Minnesota State High School Math League Newsletter

Issue #2 December 5, 2017

A message from the Executive Director, Tom Young

Good day to you. I hope the holiday season is going well for you. The year 2017 is closing fast; before you know it, 2018 will be here. Our League regular season is 2/5 done with the 3^{rd} meet coming in two weeks. Whew!

Regarding meet two: It was hard. The scores across the state reflected that. We try to walk a delicate line of making the problems accessible yet challenging. We will work harder to make the 1^{st} and 2^{nd} problems more accessible.

As a coach, I always got discouraged by hard meets. It meant we needed to work harder. But I always wondered how we could find the time to work more! Students are pulled in so many directions – how do you carve out more time? One possible answer? See the Video Initiative later in the newsletter.

At least we didn't have a repeat of Meet One and have a wrong answer. There were fewer challenges this time, as you can see from Tom Kilkelly's wrap-up on the next page. Remember, if you challenge, alert all the schools in your division.

Just a reminder about meet 3, Event B. Knowledge of circumscribed circles is important. And, on meet 3, event C, knowing how to graph complex numbers and complex numbers in polar form will be beneficial. The YouTube videos at https://www.youtube.com/watch?v=EQviquyrDxA and https://www.youtube.com/watch?v=gyAOa2sNR8Y (especially the last two minutes) might be helpful.

Good luck to all on meet 3!

Meet Two photos from Central Gopher Division

Students gathering in Cafeteria

Coaches getting last minute instructions and enjoying freshly baked Rice Krispie bars courtesy of the fine cooks at St. Cloud Cathedral!

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

A Note From the Problem Writing Team

There were only 31 challenges at Meet 2, 15 were accepted and 16 denied.

Almost half of them (14) were on Problem C1. Five challenges were accepted because the students did not use a degree symbol with the answer. (It has always been the policy of the league that answers should not be marked wrong if a student forgets to write down units of an answer.) It should be noted that statements like; "For $0^\circ \le \theta < 360^\circ$" and "For $0 \le x < \pi$" serve two purposes in trigonometry problems. They define the units of angular measurement and the a range of acceptable values. Nine of the challenges were denied because the answers were in radian measure while the problem called for degree measure.
I know that in Meet 3 there are three trigonometry problems where the units are given (degrees or radians) and a range of possible values is stated. Take note that using the wrong units or having answers outside the stated range should (will) be marked wrong.

There were 9 challenges of answers to Problem A3. Seven were accepted as variations of $r+s+\frac{rs}{100}$ but one caught our eye as especially unique: $r+s+.\,r\cdot.\,s$. Although we understood the intent, the challenge was denied due to improper mathematical notation.

In Problem D3, the answer was $-\frac{\sqrt{2}}{2}$ but because the expression "determine exactly" was used, the challenge for the answer $-\sqrt{0.5}$ was denied.

In Meet 1, given our omission of "with integer sides" in Problem B4, I hope that you didn't miss the formulas for Pythagorean Triples given in the solution: "The sides of any Pythagorean triangle are $2mn,\ m^2-n^2,\ \text{and}\ m^2+n^2$". They produce ALL the primitive (no common factors) Pythagorean Triples if *m* and *n* are relatively prime and of opposite parity (one even, one odd).

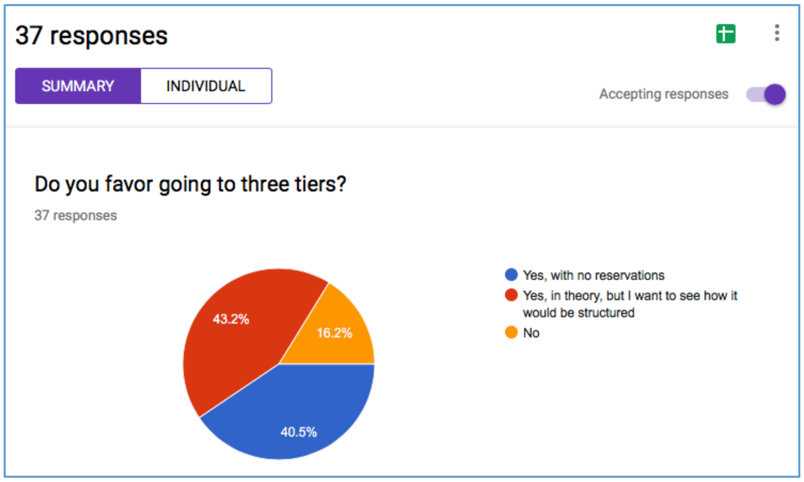
Meet 3 is coming soon! A reminder that in Event C students should be made aware of the change in wording in the event topics:

