsets of A such that each pair of elements from A occurs exactly in one of the subsets of T. All Papers Let P be an interior point of a $\triangle ABC$ and let BP and CP meet AC and AB in E and F respectively. If [BPF] = 4, [BPC] = 8 and $[CPE] = 13$, find [$AFPE$]. (Here $[\cdot]$ denotes the area of a triangle or a quadrilateral, as the case may be.) For each positive integer n, define $a_n = 20 + n^2$, and $d_n=GCD(a_n,a_{n+1})$. Find the set of all values that are taken by $ d_n$ and show by examples that each of these values are attained. Solve for real x: $\frac{1}{[x]}+\frac{1}{[2x]}=9(x)+\frac{1}{