

Gunga Bowl Set 1

- G1. [8] The grid below is to be filled with real numbers such that the sum of the 3 numbers in any row, column, or diagonal are equal. Find the number in the center square.

	19	
	?	
17		13

- G2. [8] Yoll is trying to escape from Eddie! Yoll starts at $(0,0)$ and moves in the positive y -direction at a speed of 1 unit per second. Eddie starts at $(3,0)$ and can move in any direction at a speed of 2 units per second. If Eddie chases Yoll optimally, he will catch up to Yoll after s seconds. Find s^2 .
- G3. [8] Find the unique real number x satisfying

$$\sqrt{x + \sqrt{x + 11}} + \sqrt{x - \sqrt{x + 11}} = 4.$$

Gunga Bowl Set 2

- G4. [10] Given that the product of the real roots of

$$\prod_{k=1}^{2026} (x^2 + kx + 2027)$$

can be written in the form p^n , where p is a prime number, find n .

- G5. [10] The 2026 MOAA Board consists of 6 Seniors and 6 Uppers. If Walleye wants to form a committee such that there are no more Uppers than Seniors, find the number of ways Walleye can form a non-empty committee.
- G6. [10] Three mutually externally tangent circles are drawn such that they all share a single common external tangent line. The two larger circles have radii of 4 and 9. If the radius of the smallest circle can be written as $\frac{m}{n}$, where m and n are relatively prime positive integers, find $m + n$.

Gunga Bowl Set 3

- G7. [12] Find the smallest positive integer that can be expressed as the product of two not necessarily distinct perfect squares in exactly 7 different ways.
- G8. [12] Let ABC be a triangle. The angle bisector of $\angle BAC$, the perpendicular from B to side AC , and the perpendicular bisector of AB intersect at a single point X . If $AB = 26$, find the largest possible length of BC for which the length of AC is an integer.
- G9. [12] Let $P(x)$ be a monic polynomial of degree 6. Given that $P(1) = 1$, $P(2) = 2$, $P(3) = 5$, $P(4) = 12$, $P(5) = 25$, and $P(6) = 46$, find the value of $P(7)$.

Gunga Bowl Set 4

- G10. [14] Let N be the answer to this problem, and let M be the largest proper divisor of N . Given that M is a multiple of 5, find the largest proper divisor of M^2 .
- G11. [14] A 20×26 grid is filled with nonnegative integers. Every entry in the first row and first column is 0. Whenever one moves one square to the right or one square down, the new entry is either equal to the old entry or exactly 1 larger. Find the greatest possible sum of all 520 entries in the grid.
- G12. [14] Let ABC be a triangle with $AB = 15$, $BC = 42$, and area 252. Point K lies on segment $\overline{BC}$, and point P lies within triangle ABC such that $PA \perp AB$ and $PK \perp BC$. Suppose that the area of quadrilateral $ABKP$ is exactly $\frac{1}{2}$ the area of triangle ABC . Find the area of triangle APC .

Gunga Bowl Set 5

- G13. [16] Gunga has some red, green, and blue balls, with one of each color in a bag and one of each color outside the bag. He repeatedly draws one ball randomly from the bag. If it is red, green, or blue, he puts back a green, blue, or red ball, respectively, and stops once he doesn't have any correctly colored balls left outside the bag. Find the expected number of balls Gunga will draw from the bag.

- G14. [16] Let

$$P = \frac{2^3 - 1}{2^3 + 1} \cdot \frac{3^3 - 1}{3^3 + 1} \cdot \frac{4^3 - 1}{4^3 + 1} \cdot \cdots \cdot \frac{2026^3 - 1}{2026^3 + 1}.$$

Let Q be the smallest positive integer for which PQ is an integer. Find the sum of all distinct prime divisors of Q .

- G15. [16] Ellie is given a cubic polynomial $P(x) = x^3 - 9x^2 + 15x - C$ where C is a integer. She is told that this polynomial has three distinct positive real roots. Find the maximum possible value of C .

