



iIMC - 2017

India International Mathematics Competition

Organized by - CITY MONTESSORI INTER COLLEGE, RDSO Campus, Lucknow - INDIA

Phone: +91-522-2453546, E-mail: inimc@cmseducation.org, rdso@cmseducation.org



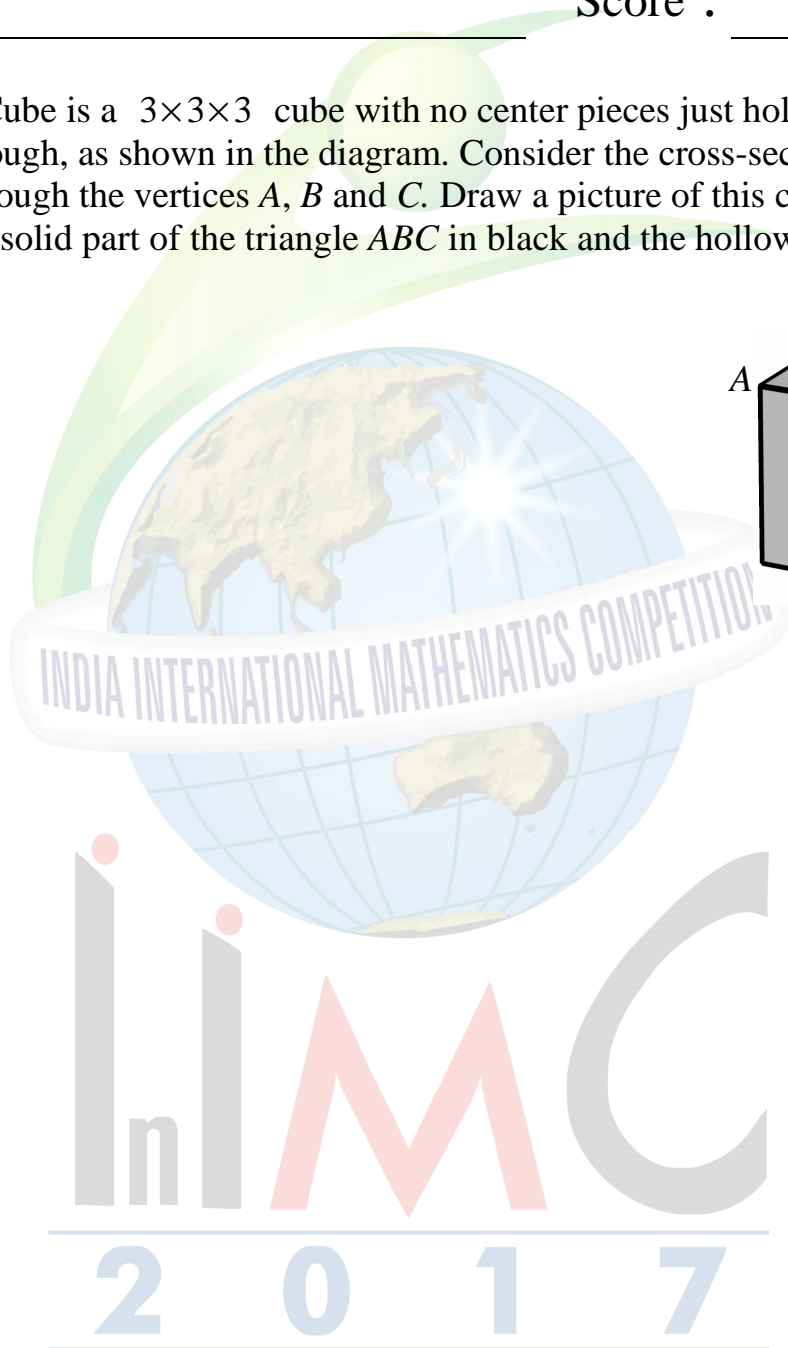
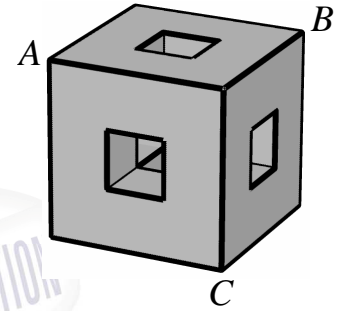
Invitational World Youth Mathematics Intercity Competition

TEAM CONTEST

28th July, 2017, Lucknow, India

Team : _____ Score : _____

1. The Void Cube is a $3 \times 3 \times 3$ cube with no center pieces just holes which can be looked through, as shown in the diagram. Consider the cross-section of the cube passing through the vertices A , B and C . Draw a picture of this cross section. (Shade the solid part of the triangle ABC in black and the hollow part in white.)



