"Math is Cool" Masters – 2013-14

December 7, 2013

Total Correct: KEY

STUDENT NAME: _____ **School Name:** _____

Proctor Name: _____ Team #: _____ Room #: _____

PRE-CALCULUS - Individual Contest – Score Sheet
DO NOT WRITE IN SHADED REGIONS

	Answer	1 or 0	1 or 0
1	27		
2	$2\sqrt{7}$		
3	264		
4	102		
5	$6\sqrt{2}$		
6	7		
7	$28 + 4\sqrt{13}$		
8	$(3, -2)$		
9	Incenter		
10	19615/12		
11	3/2, -3		
12	204		
13	$12\sqrt{3}$		
14	10		
15	1/8		
1-15 TOTAL:			

	Answer	1 or 0	1 or 0
16	4900		
17	$y = 3(x-1)^2 + 2$		
18	3100		
19	128/3		
20	(-15,125) and (3, 35) [in any order]		
21	51		
22	26		
23	$4\sqrt{39}$		
24	6		
25	64		
26	$375_{[10]}$		
27	7		
28	31		
29	157		
30	$(11{,}2, -3)$		
16-30 TOTAL:			

	Answer	1 or 0	1 or 0
31	4/3		
32	102		
33	17/30		
34	3/10		
35	$-\frac{7}{24} + \frac{76}{105}i$		
36	5346		
37	180 [°]		
38	22π		
39	$8 + 4\sqrt{2}$		
40	364		
31-40 TOTAL:			

PRE-CALCULUS

"Math is Cool" Masters – 2013-14

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9			
10			
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12			
13			
14			
15			
1-15 TOTAL:			

	Answer	1 or 0	1 or 0
16			
17			
18			
19			
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21			
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24			
25			
26			
27			
28			
29			
30			
16-30 TOTAL:			

	Answer	1 or 0	1 or 0
31			
32			
33			
34			
35			
36			
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40			
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PRE-CALCULUS

"Math is Cool" Masters – 2013-14

December 7, 2013

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STUDENT NAME: _____ **School Name:** _____

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31-40 TOTAL:			

CALCULUS

"Math is Cool" Masters – 2013-14

December 7, 2013

Total Correct:

STUDENT NAME: _____ **School Name:** _____

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CALCULUS - Individual Contest – Score Sheet
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37			
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39			
40			
31-40 TOTAL:			

CALCULUS

"Math is Cool" Masters – 2013-14

Sponsored by: EKA Chemicals

December 7, 2013

High School Mental Math Contest

Follow along as your proctor reads these instructions to you. Your Mental Math score sheet is on the back.

GENERAL INSTRUCTIONS applying to all tests:

- *Good sportsmanship is expected throughout the competition by all involved, both competitors and observers. Display of poor sportsmanship may result in disqualification.*
- *Calculators or any other aids may not be used on any portion of this contest.*
- *Unless stated otherwise, all rational, non-integer answers need to be expressed as reduced common fractions except in case of problems dealing with money. In the case of problems requiring dollar answers, answer as a decimal rounded to the nearest hundredth (ie, to the nearest cent).*
- *All radicals must be simplified and all denominators must be rationalized.*
- *Units are not necessary as part of your answer unless it is a problem that deals with time and in that case, a.m. or p.m. is required. However, if you choose to use units, they must be correct.*
- *Leave all answers in terms of π where applicable.*
- *Do not round any answers unless stated otherwise.*
- *Record all answers on the colored cover sheets in the answer column only.*
- *Make sure all answer sheets have all the information (name, team number, etc.) at the top of the sheet filled out.*
- *Tests will be scored as a 0 if answers are not recorded on the answer sheets.*
- *Blank answer sheets and answer sheets with no name will be scored as a 0.*

Mental Math – 30 sec per question

8 problems read orally to everyone - Approximately 8% of Individual Score - 25% of team score

When it is time to begin, the proctor will read the first question twice. You may not do any writing or talking while arriving at a solution. Once you have a solution, record it on the sheet in front of you. ***You may not change or cross out answers once you have written an answer down. If there are eraser marks, write-overs, or crossed-out answers, they will be marked wrong.*** *Once all students have laid their pencils on the desk, another question will be asked. If a student doesn't lay his/her pencil down, the maximum wait time is 30 seconds after completion of the second reading of the question before another question is asked. You may continue to work on a problem while the next question is being read. The value of each question is a one or zero. Each student will be asked the same eight questions. Individual scores used to determine individual placing will be determined by the sum of the Mental Math score and the Individual Test score for each individual. In addition, the top three Mental Math scores from one team will be totaled and doubled and will contribute to 25% of the team score.*

"Math is Cool" Masters – 2013-14

Sponsored by: EKA Chemicals

High School – December 7, 2013

Mental Math Contest

Mental Math – 30 sec per question

8 problems read orally to everyone - Approximately 8% of Individual Score - 25% of team score

When it is time to begin, the proctor will read the first question twice. You may not do any writing or talking while arriving at a solution. Once you have a solution, record it on the sheet in front of you. ***You may not change or cross out answers once you have written an answer down. If there are eraser marks, write-overs, or crossed-out answers, they will be marked wrong.*** *Once all students have laid their pencils on the desk, another question will be asked. If a student doesn't lay his/her pencil down, the maximum wait time is 30 seconds after completion of the second reading of the question before another question is asked. You may continue to work on a problem while the next question is being read. The value of each question is a one or zero. Each student will be asked the same eight questions. Individual scores used to determine individual placing will be determined by the sum of the Mental Math score and the Individual Test score for each individual. In addition, the top three Mental Math scores from one team will be totaled and doubled and will contribute to 25% of the team score.*

#	Problem
1	Evaluate: 6!
2	How many positive integral factors does 5,000 have?
3	All of a triangle's sides are integers when measured in meters. If two of the sides measure 18 meters and 34 meters, what is the longest the third side can be, in meters?
4	What value(s) of z satisfy $5z - 13 - 82$?
5	How many of the numbers 1, 2, 3, 4, 5, and 10 are greater than the average of the set?
6	What is the average of all of the integer multiples of 7 between 1 and 100 inclusive?
7	Suppose that one painter can paint the entire house in twelve hours, and a second painter could do it in eight hours. How many hours would it take the two painters to paint the house together?
8	What is the surface area, in square meters, of a right circular cylinder with a height of 8 m and a base diameter of 8 m?

