

\sqrt{CCML} Video Contest – Meet 2 2020-2021

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.
- 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, November 17, 2020.**

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:

(a) *Trailing zeros* of a number are defined to be all the zeros to the left of the decimal point before the first nonzero digit occurs. For example, the number 10200 has two trailing zeros (when expressed in base 10, anyway.)

How many trailing zeros does the number $12!$ have when represented in base 6? (Note that this is 12 factorial.)

(b) The *digit root* of a number is the result obtained by repeatedly adding the digits of that number until a single-digit result is obtained. For example, if the number one hundred ninety-nine is expressed in base 10, then its digit root is 1 because $1_{10} + 9_{10} + 9_{10} = 19_{10}$, $1_{10} + 9_{10} = 10_{10}$, and $1_{10} + 0_{10} = 1_{10}$. However, if one hundred ninety-nine is expressed in base 4, then its digit root is 2 because $3_4 + 0_4 + 1_4 + 1_4 = 11_4$, and $1_4 + 1_4 = 2_4$.

If a and b are chosen, without replacement, from the set $\{2,3,4,5\}$, what is the probability that the number three hundred forty-one has the same digit root when expressed in bases a and b ?

(c) Recall that a number has a *terminating* representation in a given base if all digits to the right of a certain digit are zero. For example, $(1/3)_{10}$ does not terminate in base 10, but it *does* terminate in base 3.

If a and b are randomly selected from the set $\{2,3,4,5,6\}$, with replacement, what is the probability that the number $(1/a)_{10}$ terminates when written in base b ?

• Junior/Senior Problems:

(a) If n is an integer randomly chosen from the interval $[1, 20]$ determine the probability that the limiting value of the infinitely-nested expression $n\sqrt{n\sqrt{n\sqrt{n\cdots}}}$ is an integer.

(b) If a and b are selected, with replacement, from the set of integers on the interval $[0, 1000]$, what is the probability that the limiting value of $\sqrt{a\sqrt{b\sqrt{a\sqrt{b\cdots}}}}$ is an integer? (Note that the coefficients a and b repeat in a two-cycle.)

(c) If a and b are selected, with replacement, from the set of integers on the interval $[0, 10000]$, what is the probability that the limiting value of $\sqrt[a]{b\sqrt[a]{b\sqrt[a]{b\cdots}}}$ is an integer?

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: