#0 Alpha Bowl
MAΘ National Convention 2019

Let **A** be the number of integers that satisfy the inequality $-2 < 4 - 3x \le 7 \ \ or \ 17 > 5x + 12 > 7$.

Let **B** be the value of *n* such that the line through the points (0, 4) and (*n*-2, 6) has *x*-intercept *n*.

Let **C** be $\dfrac{x^3 - y^3}{x^4 + x^2y^2 + y^4} \bullet \dfrac{x^3 + y^3}{x^2 - y^2}$.

Let **D** be the sum of the solutions to the equation: $\dfrac{x-2}{x^2-1} - \dfrac{3}{x^2+4x+3} = \dfrac{2x-1}{x^2+2x-3}$

ABCD = ?

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ABCD = ?

#1 Alpha Bowl

MAΘ National Convention 2019

Let S be the set of solutions to the system of equations below, with each element of S in the form (x,y).

$$x^2 + y^2 = 169$$
$$x^2 - y^2 = 119$$

Let **J** be the sum of all positive abscissas in S, and let **P** be the sum of all negative ordinates in S.

Let **F** be the product of the x and y-coordinates of the solution to the following system:

$$\frac{5}{x} - \frac{2}{y} = 5$$
$$\frac{4}{x} - \frac{3}{y} = -3$$

(J + P) ÷ F = ?

#1 Alpha Bowl

MAΘ National Convention 2019

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#2 Alpha Bowl
MAΘ National Convention 2019

In the binomial expansion of $(9x-y)^{1/2}$, **R** is the coefficient of the 3rd term.

Let **M** be the number of distinct subsets of the set {W, J, F, Z, L, U}.

In the binomial expansion of $\left(L+U\right)^6$, let **P** be the sum of the coefficients of the terms in which the exponent of U is greater than 2.

RMP = ?

#2 Alpha Bowl
MAΘ National Convention 2019

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RMP = ?

#3 Alpha Bowl
MAΘ National Convention 2019

Z. Simplify: $\left(\frac{x+1}{x-1}\right)\left[\frac{x^4-1}{x^2+1}+\frac{(x-1)^2}{x^2-1}\right]$

L. Simplify: $\frac{\left[(x+2)^5-(x+2)^3\right]\left(4x^2-24x+32\right)}{\left[\left(x^2+x-2\right)^2-\left(x^2-x-6\right)^2\right]\left(x^3+6x^2+11x+6\right)}$

U. Simplify: $\frac{\left(x^2-4y^2+4y-1\right)\left(4y^2-x^2\right)}{\left(x^2-x-4y^2+2y\right)\left(x^2+2y+x-4y^2\right)}$

Let A be the sum of the roots of the following equation, and let B be the product of the roots: **Z + L + U = 0**

Find $A + B$.

#3 Alpha Bowl
MAΘ National Convention 2019

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Let A be the sum of the roots of the following equation, and let B be the product of the roots: **Z + L + U = 0**

Find $A + B$.

#4 Alpha Bowl
MAΘ National Convention 2019

Let **J** = $\lim_{k\to\infty}\frac{1+4+9+25+...+k^2}{(k-1)^3}$.

Let **W** = $\lim_{x\to 0}\frac{\frac{1}{x+4}-\frac{1}{4}}{x}$.

Let **I** = $\lim_{x\to 2^+}\frac{x-2}{\sqrt{x^2-4}}$.

Let **G** = $\lim_{x\to 7^-}\frac{|8x-56|}{7-x}$.

G $\div$ **(JW) + I = ?**

#4 Alpha Bowl
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G $\div$ **(JW) + I = ?**

#5 Alpha Bowl
MAΘ National Convention 2019

A conic has an eccentricity of 1.25, and its foci are located at (0, 19) and (0, -1). Let **S** be the length of the conjugate axis.

Find **L** such that the following graph consists of two intersecting lines: $3x^2 - 4y^2 + 6x + 8y + L = 0$

Let **H** be the length of the latus rectum of $x^2 - 6x - 12y - 51 = 0$.

S + L + H = ?

#5 Alpha Bowl
MAΘ National Convention 2019

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S + L + H = ?

#6 Alpha Bowl
MAΘ National Convention 2019

The sum of the first 10 terms of a geometric series is $31+31\sqrt{2}$, and the common ratio is $\sqrt{2}$. Let **Z** be the third term.

Let **L** be the next term in the cubic sequence: 1, 6, 25, 70, 153, …

Let **U** = $\sum_{n=4}^{\infty} \frac{-1}{n^2-5n+6}$.

Z + L + U = ?

#6 Alpha Bowl
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Z + L + U = ?

#7 Alpha Bowl
MAΘ National Convention 2019

Let **W** be the number of distinguishable permutations of 03382019 that do not have a leading 0.

When the base 10 number $2019!$ is expressed in base 7, let **J** be the number of consecutive zeros at the end.

Let **F** be the number of integral values that $\frac{y}{x}$ can take, given the following inequality: $\frac{7}{2019} < \frac{x}{x+y} < \frac{8}{2019}$

W + J + F = ?

#7 Alpha Bowl
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W + J + F = ?

#8 Alpha Bowl
MAΘ National Convention 2019

1 is one of the fifth roots of 1. Let **W** be the sum of the other fifth roots of 1.

The two complex numbers whose squares equal 5-12i are M+Ri and L+Ui. Let MRLU **= I**.

If one of the solutions to $x^4 - 2x^3 - 6x^2 + 22x - 15 = 0$ is 2-i, let **G** be the sum of the real solutions.

WIG = ?

#8 Alpha Bowl
MAΘ National Convention 2019

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WIG = ?

#9 Alpha Bowl
MAΘ National Convention 2019

$$\frac{1}{\log_4 18}+\frac{1}{2\log_6 3+\log_6 2}+\frac{5}{\log_3 18}=\mathbf{Z}$$

Let **L** be the number of integral values of *x* that satisfy $\log\left(x^2\right)>\left(\log x\right)^2$.

Let **U** be the sum of the solutions to the equation $\dfrac{2}{\log_{x+1} 4}+3\log_8\left(x-3\right)-4\log_{16} 12=0$.

Z + L + U = ?

#9 Alpha Bowl
MAΘ National Convention 2019

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#10 Alpha Bowl
MAΘ National Convention 2019

$\begin{pmatrix} 4 & 9 \\ 2 & 3 \end{pmatrix} Y = \begin{pmatrix} -4 & 5 \\ -2 & 7 \end{pmatrix}$ for a matrix Y. Let **M** be the sum of the elements in Y.

$$\begin{vmatrix} 1 & 3 & -2 & -1 \\ 0 & 2 & 4 & 1 \\ 0 & -5 & 0 & 3 \\ -1 & -3 & -1 & 1 \end{vmatrix} = \mathbf{A}$$

Let **O** be the number of integral ordered pairs (x, y) that are solutions to $\begin{bmatrix} x & y \\ y & x \end{bmatrix}^2 = \begin{bmatrix} 5 & 4 \\ 4 & 5 \end{bmatrix}$.

M + A + O = ?

#10 Alpha Bowl
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M + A + O = ?

#11 Alpha Bowl

MAΘ National Convention 2019

Let **W** be the maximum value of $\sin x + \cos 2x$

Let **J** satisfy $Sin^{-1}\dfrac{J}{377} = Cos^{-1}\dfrac{20}{29} - Cos^{-1}\dfrac{12}{13}$.

$\cos\phi = \dfrac{-12}{13}; \tan\phi > 0$; $\sin\theta = \dfrac{3}{5}; \tan\theta < 0$. Let **F** satisfy $\tan(\theta+\phi) = \dfrac{F}{63}$.

WF + J = ?

#11 Alpha Bowl

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WF + J = ?

#12 Alpha Bowl
MAΘ National Convention 2019

The probability of having Lu-itis is .05. The probability of testing positive if you have Lu-itis is .98. The probability of testing positive when you do not have the disease is .10. Let **J** be the probability that you have Lu-itis if you test positive for it.

If you roll a pair of dice (one is an 8-sided die, and the other is a standard six-sided die), let **C** be the probability that you get doubles or a sum of six.

A married couple has two children. It is given that one of them is a boy. Let **G** be the probability that the other child is a boy.

(J + C) ÷ G = ?

#12 Alpha Bowl
MAΘ National Convention 2019

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#13 Alpha Bowl
MAΘ National Convention 2019

If $\sec^2(x) - 2 \cdot \tan(x) = 4$, let **J** be the number of solutions for x over the domain $[0, 2\pi]$.

If $\cot x \cos^2 x = \cot x$, let **P** be the sum of the solutions for x over the domain $[0, 2\pi]$.

Let **F** be $Sin^{-1}\left(\sin\left(\frac{5\pi}{3}\right)\right)$.

Let **R** be the measure (in degrees) of the smallest positive angle coterminal with -1126°.

JP ÷ F + R = ?

#13 Alpha Bowl
MAΘ National Convention 2019

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#14 Alpha Bowl
MAΘ National Convention 2019

A high school crew team can paddle 12 km upstream and 12 km back downstream in the same amount of time as it can paddle 25 km in still water. If the speed of the current is 2 km/h, let **A** be the team's speed in still water (answer should be in km/h).

Increasing the average speed of Mr. Lu's yacht by 13 mph resulted in a 260 mile trip taking an hour less than before. Let **B** be the original average speed of Mr. Lu's yacht, in miles per hour.

AB = ?

#14 Alpha Bowl
MAΘ National Convention 2019

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