“Math is Cool” Masters – 2013-14

Sponsored by: EKA Chemicals

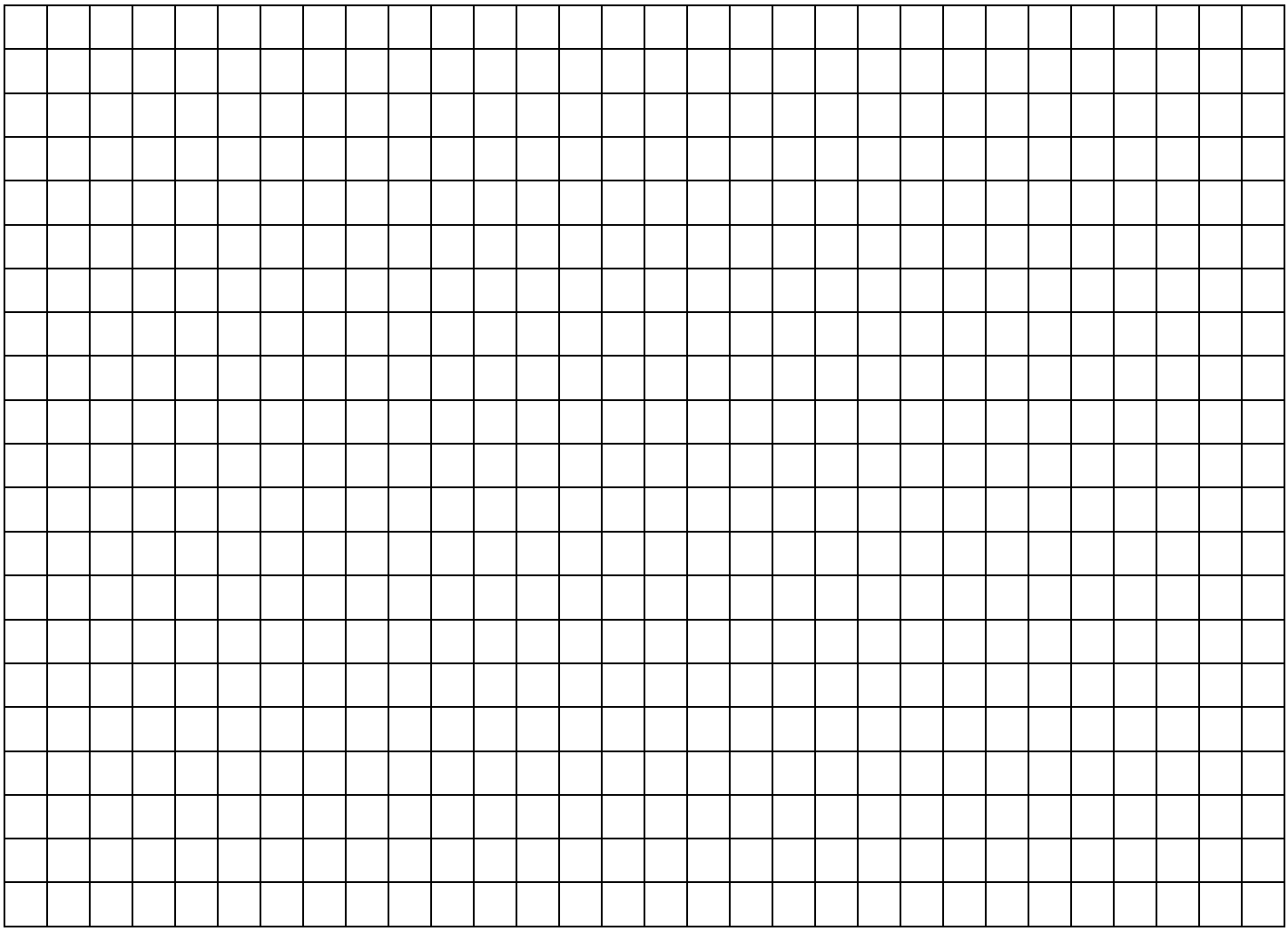
December 7, 2013

PRE-CALCULUS - Individual Contest

Tear this cover sheet and scratch paper off and fill out the top of the colored answer sheet prior to the start of the test. The graph below is for your use, if needed.

INDIVIDUAL TEST – PRE-CALCULUS - 35 minutes

You may NOT be seated next to anyone from your school. If you are MOVE NOW to avoid being disqualified! When you are prompted to begin, tear off the colored sheet and begin testing. Make sure your name and school are recorded on the answer sheet. The raw score will be 2 points for correct answers to problems 1-30 and 3 points for 31-40. Record your answers on the score sheet. No talking during the test. You will be given a 5 minute time warning.



"Math is Cool" Masters – 2013-14

Sponsored by: EKA Chemicals

December 7, 2013

PRE-CALCULUS - Individual Contest

	Questions 1-30: 2 points each
1	What value(s) of m satisfy $7m - 11 = 5m + 43$?
2	What is the length, in meters, of the other leg of a right triangle with a hypotenuse measuring 8 m and a leg measuring 6 m?
3	Evaluate 12 factorial times 2 factorial divided by 10 factorial.
4	Evaluate $\begin{vmatrix} 2 & 5 & -7 \\ -4 & 4 & 1 \\ 0 & 5 & -1 \end{vmatrix}$
5	What is the length, in meters, of the long leg of a 30-60-90 triangle with a hypotenuse measuring $4\sqrt{6}$ meters?
6	Evaluate: $\sqrt{42 + \sqrt{42 + \sqrt{42+\ldots}}}$
7	Simplify by rationalizing the denominator: $\frac{144}{7-\sqrt{13}}$
8	What are the coordinates, in the form (x, y), of the vertex of the parabola with equation $y = x^2 - 6x + 7$?
9	What is the name of the point at which a triangle's three angle bisectors meet?
10	Evaluate: $\frac{\binom{6}{2}+\begin{pmatrix} 50\cos(4\pi) \\ 3\sin(\frac{\pi}{2}) \end{pmatrix}}{\begin{vmatrix} 3 & 2 \\ -1 & 4 \end{vmatrix}+\langle 1,4\rangle\cdot\langle -2,0\rangle}$.
11	What value(s) of j satisfy $2j^2 + 3j - 9 = 0$?
12	If $h(j) = \lvert 2j - j^3 \rvert$ and $k(m) = m + m^2$, evaluate $h\left(k\left(k\left(h(1)\right)\right)\right)$.
13	Suppose that a circle with a radius of 2 is inscribed in an equilateral triangle. What is the area of the triangle?
14	If 3 farmers can plow 12 acres of their farm in 6 hours, how many acres would 5 farmers plow in 3 hours?
15	In a two-player game, a coin is repeatedly flipped. If a total of four Heads are flipped before a total of four Tails, Player One wins. Otherwise, Player Two wins. If the first flip is Heads, what is the probability that Player Two wins on the sixth flip?
16	If $a_n = 1 + 2 + \cdots + (n-1) + n + (n-1) + \cdots + 2 + 1$, evaluate a_{70}.
17	Find the equation, in the form $y = a(x - h)^2 + k$ of the parabola passing through the points (1,2) and (-1,14) if (1,2) lies on the parabola's axis of symmetry.
18	Calculate the value of $(a + b)^2 - (a - b)^2$ when $a = 31$ and $b = 25$.

19	On a hot day, a five foot tall girl walks until her head is just barely in the shadow of a twenty foot tall building. If she is 32 feet from the building at that moment, how many feet long is the building's shadow?
20	What are the coordinates, in the form (x, y), at which the graphs of $y = x^2 + 7x + 5$ and $y = -5x + 50$ intersect?
21	Ginger has a trashcan full of lemons. Smiley eats 1/3 of the lemons. Dougy steals 14 of the remaining lemons. Laundres takes 35% of the remainder and Gloosky takes three. CeeCee steals 40% of what's left and then Bagel takes half after that. After Momo takes two lemons, there is one lonely lemon left in the can. How many lemons did Ginger originally have?
22	How many positive integers less than 100 are not multiples of 2, 3, or 5?
23	Two circles have radii of 9 m and 8 m, and their centers are 25 m apart. What is the length of one of their common external tangents?
24	In the following cryptarithm, where each letter represents a unique digit from 0-9 inclusive, what is the value of A? COCA +COLA --------- OASIS
25	At Fair & Heights High School, students reported the daily temperature on each of the five weekdays. If the standard deviation of the temperature was 2 degrees and the mean temperature was 60 degrees, what is the maximum temperature they could have seen during the week?
26	Evaluate in base ten: $11_2 + 22_3 + 33_4 + \cdots + 99_{10}$.
27	If $x + y + z = 2$, $xy + yz + xz = -11$, and $xyz = -12$, what is the largest possible difference between two of these variables?
28	In a certain event at the Olympics, there are three Americans, two Russians, one Brazilian, and one Canadian. For medal counting purposes, the order of countries in the top 3 matters, but it does not matter which individual finishes where. Additionally, the order outside the top 3 does not matter. How many distinct medal results involve at least one American winning a medal?
29	What is the greatest prime factor of $13!\,12! + 12!\,11!$?
30	What is the solution, in the form (d, f, g), of the system of equations $d + f + g = 10$, $2d - f = 20$, and $3d + 5f + g = 40$?

Challenge Questions: 3 pts each

31	Evaluate: $1+\cfrac{2}{3+\cfrac{4}{1+\cfrac{2}{3+\cfrac{4}{1+\cfrac{2}{\ddots}}}}}$
32	What is the next term in the following sequence: 1, 2, 4, 8, 16, 22, 26, 38, 62, 74?
33	Two thru-hikers heading opposite directions agree to meet atop Marmot Pass and exchange car keys at noon on December 7th. However, it's hard to know exactly how fast you'll hike, and it's hard to sit around when you could be making miles. So in the end, one of the hikers decides he'll be sure to arrive sometime between 9AM and 2 PM and wait up to two hours, while the other decides she'll be sure to arrive between 10 AM and 1 PM and wait up to an hour. What is the probability that they actually meet one another?
34	Define set **A** to be the set of all positive even integers, set B to be the set of positive odd integers, set C to be the set of positive prime numbers, set D to be the set of all positive multiples of three, and set E to be the set of all positive factors of 10!. If three of the five sets are chosen at random, what is the probability that there will be a minimum of two elements in the intersection of the three chosen sets? Express your answer as a reduced fraction.
35	Simplify in terms of $i=\sqrt{-1}$: $\sum_{n=1}^{8}\left(\frac{1}{n}i^n\right)$
36	The leadership of the Math Club is a President, a Vice-President, and Vice-Squared-President, and there must be at least one person of each gender among them. If the Math Club nine boys and eleven girls, how many different ways could the leadership be chosen?
37	Find the smallest positive value of x, in degrees, where $\frac{\sin^{10}x+5\sin^8 x\cos^2 x+10\sin^6 x\cos^4 x+10\sin^4 x\cos^6 x+5\sin^2 x\cos^8 x+\cos^{10}x}{\cos^2 x-\sin^2 x}=1.$
38	Find the area, in square units, of the region inside $4x^2+9y^2+36y=108$ and outside $4x^2+y^2=4$.
39	A spherical ball with a radius of 6 cm is rolled into a corner of a room and held in place, and then a ball with radius 2 cm is placed on top of this ball, so that each ball is touching both walls and the other ball. How many centimeters is the top of the smaller ball above the floor?
40	Suppose $f_1=f_2=1$ and $f_{k+2}=f_k+f_{k+1}, k\geq 1$. If $S_n=\sum_{k=1}^{n}f_k$, what is $\sum_{n=1}^{10}S_n$?

