$\sqrt{CCML}$ Video Contest – Meet 4 2024-2025

Guidelines

- Students from each half of your team (frosh/sophomore or junior/senior) from your school may submit up to two videos on the given problem. Each video submitted must be produced by different students, but must all be from the appropriate grade band. If your school decides to submit two f/s videos, there should be different students in each video.

- Each video should be no more than SIX minutes in length. Note that this does not mean that you have to fill the entire six minutes.

- The problems are to be solved and the videos produced by student groups. The bulk of the work should be done by students. A parent or teacher holding a camera is fine, but solving a problem for the students is not.

- Videos must be produced by a group of at least two students, and at most five students. Each participating student's contribution should be made evident either from an appearance in the video or a credit at the beginning or end of the video. Indicate names of all students involved (maximum of 5) in credits or introductions at the beginning or end of the video.

- The top f/s video and j/s video from your school with earn points for your overall team score according to the attached rubric.

- Creative solutions and presentations are encouraged, but correct math is paramount. Please make the focus of your video the mathematics. If you have a creative context, great, but it should not be the focus of your video. Soundtracks should not distract or interfere with the explanation of the solution.

- Note that calculators can generally be used for exploration and conjecture, but rigorous solutions are required to earn full credit. It is generally not sufficient simply to refer to a graph or use a solver when completing a problem.

Submission

- Coaches should ensure that no more than two videos per grade band are submitted.

- **Make sure that videos are viewable by anyone with the link!**

- Coaches should upload videos to Google drive and share access with Michael Caines (macaines@cps.edu). Please use the following naming conventions for the videos: **school_level_teamnumber_contestnumber_year**. For example, a submission for CCML 3 for a f/s team from Kelly in the 2015−2016 school year should be named as follows, **kelly_fs_team1_contest3_1516**. A submission from a j/s team from Lakeview should be named **lakeview_js_team1_contest3_1516**

- **All submissions must be shared by 5pm on Tuesday, March 4, 2025.**

Please direct any questions about the contest to Michael Caines (macaines@cps.edu). Coaches who are interested in helping judge the submissions should email Michael Caines by the submission deadline.

Problems:

- **Frosh/Sophomore Problem:**

(a) Let $d(n)$ be the function that gives the number of diagonals of a polygon with n sides. Given $d(d(n)) = 27$, determine n.

(b) Let g and h be multivariable functions given by $g(x,y)=\frac{1}{2}(x+y)$ and $h(x,y)=\frac{1}{2}(x-y)$. Describe the region in the xy-plane where $g+h=x\cdot y$.

(c) Let function f be recursively defined by the relation $f(x)+2x\cdot f(\frac{1}{x})=2$ for all x in the domain of the function. Determine an explicit rule for f. That is, determine an equation for f in terms of x and constants only.

- **Junior/Senior Problem:**

Note: these problems are based upon the topic of norms, metrics, and limits, which is not part of the usual CCML topic list. This topic was selected because it matches the ICTM orals topic. You may need to do additional research before doing these problems.

(a) Compute, with explanation, $\lim\limits_{x\to 1}\dfrac{x^{100}-1}{x^{98}-1}$.

(b) Determine all points (x,y) in $\mathbb{R}^2$ that satisfy at least two of the conditions below:

- Their 1-norm (taxicab norm) is less than or equal to 1.
- Their distance to (0,1), using the Euclidean metric, is less than or equal to $\frac{1}{2}$.
- Their distance to (1,0), using the infinity metric, is less than or equal to $\frac{1}{2}$.

(c) A certain metric is defined on $\mathbb{R}^2$ as follows:

$$d((x_a,y_a),(x_b,y_b))=\begin{cases}|y_a-y_b|, & \text{if } x_a=x_b\\ |x_a-x_b|+|y_a|+|y_b|, & \text{if } x_a\neq x_b\end{cases}.$$

Demonstrate that this metric does indeed satisfy all conditions of a metric: non-negativity, identity of indiscernibles, symmetry, and the triangle inequality.

CCML Video Contest Rubric

Team Name: ____ Contest:_____ Year:________

Part (a)	0	1	2
	• No attempt is made, or the work contains profound errors.	• Problem contains some good work, but also nontrivial errors. • Explanation of work is unclear.	• Problem contains only trivial errors or no errors. • Explanation of work is clear.

Part (b)	0	1	2	3
	• No attempt is made, or the work contains profound errors.	• Problem contains some good work, but also multiple nontrivial errors. • Explanation of work is unclear.	• Problem contains no more than one nontrivial error. • Explanation of work is generally clear.	• Problem contains only trivial errors or no errors. • Explanation of work is clear.

Part (c)	0	1	2	3
	• No attempt is made, or the work contains profound errors.	• Problem contains some good work, but also multiple nontrivial errors. • Explanation of work is unclear.	• Problem contains no more than one nontrivial error. • Explanation of work is generally clear.	• Problem contains only trivial errors or no errors. • Explanation of work is clear.

Presentation	0	1	2
	• Images are sloppy or out of focus. • Audio is difficult to hear.	• Audio/video are clear. • Presentation is organized well	• Presentation is truly creative and engaging.

Score: _______ / 10

Notes: