



## A message from the Executive Director, Tom Young

The regular season is over for the 41<sup>st</sup> time. Did Wayne Roberts, our founder, ever envision that the League would last this long? It has, because of your dedication!

Go Math Team!

For those teams that didn't make it to the state tournament, congratulations on another Math League season. Take time to review the problems from this year; start recruiting for next!

Go Math Team!

### **The Invitational Event will be held on Monday, March 8th, from 4:00 to 5:30.**

The Invitational Event includes the top 50 students in the state, individual division winners, and other top state students. Students and their coaches have been notified. *Students and coaches that qualified should reserve that time now.*

The State Tournament itself will be held in the morning on **Monday, March 15th.**

## **See times listed later in the newsletter.**

We do plan to hold the Math Bowl online on **Monday, March 15th.**

Go Math Team!

- Enter a video to the Video Contest by March 1<sup>st</sup>. There's money to be made for the school of an aspiring director! See details later in the newsletter.
- Check out the fourth entry in our continuing series highlighting previous Math Leaguers. **If you know of former students that would like to share their experiences, pass their names along.**
- *And don't forget to tell your students about the opportunity to participate in the ZIML Online Competition for free for the rest of the school year!*

Go Math Team!

*Take the survey regarding student fees and the possible need for a scholarship fund to help students who otherwise wouldn't participate in Math League. This is information needed to explore starting such a scholarship funded by the computer software company, Jamf. Details later in the newsletter.*

Go Math Team!

Good Luck to the State Tournament teams and individuals!!

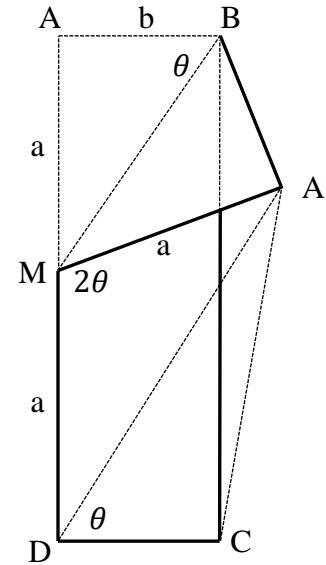
**PS: Reserve the dates for SMI (June 28 – July 2) and for the Coaches Conference (August 19 – 20). More details later in the newsletter**

## A message from Tom Kilkelly, Head of the Problem Writing Team

Congratulations to all students who competed this year! I am honored that you challenged yourself with tough extra-curricular mathematics. You probably made mistakes or didn't know the mathematics behind some problems, but remember, *every misstep is an opportunity to learn!*

To get better at solving problems, it is good practice to re-examine old problems and try to extend them or solve them in another way. For instance, let's take a deeper look at problem 2 from the Team event from Meet 5. Can you follow the steps of the solution?

Take a rectangular piece of paper ABCD with  $AB = b$ ,  $BC = 2a$ , and M the midpoint of AD. As in the figure, make a fold along MB, reflecting point A to A'. Determine the area of  $\triangle DA'C$ .



Notice the differences in this problem from the original!!

Solution:  $MB = \sqrt{a^2 + b^2}$

Let  $\angle CDA' = \theta$

Since  $MD = MA'$ ,  $\angle MDA' = \angle MA'D = 90 - \theta$

Therefore  $\angle DMA' = 2\theta$  (Why?) and  $\angle AMA' = 180 - 2\theta$

But, since  $\triangle MA'B \cong \triangle MAB$ ,  $\angle BMA = 90 - \theta$ , and so  $\angle ABM = \theta$

$$\sin \theta = \frac{a}{\sqrt{a^2 + b^2}}$$

Construct altitude  $\overline{MN}$

$$\triangle MDN \sim \triangle BMA$$

Therefore  $\frac{DN}{MA} = \frac{DM}{MB}$

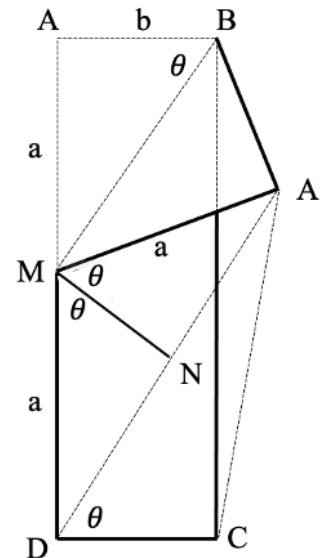
So  $\frac{DN}{a} = \frac{a}{\sqrt{a^2 + b^2}}$

$$DN = \frac{a^2}{\sqrt{a^2 + b^2}} \quad \text{and then } DA' = \frac{2a^2}{\sqrt{a^2 + b^2}}$$

$$\text{Area of } \triangle DA'C = \frac{1}{2} DC \cdot DA' \sin \theta$$

$$= \frac{1}{2} b \cdot \frac{2a^2}{\sqrt{a^2 + b^2}} \frac{a}{\sqrt{a^2 + b^2}} =$$

$$\boxed{\frac{ba^3}{a^2 + b^2}}$$



# Survey for Possible Scholarship Program

As an offshoot of preliminary talks with the computer software company Jamf, we are exploring the idea of setting up a scholarship fund for underserved students. We need more information to share with Jamf to make a better decision as to the need for such a scholarship. Please take the time and fill out the following survey.