PRE-CALCULUS

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Sponsored by: EKA Chemicals

December 7, 2013

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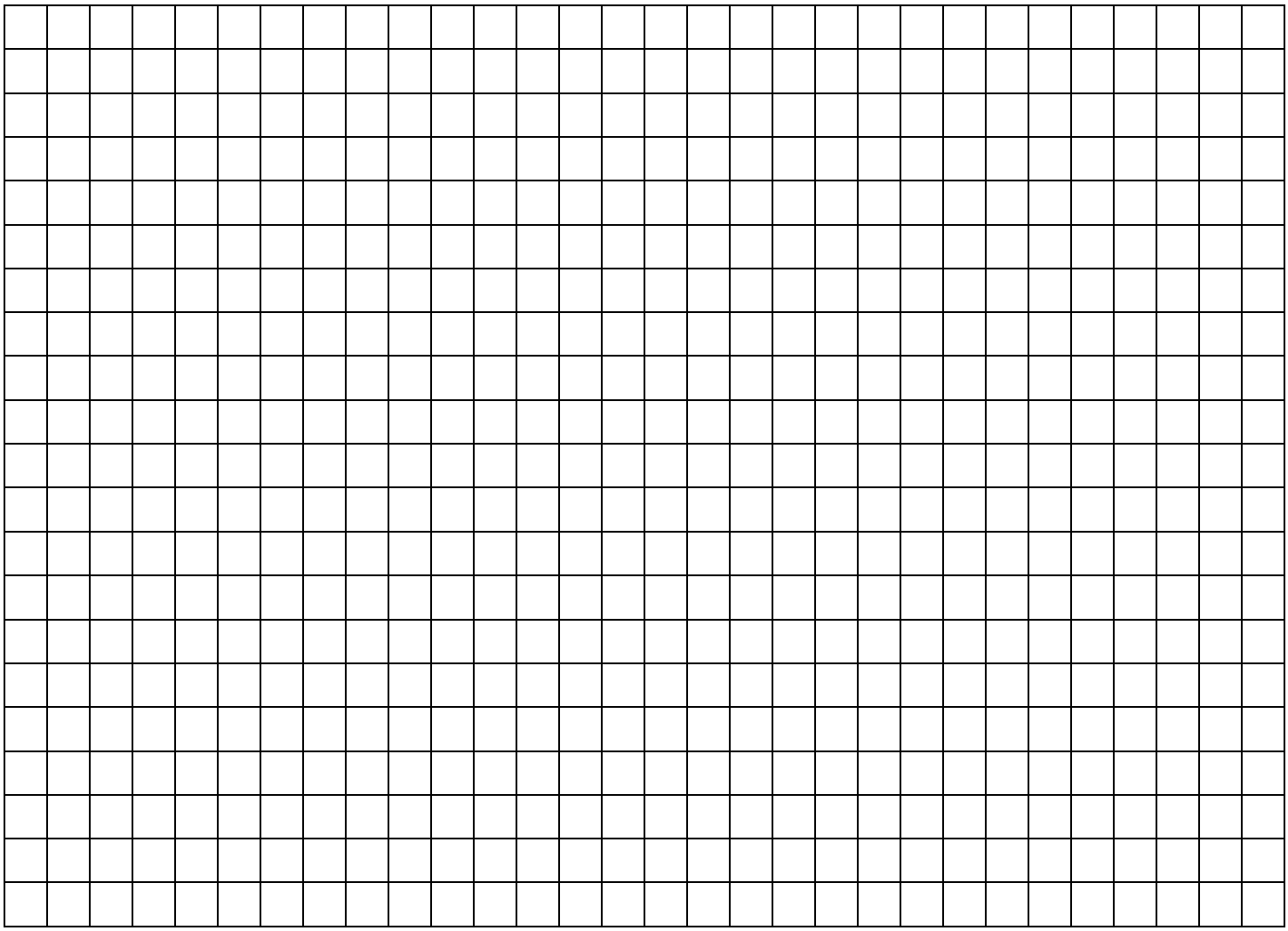

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CALCULUS - Individual Contest

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3	Evaluate 12 factorial times 2 factorial divided by 10 factorial.
4	Evaluate: $\lim_{\theta\to\infty} \frac{\sin\theta}{\theta}$
5	What is the length, in meters, of the long leg of a 30-60-90 triangle with a hypotenuse measuring $4\sqrt{6}$ meters?
6	Evaluate: $\sqrt{42+\sqrt{42+\sqrt{42+\ldots}}}$
7	Simplify by rationalizing the denominator: $\frac{144}{7-\sqrt{13}}$
8	What are the coordinates, in the form (x, y), of the vertex of the parabola with equation $y = x^2 - 6x + 7$?
9	What is the name of the point at which a triangle's three angle bisectors meet?
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20	What are the coordinates, in the form (x, y), at which the graphs of $y = x^2 + 7x + 5$ and $y = -5x + 50$ intersect?
21	Ginger has a trashcan full of lemons. Smiley eats 1/3 of the lemons. Dougy steals 14 of the remaining lemons. Laundres takes 35% of the remainder and Gloosky takes three. CeeCee steals 40% of what's left and then Bagel takes half after that. After Momo takes two lemons, there is one lonely lemon left in the can. How many lemons did Ginger originally have?
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23	Two circles have radii of 9 m and 8 m, and their centers are 25 m apart. What is the length of one of their common external tangents?
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25	At Fair & Heights High School, students reported the daily temperature on each of the five weekdays. If the standard deviation of the temperature was 2 degrees and the mean temperature was 60 degrees, what is the maximum temperature they could have seen during the week?
26	Evaluate in base ten: $11_2 + 22_3 + 33_4 + \cdots + 99_{10}$.
27	If $x + y + z = 2$, $xy + yz + xz = -11$, and $xyz = -12$, what is the largest possible difference between two of these variables?
28	If $n(m) = \frac{m^3 - 4m}{m+3}$, evaluate $n'(3)$.
29	What is the greatest prime factor of $13!\,12! + 12!\,11!$?
30	What is the solution, in the form (d, f, g), of the system of equations $d + f + g = 10$, $2d - f = 20$, and $3d + 5f + g = 40$?

Challenge Questions: 3 pts each

31	Evaluate: $1+\cfrac{2}{3+\cfrac{4}{1+\cfrac{2}{3+\cfrac{4}{1+\cfrac{2}{\ddots}}}}}$
32	In triangle ABC, AB = 4, AC = 6, and BC = 8.5. If $\lvert\cos(\angle ACB)\rvert = m/n$, where m and n are positive integers with greatest common divisor 1, find $m+n$.
33	Two thru-hikers heading opposite directions agree to meet atop Marmot Pass and exchange car keys at noon on December 7th. However, it's hard to know exactly how fast you'll hike, and it's hard to sit around when you could be making miles. So in the end, one of the hikers decides he'll be sure to arrive sometime between 9AM and 2 PM and wait up to two hours, while the other decides she'll be sure to arrive between 10 AM and 1 PM and wait up to an hour. What is the probability that they actually meet one another?
34	Define set **A** to be the set of all positive even integers, set B to be the set of positive odd integers, set C to be the set of positive prime numbers, set D to be the set of all positive multiples of three, and set E to be the set of all positive factors of 10!. If three of the five sets are chosen at random, what is the probability that there will be a minimum of two elements in the intersection of the three chosen sets? Express your answer as a reduced fraction.
35	Simplify in terms of $i=\sqrt{-1}$: $\sum_{n=1}^{8}\left(\frac{1}{n}i^n\right)$
36	The leadership of the Math Club is a President, a Vice-President, and Vice-Squared-President, and there must be at least one person of each gender among them. If the Math Club nine boys and eleven girls, how many different ways could the leadership be chosen?
37	Find the smallest positive value of x, in degrees, where $\frac{\sin^{10}x+5\sin^8 x\cos^2 x+10\sin^6 x\cos^4 x+10\sin^4 x\cos^6 x+5\sin^2 x\cos^8 x+\cos^{10}x}{\cos^2 x-\sin^2 x}=1.$
38	Find the area, in square units, of the region inside $4x^2+9y^2+36y=108$ and outside $4x^2+y^2=4$.
39	A spherical ball with a radius of 6 cm is rolled into a corner of a room and held in place, and then a ball with radius 2 cm is placed on top of this ball, so that each ball is touching both walls and the other ball. How many centimeters is the top of the smaller ball above the floor?
40	Suppose $f_1=f_2=1$ and $f_{k+2}=f_k+f_{k+1}, k\geq 1$. If $S_n=\sum_{k=1}^{n} f_k$, what is $\sum_{n=1}^{10} S_n$?

