Cheenta

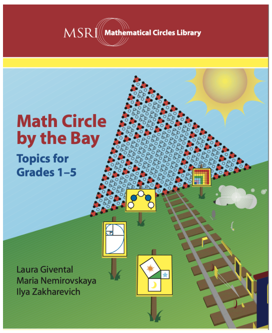
Outstanding Mathematical Science for Olympiads, ISI-CMI Entance

Since 2010, cheenta.com has trained thousands of students for math, physics and computer science olympiad, ISI BStat, BMath Entrance and CMI Entrances.

Cheenta students have reached premier universities such as Harvard, Oxford, MIT outside India and Indian Statistical Institute, Chennai Mathematical Institute, TIFR and IITs inside India for a research career in mathematical sciences.

Featured book

Math Circle by the Bay: Topics for Grades 1-5



It is difficult to find great books for elementary school kids. This title by Givental et. al. is one happy exception. It was born out Math Circle activities in the Berkeley region of California. The selection of problems and activities is outstanding.

All Cheenta programs are available online.

Math Olympiad	ISI-CMI Entrance Program
Physics Olympiad	Research for School
Computer Science	Study abroad Program
	`support@cheenta.com`

22 Lake Place Road, Kolkata 700029
West Bengal, India
`https://www.cheenta.com/`

Academeic programs for students with an exceptional interest in maths, physics and computer science.

Are you planning for a higher education in mathematical science? Then you may need a specific plan to reach the highest seats of knowledge in India and abroad. Olympiads play a very important role in this journey. Usually the best universities hold math olympiad success in highest esteem. Research projects play an important role too. Both of these tools are great for falling in love with the subject.

- ❑ For classes 1 to 5 we recommend three contests. Australian Math Competition, Math Kangaroo and MOEMS. The last one is for students in the United States.
  Be careful about other *fake* olympiads which may promote rote learning and have a negative impact on the child's mind.
- ❑ For classes 6 to 8 we recommend the following contests.
  1. American Math Competition 8
  2. University of Waterloo Contests
  3. NMTC Contests
  4. MathCounts (if you are in US)
- ❑ For classes 9 to 12 we recommend AMC 10, 12 and IOQM (the first level of Math Olympiad in India). University of Waterloo Contests, Singapore Math Contests and UKMT are also great.

Preparation for mathematical olympiads require careful planning. In this newsletter we discuss some of the useful tools for this. We recommend books and learning strategies that students and parents can use.

Books for Olympiads

While preparing for mathematical olympiads, there are many great books to choose from. The key is to select a few good titles and work on them cover to cover.

For classes 1 to 5

- ❑ Math Circle by the Bay: Topics for Grades 1-5 by Ilya Zakharevich, Laura Givental, and Maria Nemirovskaya
- ❑ Math from Three to Seven: The Story of a Mathematical Circle for Preschoolers by Alexander K. Zvonkin
- ❑ Mathematics can be fun by Yakov Perelman
- ❑ Math Circles for Elementary School Students by Natasha Rozhkovskaya

For classes 6 to 8

- ❑ Mathematical Circles: (Russian Experience) by Dmitrii Vladimirovich Fomin, Ilia Itenberg, and Sergei Aleksandrovich Genkin
- ❑ Algebra by Alexander Shen and Israel Gelfand
- ❑ Kiselev's Geometry: Planimetry by Alexander Givental

For classes 9 to 12

- ❑ Challenge and Thrill of Pre-College Mathematics by C. R. Pranesachar and V Krishnamurthy
- ❑ An Excursion In Mathematics. by M. R. Modak
- ❑ Trigonometry by Israel Gelfand and Mark Saul
- ❑ Complex Numbers from A to ...Z by Dorin Andrica and Titu Andreescu
- ❑ Euclidean Geometry in Mathematical Olympiads by Evan Chen
- ❑ Principles and Techniques in Combinatorics by Chuan Chong Chen and KOH KHEE MENG
- ❑ Secrets in Inequalities by Pham Kim Hung
- ❑ Functional Equations by Venkatachala
- ❑ Test of Mathematics at the 10+2 Level by East West Press (useful for ISI-CMI Entrances.
- ❑ Polynomials by Edward Barbeau

Success Stories

Since 2010 hundreds of Cheenta students have been successful in national and international math olympiads, ISI-CMI Entrances. Many of them went on to study in premier universities in India and abroad. Here are some of the success stories from 2022-23.

Indian National Math Olympiad 2023 and IOQM 2022

IOQM is the first level of (real) Math Olympiads in India. Students in class 8 and higher are eligible to participate in this contest. Among lakhs of students who take part in this, only 628 students qualified for the next level. Among them 7 were from Cheenta.

They were Parth Vartak, Agastya Bhagwat, Aharshi Roy, Mann Shah, Abhinav Khetan, Sarvam Vora and Piyush Jha

The next level of Math Olympiad in India is known as INMO. It is the national level math olympiad attended by students who have qualified in IOQM. 4 Cheenta students qualified in INMO and were selected for IMOTC in 2023. This is out of 7 students from Cheenta who appeared for contest. They were among the top 70 rank holders in the entire country

1. Parth Vartak
2. Abhinav Khetan
3. Piyush Jha
4. Mann Shah

Indian Statistical Institute and Chennai Mathematical Institute Entrance 2022

The BStat-BMath Entrance of Indian Statistical Institute and BSc. Math Entrance of Chennai Mathematical Institute are among the most challenging high school contests in the country. About 200 students from all over India qualify for them. In 2022, eight of them were from Cheenta.

Vemparala Bhuvan	Mayur N Sastry	Dwitimaya Sahoo
Ryan Hota	John Tom	Shravani Parulekar
Avishek Hazra	Divyanshu Gupta	

American Math Competition 2022-23 (10 and 12)

American Math Competition (AMC 10 and AMC 12) are among the first levels of Math Olympiads in the United States. However students from India and other countries are allowed to participate in it. In 2022-23 eleven students from Cheenta succeeded in this international math olympiad.

Aratrik Pal	Aharshi Roy	Neer Mehta
Mann Shah	Parth Vartak	Nathan Jais
Soumabha Roy	Nidhi Lohana	Souradip Das
Anika Chopra	Aarush Kalia	

Several Cheenta students have been successful in the last year in easier contests such as AMC 8, Math Kangaroo, Singapore Math Contest, SASMO, ZIO, ZCO. Due to lack of space we omit their names from this newsletter. A big congratulations to all successful children.

Dennis Sullivan won the Abel prize in 2022.
His favorite equation is $\partial\partial = 0$ or in other words, boundary of a boundary is nothing.

Coordinate geometry versus pure geometry

Coordinate geometry is a powerful tool to solve geometry problems. However sometimes, using pure geometry, we can learn more about the inner workings of a problem that is hidden by coordinate bashing. Here is an example.

Problem:

A triangle ABC has a fixed base BC. If $AB : AC = 1 : 2$, then the locus of the vertex A is

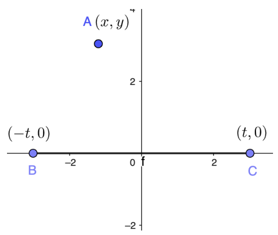
1. a circle whose centre is the midpoint of BC;
2. a circle whose centre is on the line BC but not the midpoint of BC;
3. a straight line;
4. none of the above.

This problem is from ISI BStat Entrance 2008 (Objective Problem 15). We solve this problem using two ways. First we do some simple coordinate bashing. This readily reveals the answer. However next we use pure geometry techniques to learn more about the problem.

Coordinate Bashing

Suppose coordinate of $B = (-t, 0)$ and $C = (t, 0)$ where t is a constant number. That is without loss of generality we assume the origin of the coordinate plane is at the midpoint of BC. Since A is a moving point, we assume its coordinates to be (x, y). Since it is given that $\frac{AB}{AC} = \frac{1}{2}$ therefore we compute using distance formula.

$$AB = \sqrt{(x+t)^2 + y^2}$$
$$AC = \sqrt{(x-t)^2 + y^2}$$



By the given condition we have

$$2 \times \sqrt{(x+t)^2 + y^2} = \sqrt{(x-t)^2 + y^2}$$

By squaring both sides and simplying we get

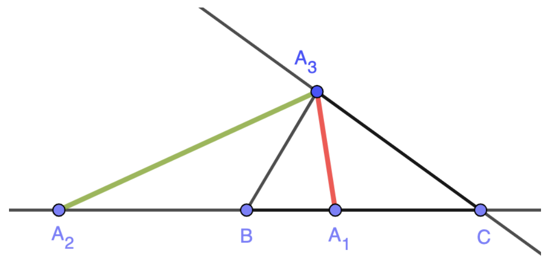
$$(x + \frac{5t}{3})^2 + y^2 = \frac{16t^2}{9}$$

This is an equation of a circle whose center is on the line BC but not at the center of BC. Hence we are done.

Pure Geometry

The same problem can be done using pure geometry. First choose the position of A between B and C. There is exactly one such point which divides the segment BC in $1 : 2$ ratio. Call that point A_1. Let $BA_1 = x$. Then $A_1C = 2x$. Similarly there is a point A_2 on extended segment BC such that $\frac{A_2B}{A_2C} = \frac{1}{2}$. Then $A_2B = 3x$.

Now suppose A_3 is any other position of A that is not on the line BC. Join A_3A_1, A_3A_2, A_3B, A_3C.



Now notice that by definition of the point A we have

$$\frac{A_3B}{A_3C} = \frac{A_1B}{A_1C} = \frac{1}{2}$$

By angle bisector theorem, this implies that A_3A_1 is the internal angle bisector of $\angle BA_3C$. Similarly A_3A_2 is the external angle bisector of $\angle BA_3C$. Hence $\angle A_3A_2A_1 = 90°$ implying the point A_3 is on a circle with diameter A_2A_1.

Cheenta Math Circle : Collaborations with rural schools

Beniagram is a remote village in Murshidabad district of West Bengal. On 4th March, 2023, Cheenta Team drove about 250 kilometers from Calcutta to attend a school inauguration there. The experience was interesting.

A few young men, Safiqul being one of them, have built a residential English medium school for the masses in a village near Farakka. They have kept the tuition fee much lower than other similar schools in the area.

They want to collaborate with Cheenta for capacity building in mathematical sciences. This may include Math Circles, teacher training, student-talent identification, math, computer science and physics olympiad programs and mathematical science labs in future. Our dream is to energise the rural education ecosystem by brining in knowhow from the outside world.

Cheenta team has several members from rural and semi-urban areas. One of the most important faculty member Raghunath, hails from Namakkal in Tamil Nadu. Another faculty Tanmoy is from Purushottompur village in Medinipur district of West Bengal. Somnath, one of our admins, is from Mathurapur village in South 24 Parganas.

Cheenta Math Circle program has been active for over 3 years now. Several students in our program are actively collaborating in rural schools from Sundarbans and Purulia district to implement math circles in the style of eartern Europe.

India has one of the youngest work forces in the world. What if we harness that potential at the rural level and promote innovation? We think this may untap one of the greatest reserves of human creativity that mankind has seen so far.

Sharygin Geometry Olympiad

In 2022, Cheenta hosted the final round of Sharygin Geometrical Olympiad in Kolkata center for Indian participants. This was in collaboration with the Organizing committee from MOSCOW CENTER FOR LIFELONG MATHEMATICAL EDUCATION.

Sharygin Geometrical Olympiad is an international competition on geometry. High-school students of four elder grades (8-11 grades in Russia) are eligible to participate. There are two rounds: qualification round per correspondence and a final round.

The contest was held as an oral exam. That is, the participants make their drafts and figures but don't deliver a complete paper, and they deliver their solutions in oral form to the Jury using their drafts and figures.

The only possible marks are 1 (solved) or 0 (unsolved).

Each participant has three attempts to deliver the solution of a given problem (of course, if he has got 1 then he stops to deliver this problem).

Here are Day 1 problems. The Day 2 problems will be published in the next newsletter.

Day 1 - Grade 8

- Let $ABCD$ be a convex quadrilateral with $\angle BAD = 2\angle BCD$ and $AB = AD$. Let P be a point such that $ABCP$ is a parallelogram. Prove that $CP = DP$.
- Let $ABCD$ be a right-angled trapezoid and M be the midpoint of its greater lateral side CD. Circumcircles ω_1 and ω_2 of triangles BCM and AMD meet for the second time at point E. Let ED meet ω_1 at point F, and FB meet AD at point G. Prove that GM bisects angle BGD.
- A circle ω and a point P not lying on it are given. Let ABC be an arbitrary regular triangle inscribed into ω and A', B', C' be the projections of P to BC, CA, AB. Find the locus of centroids of triangles $A'B'C'$.
- Let $ABCD$ be a cyclic quadrilateral, O be its circumcenter, P be a common points of its diagonals, and M, N be the midpoints of AB and CD respectively. The circle OPM meets for the second time segments AP and BP at points A_1 and B_1 respectively, and the circle OPN meets for the second time segments CP and DP at points C_1 and D_1 respectively. Prove that the areas of quadrilaterals AA_1B_1B and CC_1D_1D are equal.

Day 1 - Grade 9

- Let BH be an altitude of right-angled triangle $ABC\,(\angle B = 90°)$. An excircle of triangle ABH opposite to B touches AB at point A_1; a point C_1 is defined similarly. Prove that $AC \| A_1C_1$.
- Let circles s_1 and s_2 meet at points A and B. Consider all lines passing through A and meeting the circles for the second time at points P_1 and P_2 respectively. Construct by a compass and a ruler a line such that $P_1A \cdot AP_2$ is maximal.
- A medial line parallel to the side AC of a triangle ABC meets its circumcircle at points X and Y. Let I be the incenter of triangle ABC and D be the midpoint of the arc AC not containing B. A point L lie on segment DI in such a way that $DL = BI/2$. Prove that $\angle IXL = \angle IYL$.
- Let ABC be an isosceles triangle with $AB == AC$, P be the midpoint of the minor $arcAB$ of its circumcircle, and Q be the midpoint of AC. A circumcircle of triangle APQ centered at O meets AB for the second time at point K. Prove that lines PO and KQ meet on the bisector of angle ABC.

Day 1 - Grade 10

- Let $A_1A_2A_3A_4$ and $B_1B_2B_3B_4$ be two squares oriented clockwisely. The perpendicular bisectors to segments $A_1B_1, A_2B_2, A_3B_3, A_4B_4$ meet the perpendicular bisectors to segments A_2B_2, A_3B_3, A_4B_4, A_1B_1 at points P, Q, R, S respectively. Prove that $PR \perp QS$.
- Let $ABCD$ be a convex quadrilateral. The common external tangents to circles ABC and ACD meet at point E, the common external tangents to circles ABD and BCD meet at point F. Let F lie on AC, prove that E lies on BD.
- A line meets a segment AB at point C. What is the maximal number of points X of this line such that one of angles AXC and BXC is equal to a half of the second one?
- Let $ABCD$ be a convex quadrilateral with $\angle B = \angle D$. Prove that the midpoint of BD lies on the common internal tangent to the incircles of triangles ABC and ACD.

Admission open at Cheenta

Cheenta
passion for mathematics

Admission is open for the Cheenta Math Olympiad Program, Physics Olympiad Program and Informatics Olympiad Program. We are also accepting students aspiring for ISI-CMI Entrances and research projects. We do not offer direct admission to students. Visit www.cheenta.com to apply for a trial and selection class to get started.