## Survey for scholarship



## 2020 – 2021 State Tournament Schedule

**All events** will be held online via Zoom. Calculators on Team Event only. All answers are integers.

### **Invitational Event: Monday, March 8, 2021**

- 4:00 pm Zoom meeting begins, welcome, instructions
- 4:05 pm Students take Invitational in Online Scoring System. Students stay on Zoom
- 4:40 pm Invitational ends
- 4:40-4:50 Invitational graded, solutions released
- 5:00-5:30 Challenge window (separate Zoom link to enter challenge meeting will be provided)
- 5:30 pm Math Bowl qualifiers announced

### **Tournament and Math Bowl: Monday, March 15, 2021**

- 9:00 am Zoom event begins, welcome, introductions, season awards
- 9:15 am Math Bowl begins
- 10:00 am First individual event. Second individual event begins when first event is completed.
- 10:40 am Individual Events Solutions released
- 11:00-11:30 Team Event
- 11:35 am Team Event Solutions released
- 11:45-12:15 Tournament challenge window (Separate Zoom link to enter challenge meeting will be provided to coaches)
- 12:15 pm Tournament Awards

# Summer Coaches Conference 2021

**Date: Probably August 19 - 20**

Last summer, we had to postpone our 40-year celebration due to the pandemic. Hopefully we will be able to hold a celebration this August honoring our new Hall of Famers and toasting to another 40 years!



## 2021 Summer Math Institute June 28<sup>th</sup> through July 2<sup>nd</sup> at Augsburg University

The League will offer two one-week programs of the Summer Mathematics Institute in 2021. It will either be online day camp or an in-person day camp. Augsburg's dorms will be shut down for the summer. But either way, there will be a Math League Math Camp!!

One will be for students entering grades 7-9 in fall of 2021. **The topic would be Knots! and taught by Annie Perkins.**

The other will be for students entering grades 10-12 in fall of 2021. **The topic would be Probability Theory in Math League and the AMC and taught by Ken Suman.**

Stay tuned for sign-up information

## The Roberts Award Scholarship

The Roberts Award Scholarship(s) were established in honor of the League founder, Dr. Wayne Roberts of Macalester College.

The Scholarship(s) are offered to help offset the costs for students interested in attending an out-of-state math opportunity. They are offered once each year. A set amount of funds will be available each year, and multiple awards are possible.

**Deadline to apply for this season is April 30, 2021**

Applications can be found on our web site at: [http://mnmathleague.org/?page\\_id=1033](http://mnmathleague.org/?page_id=1033)

# The Impact of Math Team

The call went out last summer to Math League alumni to Share Your Story. Here is one alumna who shared:

## Yvonne Zhou

1987 Graduate of Breck HS

**Undergraduate:** BA, Computer Science/ Mathematics, Macalester 1991

**Graduate Degree:** MS, Computer Science, University of MN 1993

**Currently works as :** Lead Engineer at Salesforce



### The impact of Math Team on my life and learning:

It's been a long time since I was in the math league. For four years at Macalester College, I assisted Professor Wayne Roberts with the math league. It was the best job a college student could have hoped for. After graduating college with a mathematics and computer science degree, I got interested in working with data and databases. Data storage and indexing methods became my career.

Moving to San Francisco opened my eyes. There are so many entrepreneurs and so many startups! After joining my first startup, I was hooked. In a small company, you can learn so much, you get to do everything, and you really feel your contribution to the company. You can see the difference you make. I am fortunate to have worked with many successful startups which were acquired by larger companies or have gone public. This is how I came to Salesforce. The startup I worked for was acquired in 2016.

For the past eight years, I have been a data architect and a lead engineer at Salesforce in San Francisco, working with a team of software engineers responsible for building the back-end data processing and analytics infrastructure through which vast amounts of data flow in support of critical business customer operations. We built it using Kafka, Kubernetes, Spark, AWS EMR, AWS data pipeline, DynamoDB, RDS, and Redshift. We have also designed and developed real-time streaming products that continuously analyze tens of thousands of events per second, covering the activity of over three billion internet clients.

While this all sounds very technical, the service we provide is to help our customers to make sense of their data. The result of our analysis will help our customers to make better decisions and improve their business strategies. We also work with data scientists who use their mathematical background to implement their machine learning algorithms, so our software can learn to increase its predictive accuracy over time.

As I am writing this, and looking back to math league and college days, I truly believe mathematics has brought me to where I am now as a computer scientist. Discrete mathematics, such as graph theory, number theory, logic notation and more, is the foundation of computer science. Mathematics provides me the analytical skills I need every day to solve customer problems and data analysis. A strong background in mathematics is crucial to building and improving machine learning algorithms.

A simple love for math has helped me to build a successful career.

# Congratulations to these retirees!!

## Jeanne Bruns



I have so enjoyed my years of teaching and coaching, thanks to the scores of wonderful students and colleagues throughout the years.

I am a graduate of UMD (BAS) and SCSU (MA in Math).

I've had 33+ years of teaching in three districts: ISD 710 (St. Louis Co - Cotton High School), Atwater-Cosmos-Grove City, and 26 years at Albany High School.

I taught 7th grade at Albany for 19 years, followed by 7 years at the high school level. I coached a middle school math team for many, many years (both MJHML and MATHCOUNTS) and both middle school/high school math team for 3 years, followed by 1 year of just SH math team.

## Mary Rueter



I began my career teaching math in the fall of 1988. I coached the math team at Cathedral high school in 2006 – 2013. I coached the math team at Saint John's Preparatory School in 2015 – 2021. I took a break of a couple years as a transitioned to a new school and the IB curriculum. My teams have been to the state tournament 10 times.

# Free Texts from the Summer Math Institute!!

Dr. Ken Suman, a retired mathematics professor at Winona State University, has been our lead teacher in the 10<sup>th</sup> – 12<sup>th</sup> grade SMI for the past two years. In 2018, students at SMI studied Counting Techniques and in 2019, they studied the Theory of Equations.

Dr. Suman wrote texts for the classes, specifically with Math League in mind. These texts are a goldmine of information. Dr. Suman has willingly shared his expertise and suggested that the texts be available to all Math Leaguers.

To that end, the pdfs of the texts can be found at [scoringmnmathleague.org](http://scoringmnmathleague.org) under the Coaches Corner tab. Then click on Topic Resources and you'll see the links.



**Great Opportunity!!  
ZIML Competition News**

**Minnesota Math League students can participate in the ZIML Competitions for free for the rest of the school year!! Here are the instructions:**

To enroll in the contests, students will need to create a free account on the site [ziml.areteem.org](https://ziml.areteem.org), if they don't have one already. Once they are logged in, they can go to the "Monthly Contests" page (<https://ziml.areteem.org/ziml/monthlycontests.php>) and choose which division they want to register for.

Once in the division page they will be asked for a payment method OR an enrollment key; they can use enrollment code MNMLSp2021 in the box below that says "Enroll using an enrollment key", so no payment information is necessary. If a student wishes to participate in more than one division, they need to repeat these steps for each division.

Then, on the weekend of the contest, they need to go back to the contest page and the contest quiz will be available. Students can participate any time during the weekend (Friday at 00:01 to Sunday 23:59), but once they start the quiz the timer will give them one hour to finish.

The code we provided you is valid for all remaining monthly competitions for the current school year. They will need to follow the above steps each time to register.

In addition to the monthly competitions, students can find daily problems of various levels (the Daily Magic Spells), as well as all past AMC 8, 10, 12, and AIME tests for practice.

## **Zoom International Math League**





# MN State High School Math League Math Team Video Contest

1<sup>st</sup> place: \$200 to school's math team

2<sup>nd</sup> place: \$150 to school's math team

3<sup>rd</sup> place: \$100 to school's math team

## Video Guidelines:

**Produce a 90 second video explaining why you like to be involved in the Math League. Videos might include: student interviews, teacher endorsements, sample problems, or video of practices/meets.**

## Video Entry Submission:

**Videos are due to the Math League Office  
([mathleague@augsborg.edu](mailto:mathleague@augsborg.edu))  
by *March 1<sup>st</sup>, 2021.***

- **Videos contest entries must be sent and approved by the school math team coach.**
- **Winning schools will be notified by March 6, 2021.**
- **Winning videos will be shown at the State Tournament on March 15, 2021, uploaded to the Math League Facebook page, and may be used for other promotional purposes.**

Questions? Email [mathleague@augsborg.edu](mailto:mathleague@augsborg.edu)



# Common Meet Protocols

Coaches must verify each student's score, and mark team done with each event.

Coaches can give credit if:

- the student includes units in the answer. (e.g. 6 degrees when the answer should be 6)
- there is an issue like adding a space to the answer (SPACE 6 instead of 6).
- the student writes something akin to  $x = 6$ .

All other discrepancies should be challenged. For instance, coaches should **not** give credit to mistyped answers even if the students have the correct answer on their scratch work. Challenges regarding incorrectly typed answers were denied unless there were issues with the computer system not working.