CALCULUS

"Math is Cool" Masters – 2013-14

Sponsored by: EKA Chemicals

11th & 12th Grade – December 7, 2013

Individual Multiple Choice Contest

1	Rich wants to invest $5,000 into a bank account. Which of the following forms of interest will result in the most growth of his account after 5 full years? A) 6% annual interest, compounded monthly B) 5% annual interest with a $50 bonus added each year C) 6.25% annual interest, compounded quarterly D) 6.5% annual interest E) Answer not given.
2	What is the average of the N smallest positive perfect squares? A) $\frac{n^2}{3}$ B) $\frac{(n+1)(2n+1)}{6}$ C) $\frac{(n+2)(2n+3)(3n+4)}{3n}$ D) $\frac{n(n+1)(2n+1)}{6}$ E) Answer not given.
3	Find the probability that a randomly selected positive integral divisor of 6750 is odd and is a perfect cube. A) $\frac{1}{16}$ B) $\frac{3}{32}$ C) $\frac{1}{8}$ D) $\frac{3}{16}$ E) Answer not given.
4	Anne is currently five times as old as Benjamin, but in two years she will only be four times as old as Benjamin. How old will Anne be then? A) 28 B) 30 C) 32 D) 36 E) Answer not given.
5	What is the surface area, in square meters, of a paperweight in the shape of a cube with edges measuring 8 m that has smaller cubes with edges measuring 2 m carved out of the center of each face? A) 456 B) 480 C) 504 D) 528 E) Answer not given.
6	In the town of Maxville, Walt throws a set of darts at two dartboards. He first throws at one board, records his score and then reuses the same set of darts on the second board. In the end, he finds that 28% of his darts hit a bull's-eye on both dartboards, while 50% of his darts hit a bull's-eye on the second board. What percent of those darts that hit the second board's bull's-eye also hit the first board's bull's-eye? A) 28% B) 50% C) 56% D) 72% E) Answer not given.

7	Ten suspects were asked about their role in a crime, and the polygraph says they all lied. What is the largest number of these suspects that could have been involved in the crime? Note: "I" refers to the speaker, not to another suspect. Z: Y, X, & W were all part of it. Y: Neither V, U, nor T was part of it. X: Either S, R, or Q was part of it. W: Neither V nor I was part of it. V: Either X, U, or R was part of it. U: Y, T, and Z were all part of it. T: S & I were both part of it. S: Neither Z, W, T, nor Q were part of it. R: Either X or Q was part of it. Q: Z, U, R, and I were all part of it. A) 4 B) 5 C) 6 D) 7 E) Answer not given.
8	A triangle has sides measuring 9 m, 10 m, and 13 m. What is the length, in meters, of the altitude to the shortest side? A) $\frac{4\sqrt{14}}{3}$ B) $\frac{19\sqrt{14}}{9}$ C) $\frac{8\sqrt{14}}{3}$ D) $\frac{25\sqrt{14}}{9}$ E) Answer not given.
9	At a cruel birthday party, six identical goodie bags are distributed among the six guests without regard for fairness (maybe one guest gets all six, etc.). In how many ways can this be done? A) 402 B) 422 C) 447 D) 462 E) Answer not given.
10	What are the coordinates, in the form (x, y), of the point on the line $y = 2x + 3$ that is closest to the point $(4, -5)$? A) $\left(-\frac{8}{3}, -\frac{7}{3}\right)$ B) $\left(-\frac{12}{5}, -\frac{9}{5}\right)$ C) $\left(-\frac{7}{3}, -\frac{5}{3}\right)$ D) $\left(-\frac{5}{2}, -2\right)$ E) Answer not given.

"Math is Cool" Masters – 2013-14

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11th & 12th Grade – December 7, 2013

Team Contest

1	Evaluate as a Roman numeral: CCCLIV + DCCLXV
2	Find the area of a 75^{O} sector of a largest possible cross-section of a sphere with surface area 56π.
3	How many unique pairs of integers (*x, y*), such that $-50 \leq x \leq 50$ and $-50 \leq y \leq 50$, satisfy the equation below? $$2x - 4y = 0$$
4	If, at the end of the year, it takes Jill 5 hours to clean the classroom by herself and it takes Jack 3 hours to clean the classroom by himself, how many minutes would it take for them to do the task together?
5	In triangle ABC, AC $= \sqrt{2}/2$, BC $= 1$, and $m\angle A$CB $= 105°$. The length of segment AB is equal to $\cos\theta + \sin\theta$, where θ is an angle in degrees and $0 < \theta < 90°$. Find the largest possible value of θ.
6	Find the area of the quadrilateral with vertices at the points $(-1,-3)$, $(2,3)$, $(4,-1)$, and $(-2,3)$.
7	Team A won sixteen of their sixty games last season. If Team B wants to have a twenty-five percent better winning percentage in their ninety-game season, how many games must they win? Note: if Team A's percentage were 4%, Team B would want their percentage to be 5%, not 29%.
8	Given the infinite geometric sequence starting with 1 and having common ratio 1/3, a second sequence is constructed by the following rule: each term of the original sequence is used as the radius of a sector, the area of which is the corresponding term in the second sequence. The first term uses a full circle, and each consecutive sector has a central angle half that of the previous one. What is the sum of the terms of the second sequence?
9	In the game of poker, a full house is a set of five cards that contains a three of a kind and a pair. For example, this forms a full house: 5♠, 5♣, 3♦, 5♦, 3♥. Let p and q be relative prime integers such that p/q is the probability of getting a full house when dealt a random 5-card hand. Find the value of $p + q$.
10	Function f has the property that if a real number x is in the domain of f, $1/x$ is also in the domain. Furthermore, $f(x) + f\left(\frac{1}{x}\right) = x$. Assuming the domain of f is non-empty, find the arithmetic mean of all the elements in the domain of f.

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11th & 12th Grade – December 7, 2013

Pressure Round Contest

1	How many sets of three consecutive odd primes exist?
2	When 18 liters of a 34% acid solution are combined with 30 liters of a 22% acid solution, what percent of the resulting solution is acid?
3	What is the constant term when $\left(x^2 + 3 + \frac{4}{x}\right)^5$ is expanded and like terms are combined?
4	Each statement below is worth the number of points listed if it is true, but is worth 0 points if it is false. What is the total value of all statements? (1) 98134 is divisible by 7 (2) 37,428 is a perfect square (4) 22,627 has 11 as its smallest prime factor (8) 317 is a composite number (16) 120 positive integers are factors of 75,600
5	What is the total surface area, in square meters, of a right rectangular pyramid with a length, width, and height of 4 m, 6 m, and 7 m respectively?

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11th & 12th Grade – December 7, 2013

COLLEGE KNOWLEDGE BOWL ROUND #1 – SET 1

#	Problem	Answer
1	What word best describes a polynomial of degree two?	Quadratic (NOT Parabola)
2	What is the product of the coordinates of the intersection closest to the origin of the curves Y-EQUALS-ONE-THIRD-OF-THE-SQUARE-ROOT-OF-THREE $\left(y = \frac{\sqrt{3}}{3}\right)$ and Y-EQUALS-THE-TANGENT-OF-X $(y = \tan x)$, where X is measured in radians?	$\frac{\pi\sqrt{3}}{18}$
3	What is the product of 317 and 11?	3487
4	The cat shelter has human employees and feline occupants. If there are a total of 59 heads and 130 feet, how many cats are currently in the shelter?	6
5	A circle with radius 1 is inscribed in a square. Another smaller square is placed in the corner of the square so that one vertex just touches the circle. What is the side length of the smaller square?	$1 - \frac{\sqrt{2}}{2}$ *or* $\frac{2 - \sqrt{2}}{2}$
6	In a survey of 144 people, 56 like candy canes and 36 like advertisements. If these preferences are independent of one another, how many people like neither?	66
7	If the first and second terms of an arithmetic series are six and seventeen respectively, what is the sum of the ninth and tenth terms?	199
8	What are the coordinates, in the form (x, y), of the point that is two-thirds of the way from the point $(1,8)$ to the point $(-5,17)$?	$(-3,14)$
9	If the half-life of a radioactive substance Mathium is 4 hours and we start with a 400 mg sample, how many milligrams of the substance will remain after one day? Give your answer as a decimal.	6.25mg
10	What is the probability of randomly choosing an integer between 30 and its additive inverse (inclusive) such that the integer divided by five produces a positive integer?	6/61

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11th & 12th Grade – December 7, 2013

COLLEGE KNOWLEDGE BOWL ROUND #2 – SET 2

#	Problem	Answer
1	A number cannot be written in the form P-OVER-Q, where P and Q are integers. What word can be used to describe all such numbers?	Irrational
2	The angle FOUR-THOUSAND-NINE-HUNDRED-TWENTY-FIVE-PI-OVER-TWELVE $\left(\frac{4925\pi}{12}\right)$ radians is coterminal to x degrees, where $0 < x < 360$. Find the value of x.	75
3	Suppose Andy has a standard 52-card deck. Andy pulls a card at random. If it is an ace, Andy will do 11 push-ups; if it is a face card, Andy will do 10 push-ups; otherwise, Andy will do the number of push-ups of the card's value. If Andy goes through the entire deck in this manner, how many push-ups will he do?	380 [push ups]
4	Excluding 0 and 1, what is the first perfect square in the Fibonacci Sequence?	144
5	What is the distance between the x-intercepts of the parabola with equation Y-EQUALS-THREE-X-SQUARED-MINUS-FOUR-X-MINUS-FIVE $(y = 3x^2 - 4x - 5)$?	$\frac{2\sqrt{19}}{3}$
6	How many prime numbers are there less than 50?	15
7	I have three different horror books, four ***identical*** fantasy books, and five different science fiction books. In how many distinguishable ways can I arrange these books next to one another on a shelf if I wish to keep books in the same genre together?	4320
8	You have thirteen coins worth a total of thirty-seven cents. If each coin is either a penny, nickel, or dime, what coins do you have?	Six nickels and seven pennies
9	The logarithm in base B of C is A $(\log_b c = a)$ and the logarithm in base C of B is A-MINUS-ONE $(\log_c b = a - 1)$. List all possible values of A.	$\frac{1 \pm \sqrt{5}}{2}$ ONE-PLUS-OR-MINUS-ROOT-FIVE-OVER-TWO
10	A regular hexagon is circumscribed by a circle with a circumference of 12π (twelve "pie"). What is the area of the region inside the circle and outside the hexagon?	$36\pi - 54\sqrt{3}$

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11th & 12th Grade – December 7, 2013

COLLEGE KNOWLEDGE BOWL ROUND #3 – SET 3

#	Problem	Answer
1	The probability of an event lies between what and what?	0 and 1
2	What is the remainder when eight factorial is divided by ten?	0
3	What are the coordinates, in the form X-COMMA-Y (x, y), of the reflection of the point ONE-COMMA-TWO $(1,2)$ across the line Y-EQUALS-NINE-MINUS-X $(y = 9 - x)$?	$(7,8)$ SEVEN-COMMA-EIGHT
4	What is the surface area, in meters, of an icosahedron with edges measuring 2 m?	$20\sqrt{3}$
5	What is the sum of the twenty-three smallest positive odd integers?	529
6	What is the units digit of 2013 raised to the 2013th power?	3
7	You are at your favorite ice cream store, and you want to get a three-scoop bowl of ice cream. If the store has 12 flavors of ice cream, and you get three scoops in your bowl, each of a different flavor, how many different combinations can you make?	220
8	Solve for x: 2 to the power 4x+3 equals to 8 to the power 2x-1	[x=]3
9	What is the maximum value of $\sin\theta + \cos\theta$?	$\sqrt{2}$
10	A cow is tied to an external corner of a rectangular barn measuring 20 m by 30 m. If the cow's rope is 45 m long and the cow cannot get inside the barn, what is the total area, in square meters, within which the cow can wander?	$\frac{6925\pi}{4}$

