

\sqrt{CCML} Video Contest – Meet 3 2022-2023

Guidelines

- Students from each half of your team (freshman/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 will 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.

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, January 17, 2023.**

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:

- **Freshman/Sophomore Problems:**

Let circle O have radius r . Given a point P , we define P' to be the *inverse of point P with respect to circle O* if P' lies on the ray OP such that $OP \cdot OP' = r^2$.

- (a) The point with coordinates $(3/5, 4/5)$ is inverted with respect to a circle of radius 5, centered at the origin. Determine the coordinates of the resulting point.
- (b) The points $A(5,0)$ and $B(5,5\sqrt{3})$ are inverted over a circle of radius 1, centered at the origin to, to yield points A' and B' , respectively. Given that O is the origin, determine the measure of angle $OA'B'$.
- (c) Let circle O be centered at the origin and have a radius of 2. Let circle M have a center at $(h, 0)$ and a radius of 3. If the point $(1,0)$ is inverted with respect to circle O , and the resulting point is inverted with respect to circle M , the final point obtained is again $(1,0)$. Determine all possible values of h .

- **Junior/Senior Problems:**

Note: for the problems below, inputs are assumed to be in radians where relevant.

- (a) Find any fixed points of the rule $h(x) = \sin x$.
- (b) Let $f(x) = \cos(\cos(x))$ and $g(x) = \sin(\sin(x))$. Compute the maximum value of $|f(x) - g(x)|$.
- (c) Use the amazing identities $\sin x = \frac{1}{2i}(e^{ix} - e^{-ix})$ and $\cos x = \frac{1}{2}(e^{ix} + e^{-ix})$ to “simplify” the expression $(\sin x)^4$. Your final answer should contain sines and/or cosines to the first power only, as well as constants.

CCML Video Contest Rubric

Team Name: _____ Contest: _____ Year: _____

Part (a)	0	1		2
	<ul style="list-style-type: none"> No attempt is made, or the work contains profound errors. 	<ul style="list-style-type: none"> Problem contains some good work, but also nontrivial errors. Explanation of work is unclear. 	<ul style="list-style-type: none"> Problem contains only trivial errors or no errors. Explanation of work is clear. 	
Part (b)	0	1	2	3
	<ul style="list-style-type: none"> No attempt is made, or the work contains profound errors. 	<ul style="list-style-type: none"> Problem contains some good work, but also multiple nontrivial errors. Explanation of work is unclear. 	<ul style="list-style-type: none"> Problem contains no more than one nontrivial error. Explanation of work is generally clear. 	<ul style="list-style-type: none"> Problem contains only trivial errors or no errors. Explanation of work is clear.
Part (c)	0	1	2	3
	<ul style="list-style-type: none"> No attempt is made, or the work contains profound errors. 	<ul style="list-style-type: none"> Problem contains some good work, but also multiple nontrivial errors. Explanation of work is unclear. 	<ul style="list-style-type: none"> Problem contains no more than one nontrivial error. Explanation of work is generally clear. 	<ul style="list-style-type: none"> Problem contains only trivial errors or no errors. Explanation of work is clear.
Presentation	0		1	2
	<ul style="list-style-type: none"> Images are sloppy or out of focus. Audio is difficult to hear. 		<ul style="list-style-type: none"> Audio/video are clear. Presentation is organized well 	<ul style="list-style-type: none"> Presentation is truly creative and engaging.

Score: _____ / 10

Notes: