The Eighth International Young Mathematicians' Convention

IYMC-Mathematica 2018

2nd to 5th December 2018

Organised by: City Montessori School, Gomti Nagar Campus-1, Lucknow, India

International Young Mathematicians' Convention

Senior level

Team Contest

Time limit: 60 minutes

Information:

- You are allowed 60 minutes for this paper, consisting of 6 questions printed on separate sheets. For questions 1, 3 and 5, only numerical answers are required. For questions 2, 4 and 6, full solutions are required.
- Each question is worth 40 points. For odd-numbered questions, no partial credits are given. There are no penalties for incorrect answers, but you must not give more than the number of answers being asked for. For questions asking for several answers, full credit will only be given if all correct answers are found. For even-numbered questions, partial credits may be awarded.
- Diagrams shown may not be drawn to scale.

Instructions:

- Write down your team's name on the spaces provided on every question sheet.
- Enter your answers in the spaces provided after individual questions on the question paper.
- During the first 10 minutes, the three team members examine the 6 questions together, and altogether discuss them. Then they distribute the questions among themselves, with each team member is allotted at least 1 question.
- During the next 50 minutes, the three team members write down the solutions of their allotted problems on the respective question sheets, with no further communication / discussion among themselves.
- You MAY NOT use instruments such as protractors, calculators and electronic devices.
- At the end of the contest, you must hand in the envelope containing all question sheets and all scrap papers.

Team: _____ ***Score:*** _____

For Juries Use Only

No.	1	2	3	4	5	6	Total
Score							
Score							

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1. Let a and b be real numbers such that the equation $x^4 + ax^3 + 2x^2 + bx + 1 = 0$ has at least one real root, what is the minimum possible value of $a^2 + b^2$?

Answer: _____

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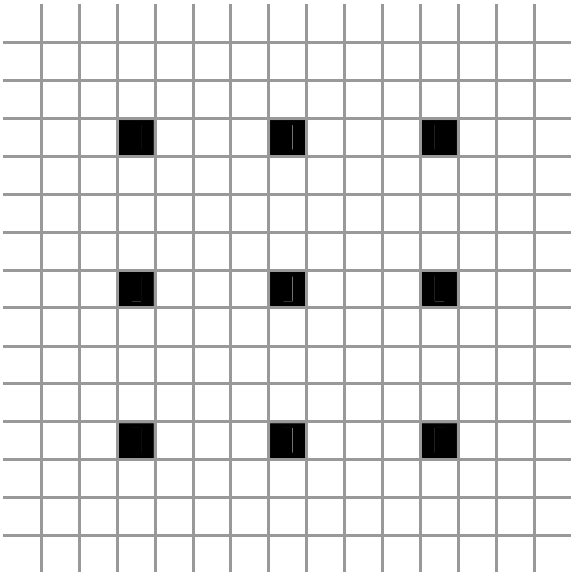
2. On an infinite chessboard, the squares at the intersections of every fourth row and every fourth column are removed. Prove that it is not possible for a Knight to visit every square exactly once which has not been removed.



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3. Suppose $x=\dfrac{a}{a^2+16}$, where a is a real number. What is the minimum value of $\sqrt{1+8x}+\sqrt{1-8x}$?

Answer: _____

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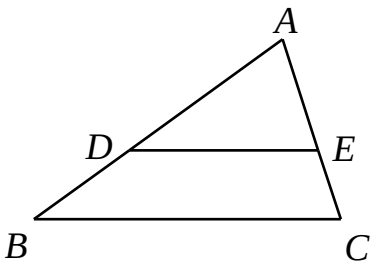
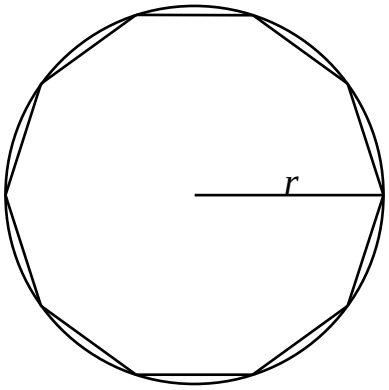
4. In the figure, points D and E lies along sides AB and AC of triangle ABC such that DE is parallel to BC. It is known that $AD = DE = AC = r$ and $BD = AE = s$. Now, a regular decagon is inscribed in a circle whose radius is r. Prove that the length to a side of this decagon is equal to s.





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5. For any positive integer n and non-zero digits a, b and c, let A_n be an n-digit integer each of whose digits is equal to a; let B_n be an n-digit integer each of whose digits is equal to b and let C_n be an $2n$-digit (not n-digit) integer each of whose digits is equal to c. What is the maximum value of $a+b+c$ for which there are at least two values of n such that $C_n - B_n = A_n^2$?

Answer: _____

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6. How many positive integers $n \leq 2018$ are there so that it is possible to arrange the numbers from 1 to n in some order, such that the average of any group of two or more adjacent numbers is not an integer?

Answer: _____