**Students should be reminded that all answers are integers.**

Also, the students should be told how the computer system registers their answers. The textbox for submitting the answer is blank when the event starts. When students enter an answer, the textbox turns yellow. (NOTE: this is a change in the color) When they click away from that textbox, it will turn white and the answer should stay displayed. This indicates that the system has registered their answer. When students finish the event, only then should they hit submit. If they hit submit before they are done, they are locked out. When the 15-minute time limit expires, answers are automatically submitted. Students do not have to hit submit if they are timed out. Students that ask to enter an answer after the time limit expires, claiming that they didn't get a chance to enter their answer, should not be allowed to challenge that.

**Students should be reminded that calculators are not allowed on individual events.**

When auditing student responses, we noted instances of answers like  $3.6 \text{ E}-15$ . That is worrisome. One coach remarked that we are actually only “wink, wink” enforcing that rule. That is **not** our position. We see this as an opportunity to show students that ethical behavior is valued. It is up to each coach to monitor their students and help them see the value in maintaining the integrity of the process.

**Even if coaches verify results, mistakes will be made.**

We are able to see all the answers submitted for a particular problem. Coaches missed correct answers and didn't give the student credit and, on the flip side, gave credit when it shouldn't have been given. We sent emails to those coaches noting the discrepancies. We will do this for each meet to make the scores are as accurate as possible.

**Certain online calculators are allowed on the team event.**

Some students argued that since they are in distance learning mode, they cannot access their school's calculators and therefore should be allowed to access online calculators. We feel that students can use the calculators at <http://minnesota.pearsonaccessnext.com/stand-alone-calculators/> during the team event.

**Zoom-like tools are allowed on the team event.**

Teams can use the share screen, or other Zoom-like tools when they are working as a team. However, if the meeting platform contains a calculator, it cannot be accessed.

## Problem Corner

an effort to spur conversation

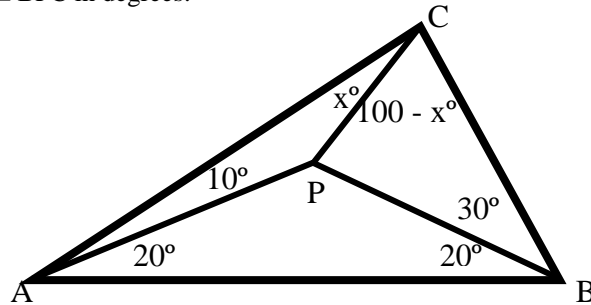
If you'd like to contribute a problem or send in a solution, email [tomyoungmathman@gmail.com](mailto:tomyoungmathman@gmail.com)

Student solutions encouraged!

## Newsletter 23 Puzzler:

from ZIML Math Competition Book Varsity Division 2018 – 2019 January 2019 problem 6

In  $\triangle ABC$ ,  $\angle BAC = 30^\circ$ ,  $\angle ABC = 50^\circ$ . Let Point P be in  $\triangle ABC$ , such that  $\angle BAP = \angle ABP = 20^\circ$  as shown in the diagram. Find the measure of  $\angle BPC$  in degrees.



**Solution** from ZIML Math Competition Book Varsity Division 2018 – 2019 January 2019 problem 6

$\angle ACB = 100^\circ$ ,  $\angle CAP = 10^\circ$ , and  $\angle CBP = 30^\circ$

Let  $x$  = the measure of  $\angle ACP$ . Then  $100 - x$  = the measure of  $\angle BCP$

Using the trigonometric form of the Ceva's Theorem:

$$\frac{\sin 20}{\sin 10} \cdot \frac{\sin x}{\sin(100-x)} \cdot \frac{\sin 30}{\sin 20} = 1$$

Simplifying gives  $\sin x = 2 \sin 10 \sin (100 - x)$

Applying the Product to Sum Formula on the right-hand side

$$\sin x = \cos(90 - x) - \cos(110 - x) = \sin x - \cos(110 - x)$$

Therefore  $\cos(110 - x) = 0$  which means  $110 - x = 90$  so  $x = 20$

Therefore  $\angle PCB = 80^\circ$  and  $\angle BPC = 70^\circ$

## NEW PUZZLER FOR NEWSLETTER #24

Define the extouch midpoint of a triangle as such: Beginning at a vertex, travel halfway around the triangle. The point reached is an extouch midpoint. There are 3 such extouch midpoints in a triangle.

Problem 1: Prove the 3 extouch midpoints lie on the 3 sides of the triangle, one per side.

Problem 2: Given an isosceles triangle with legs of length  $a$  and base of length  $b$ , find the formula (in terms of  $a$  and  $b$ ) for the base of the isosceles triangle formed by joining the extouch midpoints of the original triangle.