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11th & 12th Grade – December 7, 2013

COLLEGE KNOWLEDGE BOWL ROUND #4 – SET 4

#	Problem	Answer
1	How many ways are there to choose a ranked list of 100 top web search results from 100,000 relevant webpages? Express your answer as a quotient of two factorials.	$\frac{100000!}{99900!}$
2	What is the quotient when the number seventeen is divided by its multiplicative inverse?	289
3	What is the sixth term of the Fibonacci sequence, if the first two terms are both one?	8
4	What value(s) of *h* satisfy TWO-H-SQUARED-PLUS-FOUR-H-MINUS-7-EQUALS-ELEVEN $(2h^2 + 4h - 7 = 11)$?	$-1 \pm \sqrt{10}$
5	Evaluate: TEN-ROOT-TWO-TIMES-THE-SINE-OF-THE-QUANTITY-SIX-HUNDRED-TWENTY-ONE-PI-OVER-FOUR [PAUSE] PLUS-TWELVE-ROOT-THREE-TIMES-THE-COSINE-OF-THE-QUANTITY-ONE-THOUSAND-THIRTY-ONE-PI-OVER-SIX $\left(10\sqrt{2}\sin\left(\frac{621\pi}{4}\right) + 12\sqrt{3}\cos\left(\frac{1031\pi}{6}\right)\right)$	8
6	Evaluate: $\left(\frac{64}{729}\right)^{-\frac{2}{3}}$	$\frac{81}{16}$
7	What is the prime factorization of 504?	$2^3 \cdot 3^2 \cdot 7$
8	A quadrilateral has two diagonals that perpendicularly bisect each other. What is the most specific name that describes ***every*** quadrilateral with this property?	Rhombus
9	What percent of TWO-SEVENTHS is ONE-OVER-THIRTY-FIVE?	10[%]
10	An icosahedron has how many vertices?	12

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11th & 12th Grade – December 7, 2013

COLLEGE KNOWLEDGE BOWL ROUND #5 – SET 5

#	Problem	Answer
1	How many diagonals can be drawn in a convex 13-gon?	65
2	Two fair coins are tossed simultaneously. What is the probability of getting at most one tail?	3/4
3	If B and C have a sum of 16 and a product of 48, what is B-squared-minus-C-squared?	128
4	What is the area of the region of the Cartesian Plane bounded by Y-EQUALS-THIRTY-SEVEN-MINUS-X-SQUARED $(y = 37 - x^2)$ and Y-EQUALS-1 $(y = 1)$?	288
5	What is one-zero-one base two plus one-one base 2 as a base 2 number?	1000_2
6	What percent of 250 is 180?	72 [%]
7	Set C is the set of positive three-digit multiples of three, while Set D is the set of positive three-digit multiples of four. How many elements are in the set $C \cap D'$?	225
8	What is the sum of the nine smallest positive perfect cubes that do not have any digits that are threes?	2682
9	Two baseball teams are playing in a best-of-7 series. In other words, once one team wins 4 games, the series ends. The two-teams are evenly matched, so each has the same chance of winning any given game. Find the probability the series goes exactly 5 games.	1/4
10	What is the value of the smaller angle (in degrees) between the hour and minute hand of a standard analog clock at 11:23 pm?	$\frac{313}{2}$ or 156.5 [°]

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11th & 12th Grade – December 7, 2013

COLLEGE KNOWLEDGE BOWL ROUND #6 – SET 6

#	Problem	Answer
1	Evaluate: THE-LIMIT-AS-P-GOES-TO-SEVEN-OF-THE-QUANTITY-P-SQUARED-MINUS-FORTY-NINE-OVER-THE-QUANTITY-P-MINUS-SEVEN $\left(\lim_{p\to 7}\frac{p^2-49}{p-7}\right)$	14
2	If Q quarters can buy exactly C cups of sugar, how many cups of sugar can you buy for $1.35?	$\frac{27C}{5Q}$
3	When three fair coins are tossed together, what is the probability that all of the coins land with the same face up?	¼
4	Express one-three-seven base 8 as a base 10 number.	95
5	Baby Lala fans have a half-life of 45 days. If Baby Lala has ten million fans today, how many fans she will have one year from now, to the nearest thousand?	39000
6	Find the geometric mean of 12 and 75.	30
7	What is the maximum number of regions we can divide a plane into with 6 straight lines on that plane?	22
8	Take the number of sides of a heptagon and add it to the number of vertices of a rectangular prism. Multiply this number by the measure of the central angle of a dodecagon. What is the result?	450
9	If the leftmost number in a row of Pascal's Triangle is the zeroth number in that row, and the top row consisting of a single 1 is the zeroth row, what is the sum of the first element of every even numbered row of Pascal's Triangle between rows 13 and 27?	140
10	Bag A contains three red and five blue marbles, while Bag B contains four red and six blue marbles. If a bag is chosen at random and then a marble is chosen at random from that bag, what is the probability that the marble is red?	$\frac{31}{80}$

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High School – December 7, 2013

COLLEGE KNOWLEDGE BOWL ROUND – EXTRA

#	Problem	Answer
1	What is the measure, in degrees, of the complement to the supplement of a $123°$ angle?	33
2	What are the coordinates, in the form X-COMMA-Y (x, y), of the y-intercept of the line THREE-X-PLUS-FOUR-Y-EQUALS-THIRTY $(3x + 4y = 30)$?	$\left(0, \frac{15}{2}\right)$
3	What is the equation of the axis of symmetry of the parabola with equation Y-EQUALS-TWO-X-SQUARED-MINUS-X $(y = 2x^2 - x)$?	$x = \frac{1}{4}$

Final Score:

KEY

(Out of 8)

"Math is Cool" Masters -- 2013-14

School:_____ Room # _____ Team #_____

Name: _____Proctor: _____

High School **Mental Math** – 30 sec per question

8 problems read orally to everyone - Approximately 8% of Individual Score - 25% of team score

When it is time to begin, the proctor will read the first question twice. You may not do any writing or talking while arriving at a solution. Once you have a solution, record it on the sheet in front of you. ***You may not change or cross out answers once you have written an answer down. If there are eraser marks, write-overs, or crossed-out answers, they will be marked wrong.*** *Once all students have laid their pencils on the desk, another question will be asked. If a student doesn't lay his/her pencil down, the maximum wait time is 30 seconds after completion of the second reading of the question before another question is asked. You may continue to work on a problem while the next question is being read. The value of each question is a one or zero. Each student will be asked the same eight questions. Individual scores used to determine individual placing will be determined by the sum of the Mental Math score and the Individual Test score for each individual. In addition, the top three Mental Math scores from one team will be totaled and doubled and will contribute to 25% of the team score.*