Complex Numbers in the Complex Plane

$(a,b)=a+bi$ and $(r,\theta)=r(\cos\theta+i\sin\theta)=r\text{cis}\theta$

Moving to Three Tiers?

Thanks to all who filled out the surveys about moving to three tiers. Here's a snapshot of the responses:



It appears there is support for going to 3 tiers, but more explanation as to how we might proceed is in order.

This past summer, a committee met and discussed different possibilities for a 3-tier structure. Here was their proposal:

> **Schools still compete during the regular season in their current divisions. The current divisions are deeply rooted with friendships and expectations of how a meet is to be run. The committee does not want to change that history. Individual honors in the division would remain the same. Individual invitations to state would remain the same. However, the teams in each division would be assigned a virtual section, based on size and previous performance, for the purpose of deciding what teams advance to the state tournament. The division winner would not automatically advance to state.   The committee felt this makes a more equitable (invitation to) state structure, since there are divisions where, due to proximity, smaller schools are competing against larger schools.**
>
> **Specifically, schools in the league would be split into thirds, first by size then adjusted based on previous year's success. Adjustments would be made every two years using the previous two year averages. Tier 2 and 3 teams who average in the top 15 in the previous two years would compete in Tier 1, regardless of their school's size. Tier 3 teams who average in the top 50 in the previous two years would compete in Tier 2. Teams that have previously been bumped up will be dropped down, if the 2-year review dictates it. Any school will have the option to "play up" to a higher Tier.**
>
> **We envision each Tier being divided into 8 evenly distributed sections from different geographic regions across the state. The highest scoring team from each section would be invited to the state tournament with an additional 2 wild card teams (highest scoring teams in the Tier that didn't win a section). Therefore, there would be 10 teams from each Tier receiving automatic bids with the rest of the field to be filled out by choosing the next 6 to 10 highest scoring teams from across the state regardless of tier. The Hibbing Rule would be gone. The number of wild cards in each Tier, or those needed to fill out the state field, could change depending on the prearranged limit (currently 38) as to the total number of teams invited to the state tournament.**

Please talk about this idea at meet 3. Specific ideas for the virtual sections will be detailed in the next newsletter.   Please fill out another survey regarding this idea, which can be found at:

> https://goo.gl/forms/3jlHfvFNqFmyEMqD2

Video Initiative

Wouldn't it be nice if each topic for Math League had a video associated with it? Each video could explain the topic and show solutions to previous League problems associated with that topic. Executive Director Tom Young has asked past League participants to help in this endeavor. Watch this Newsletter for progress along those lines.

Video Contest!

There's money to be made! Calling all schools to produce a 90 second video explaining why you like to be involved in the Math League. Student interviews, teacher endorsements, sample problems, or video of practices/meets are all possible components of such a video. Videos are due to the League Office (mathleague@augsburg.edu) by February 15th, 2018. Videos must be sent by, and approved by, the school math team coach. A committee will decide the winners and the winning videos will be shown at the State Tournament.

First prize: $200 to the math team at winning school
Second Prize: $150 to the math team at 2nd place school
Third Prize: $100 to the math team at 3rd place school

Embrace your inner Steven Spielberg!

Math League now offering AMC 10 and 12 Competitions!