Answer: _____



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2. There are 314 coins in 21 open boxes. In each move, you can take 1 coin from each of any two boxes and put them into a third box. In the final move, you take all the coins from one box. What is the maximum number of coins you can get?



Answer: _____ coins

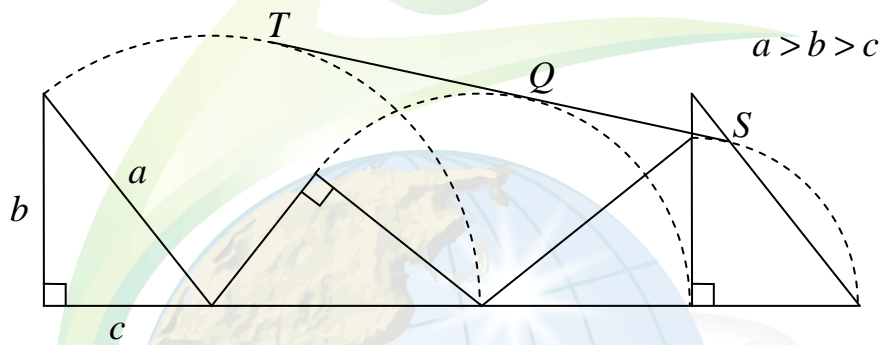
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3. A right triangle with hypotenuse a stands on its shorter side $c = 1$. We rotate it sequentially three times as it is shown below.



If TS is a common tangent of the three arcs, find a .

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Answer: _____



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4. Find all ordered pairs (x, y) of positive integers which satisfy the equation $x^3 + y^3 = x^2 + 18xy + y^2$.



Answer: _____



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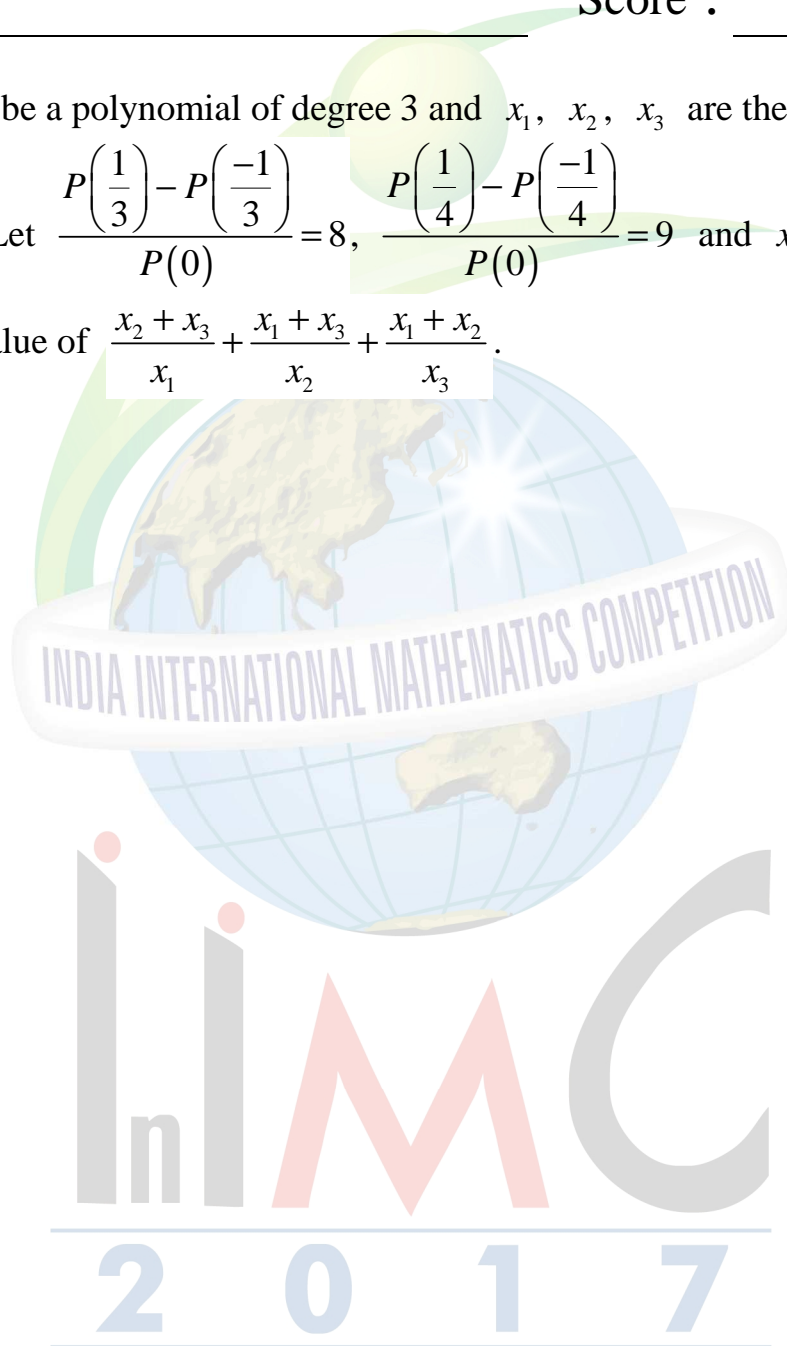
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5. Let $P(x)$ be a polynomial of degree 3 and x_1, x_2, x_3 are the solutions of

$$P(x) = 0. \text{ Let } \frac{P\left(\frac{1}{3}\right) - P\left(\frac{-1}{3}\right)}{P(0)} = 8, \frac{P\left(\frac{1}{4}\right) - P\left(\frac{-1}{4}\right)}{P(0)} = 9 \text{ and } x_1 + x_2 + x_3 = 35.$$

Find the value of $\frac{x_2 + x_3}{x_1} + \frac{x_1 + x_3}{x_2} + \frac{x_1 + x_2}{x_3}$.



Answer: _____

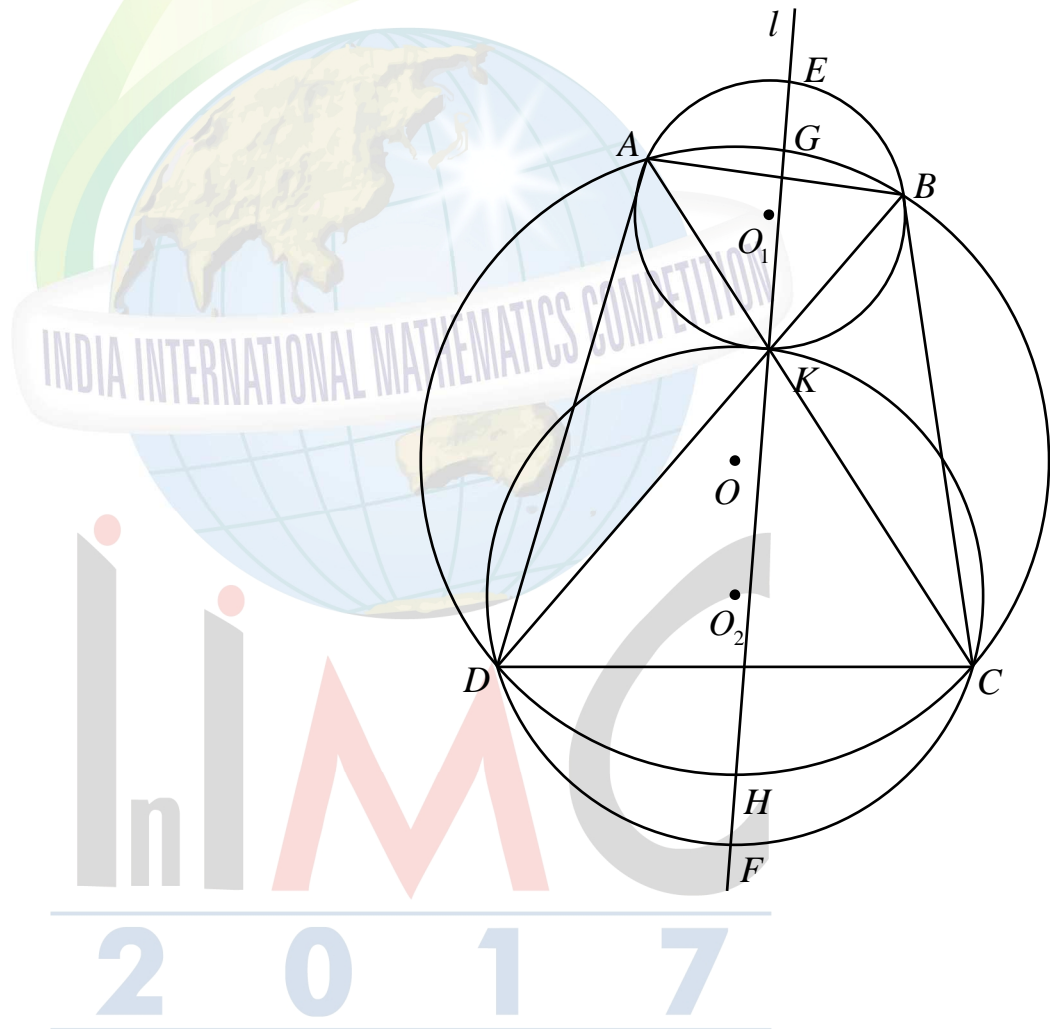
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6. The quadrilateral $ABCD$ is inscribed in a circle with center O . Connect AC and BD intersecting at K . O_1 is the circumcenter of triangle ABK and O_2 is the circumcenter of triangle CDK . A line l through K intersect the two circumcircles at E and F respectively, and the circumcircle of $ABCD$ at G and point H . Prove that $EG = FH$.