	Answer	1 or 0	1 or 0
1	720		
2	20		
3	51		
4	19		
5	2		
6	105/2		
7	4.8 or $\frac{24}{5}$ [hours]		
8	96π		

Math is Cool" Masters – 2013-14

11th & 12th Grade – December 7, 2013

Final Score:

KEY

Student Name_____

Proctor Name_____Room #_____

First Score

(out of 20)

SCHOOL NAME_____ Team #_____

INDIVIDUAL MULTIPLE CHOICE - 15 minutes – 10 problems – 20% of team score

This test is the only test where you will be penalized for incorrect responses. You will receive 2 points for a correct letter response, 0 points for leaving it blank and -1 point for an incorrect response. It is not necessary to write your personal name on the test, but you may put it at the bottom of the test so your coach will be able to give you back the correct test. This test is taken individually, but it is part of your team score, including zeros for missing team members. Your team score will be calculated by taking the mean of your four team members' scores. When you are prompted to begin, tear off the colored sheet and begin testing. ***Since this is a multiple choice test, ONLY a letter response should be indicated as an answer on the answer sheet.*** *No talking during the test.*

DO NOT WRITE IN SHADED REGIONS

	Answer	-1, 0 or 2	-1, 0 or 2
1	D		
2	B		
3	C		
4	C		
5	B		
6	C		
7	A		
8	C		
9	D		
10	B		

"Math is Cool" Masters – 2013-14

11th & 12th Grade – December 7, 2013

Final Score:

KEY

SCHOOL NAME_____ **Team #** _____

First Score

(out of 10)

Proctor Name_____Room #_____

Team Contest – Score Sheet

TEAM TEST - 15 minutes – 30% of team score

*When you are prompted to begin, tear off the colored sheet and give a copy of the test to each of your team members and begin testing. Each problem is scored as **1 or 0**. Record all answers on the colored answer sheet.*

DO NOT WRITE IN SHADED REGIONS

	Answer	1 or 0	1 or 0
1	MCXIX		
2	$\frac{35\pi}{12}$		
3	51		
4	112.5 or 112 1/2 or $\frac{225}{2}$ [minutes]		
5	60		
6	24		
7	30		
8	$\frac{18\pi}{17}$		
9	4171		
10	0		

"Math is Cool" Masters – 2013-14

11th & 12th Grade – December 7, 2013

Final Score:
KEY
First Score

Proctor Name_____Room #_____

SCHOOL NAME_____Team #_____

PRESSURE ROUND - 10 minutes – 5 problems - 5 rounds – 15% of team score

When it is time to begin, you will be handed a packet of five problems. There is a copy of the problems for each team member. Two minutes after the start of the test you are expected to submit an answer for one of the problems (it can simply be a guess). The maximum value of this answer is 1 point. In another two minutes you are expected to submit another answer to one of the four remaining problems; its maximum value is two points. This process will continue until all the problems are answered and each consecutive problem's worth will go up by one point. You must submit your answers on the colored sheets given to you. If you do not have an answer at the end of a two minute period, you must still submit an answer sheet with an identified problem number on it. Failure to do so will result in loss of points. This event is timed, and you will be given a verbal 5 second warning and told to hold your answer sheet up in the air. You may keep working as the sheets are collected. If a team answers the same question more than once, only the first answer will be scored and the other attempts will be ignored.

Pressure Round Answers

	Answer
1	1
2	$\frac{53}{2}$
3	4563
4	20
5	$24 + 4\sqrt{58} + 6\sqrt{53}$

Final Score:

(Out of 8)

"Math is Cool" Masters -- 2013-14

School:_____ Room # _____ Team #_____

Name: _____Proctor: _____

High School **Mental Math** – 30 sec per question

8 problems read orally to everyone - Approximately 8% of Individual Score - 25% of team score

When it is time to begin, the proctor will read the first question twice. You may not do any writing or talking while arriving at a solution. Once you have a solution, record it on the sheet in front of you. ***You may not change or cross out answers once you have written an answer down. If there are eraser marks, write-overs, or crossed-out answers, they will be marked wrong.*** *Once all students have laid their pencils on the desk, another question will be asked. If a student doesn't lay his/her pencil down, the maximum wait time is 30 seconds after completion of the second reading of the question before another question is asked. You may continue to work on a problem while the next question is being read. The value of each question is a one or zero. Each student will be asked the same eight questions. Individual scores used to determine individual placing will be determined by the sum of the Mental Math score and the Individual Test score for each individual. In addition, the top three Mental Math scores from one team will be totaled and doubled and will contribute to 25% of the team score.*

	Answer	1 or 0	1 or 0
1			
2			
3			
4			
5			
6			
7			
8			

Math is Cool" Masters – 2013-14

11th & 12th Grade – December 7, 2013

Final Score:

Student Name_____

First Score

(out of 20)

Proctor Name_____Room #_____

SCHOOL NAME_____ Team #_____

INDIVIDUAL MULTIPLE CHOICE - 15 minutes – 10 problems – 20% of team score

This test is the only test where you will be penalized for incorrect responses. You will receive 2 points for a correct letter response, 0 points for leaving it blank and -1 point for an incorrect response. It is not necessary to write your personal name on the test, but you may put it at the bottom of the test so your coach will be able to give you back the correct test. This test is taken individually, but it is part of your team score, including zeros for missing team members. Your team score will be calculated by taking the mean of your four team members' scores. When you are prompted to begin, tear off the colored sheet and begin testing. ***Since this is a multiple choice test, ONLY a letter response should be indicated as an answer on the answer sheet.*** *No talking during the test.*

DO NOT WRITE IN SHADED REGIONS

	Answer	-1, 0 or 2	-1, 0 or 2
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

"Math is Cool" Masters – 2013-14

11th & 12th Grade – December 7, 2013

Final Score:

SCHOOL NAME_____ **Team #** _____

First Score

(out of 10)

Proctor Name_____Room #_____

Team Contest – Score Sheet

TEAM TEST - 15 minutes – 30% of team score

*When you are prompted to begin, tear off the colored sheet and give a copy of the test to each of your team members and begin testing. Each problem is scored as **1 or 0**. Record all answers on the colored answer sheet.*

DO NOT WRITE IN SHADED REGIONS

	Answer	1 or 0	1 or 0
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			