The MN State HS Math League will be offering the AMC 10 and AMC 12 (both versions A and B) to students whose school does not offer the test. The AMC 10/12 A is Wednesday, February 7th and the AMC 10/12 B is Thursday, February 15th. Tests will be $5.00 per person. Tests will be given at Augsburg University, time TBD. Look for a registration form, coming soon, on the League website. On each date, the number of students is limited to 30 for the AMC10 and also 30 for the AMC 12. For more information about the AMC tests, see https://www.maa.org/math-competitions/amc-1012

State Meet T – shirt Design Contest returning!

Each year, the league provides t-shirts for sale to the tournament participants. Do you want to design the t-shirt for the 2018 State Tournament? If so, the one-color design should include these words: "MN State High School Math League", "State Tournament", and "March 12, 2018". Your one-color design should be emailed to mathleague@augsburg.edu in pdf file format by February 5th , 2018. Include name, grade, and school in your email submission. Winner will be notified by February 16th, 2018. The prize? A $50 VISA gift card!

Other Math Competitions open to Minnesota teams

State Universities that host a math competition during the year.

Tri-College Mathematics Contest, being held this year on Thursday, March 1, 2018, at Concordia College in Moorhead. The contest is jointly sponsored by Concordia College, Minnesota State University Moorhead, and North Dakota State University in Fargo, ND. The contest rotates locations and rotates which school writes the exam; hence there is no central website to link to.

This contest attracts students from all over North Dakota, northern South Dakota, and northwest and west-central Minnesota.

Something to add to the list for the next newsletter! The contact is Doug Anderson at Concordia.
http://faculty.cord.edu/andersod/

A good resource for problems from national and world competitions

The Art of Problem Solving
https://artofproblemsolving.com/community/c13_contest_collections

follow us on Facebook "Minnesota State High School Mathematics League" @MNSHSML and Twitter @MNHSMathLeague

Mathematics in Comics

Problem Corner

an effort to spur conversation

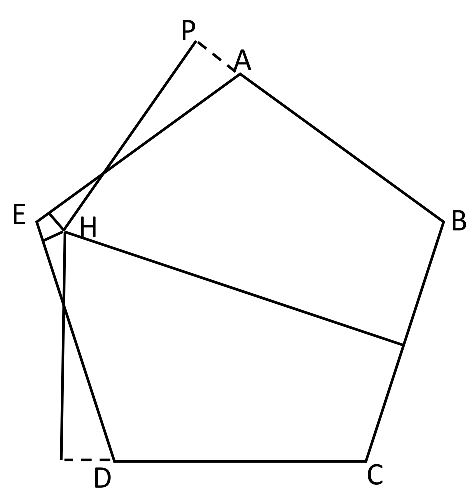
If you'd like to contribute a problem or send in a solution, email tyoung@district16.org

Student solutions encouraged!

Consider the extension of Viviani's theorem which states: In a regular polygon, the *sum of the distances to the sides* from an interior point is independent of the location of the point. Specifically, the sum equals n times the apothem where n is the number of sides.

Often, this theorem is introduced in the context of the surfer and the hut. That is, a surfer lives on a regular polygonal island and wants to surf each beach equally. Where should the surfer build his hut?

An illustration: Consider the regular pentagon ABCDE below, and point H.



For this location of H, and for Viviani's theorem to hold, the distances to sides AB and CD are drawn to the extensions of sides AB and CD. The 5 segments add to 5 times the apothem.

It could be argued that by traveling from H to P, the surfer would not be surfing in the waters of beach AB, but rather in the waters of beach AE.

To travel the shortest distance to beach AB, the surfer would have to travel to point A, which is longer than HP.

Question: For what regular polygons is the surfer always able to build a hut anywhere on the island and still surf each beach equally? (HINT: the illustration above shows it's not always true)

Extension: For the regular polygons where the surfer is unable to build her hut anywhere, what method can be used to find the points that are "hut - worthy?"

Extension: What shapes encompass the "hut – worthy" points?