2 0 1 7



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7. Given that $a > 0$, $x_n = a^n - \frac{1}{a^n}$ where $n = 1, 2, 3, \dots$. If $x_1 = 3$, find the units digit of x_{2017} .



Answer: _____



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8. Suppose x, y and z are all non-negative real numbers. Let k and m be the minimum possible values of $\frac{x^2 + y^2 + z^2 + 1}{xy + yz + z}$ and $\frac{x^2 + y^2 + z^2 + 1}{xy + y + z}$ respectively.

Find $km + k + m$.



Answer: _____



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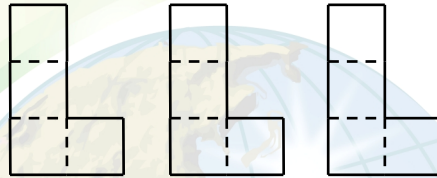
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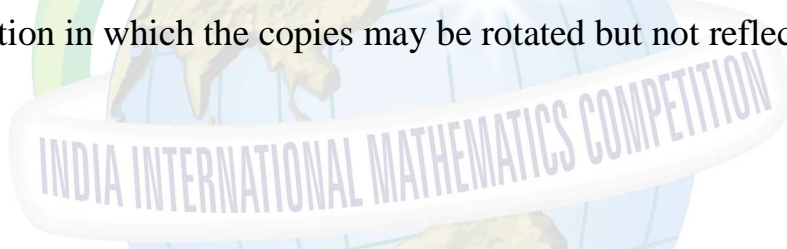
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- 9. Use three non-overlapping copies of a L-tetromino to construct a symmetric figure. Each L-tetromino must have a common point with at least one other L-tetromino.



Find a solution in which the copies may be rotated but not reflected.



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Answer: _____



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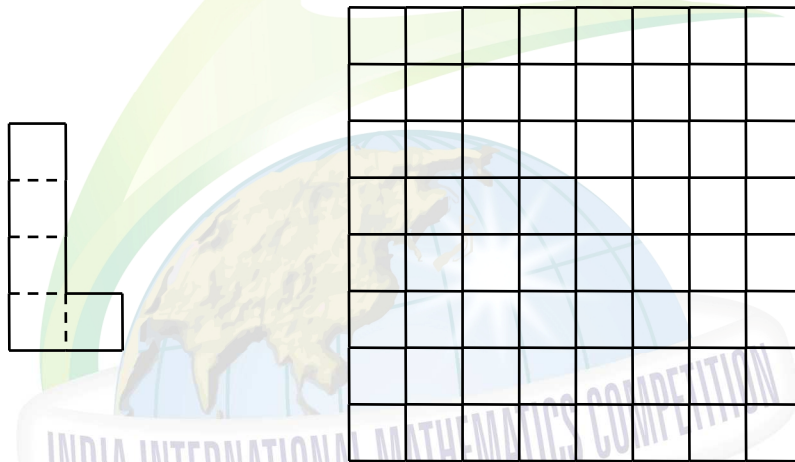
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10. How many ways are there of placing a single L-pentomino on the 8×8 chessboard so that it completely covers some five small squares of the chessboard?



Answer: _____ ways