Gunga Bowl Set 6

- G16. [18] Suppose that real numbers x, y, z satisfy

$$\frac{1}{2} \left(\frac{1}{x} + \frac{1}{y} + \frac{1}{z} \right) = \frac{1}{xyz} = x + y + z - xyz.$$

The smallest possible value of $x^2 + y^2 + z^2$ can be written as $\frac{m}{n}$, where m and n are positive co-prime integers. Find $m + n$.

- G17. [18] Let f be a polynomial with nonnegative integer coefficients. Suppose that $f(1) = 11$ and $f(f(1) + 1) = 69696$. Find $f(f(1) - 1)$.
- G18. [18] Compute

$$\sum_{x=1}^9 \sum_{y=1}^{x^2} \sum_{z=\lceil \sqrt{y} \rceil}^x \frac{y}{z^2 x},$$

where $\lceil n \rceil$ denotes the smallest integer greater than or equal to n .

Gunga Bowl Set 7

- G19. [20] On a 3×7 board, a laser beam shoots in horizontally to the right from the top-left grid. Ishan can choose to place a double-sided mirror in some grids along exactly one of the two diagonals. A configuration of mirrors is called *return-to-sender* if the laser beam reaches the top-left grid a second time. Find the number of return-to-sender configurations.
- G20. [20] Let ABC be a triangle with $AB = 77$, $BC = 66$, and $CA = 77$. Let M be the midpoint of AB , and O be the circumcenter of ABC . Suppose that point D lies on segment AC and point O' lies on ray MO such that $\frac{AC}{CD} = \frac{MO'}{MO} = 3$. Line DO' intersects the angle bisector of $\angle BAC$ at point G . Find the distance from A to line BG .
- G21. [20] Find the number of ordered triples (p, q, r) , where p, q, r are primes no greater than 13, such that there exist two positive rational numbers u and v satisfying

$$u + v = \frac{q}{p} \quad \text{and} \quad uv = \frac{r}{p}.$$

Gunga Bowl Set 8

- G22. [22] Alice is stacking a group of A RSM frisbees and B MehtA+ frisbees, where neither sponsor has more than twice as many frisbees as the other. If there are exactly 246 ways for her to stack the frisbees such that no three consecutive frisbees can be from the same sponsor, find $A + B$.
- G23. [22] Isosceles triangle ABC with $AB = BC$ has its incircle γ centered at I with radius 3 touching side BC at D . Let M be the midpoint of BC , and suppose that lines MI and AD intersect on γ . If S is the area of ABC , compute S^2 .
- G24. [22] Let a and b be positive real numbers, and suppose that the graphs of the equations

$$y = ax^2 - b \quad \text{and} \quad x = ay^2 - b$$

intersect at 4 distinct points A, B, C , and D , with their x -coordinates increasing in that order. The perpendicular bisectors of AB and CD meet at P . If the distance from P to the origin is 400, find the smallest possible value of $\lfloor b \rfloor$.

Gunga Bowl Set 9

This set consists of three estimation problems, with scoring schemes described.

- G25. [30] Estimate N , the total number of participants (in person and online) at MOAA this year.
An estimate of e gets a total of $\max\left(0, \left\lfloor 150 \left(1 - \frac{|N-e|}{N}\right) \right\rfloor - 120\right)$ points.
- G26. [30] Estimate L , the total number of letters in all the teams that signed up for MOAA this year, both in person and online.
An estimate of e gets a total of $\max\left(0, \left\lfloor 150 \left(1 - \frac{|N-e|}{N}\right) \right\rfloor - 120\right)$ points.
- G27. [30] Estimate S , the sum of all submitted answers across every round of MOAA 2026 (besides Gunga Bowl Set 9) that includes either the digit 6 or 7.
An estimate of e gets a total of $\max\left(0, 30 - \left\lfloor \frac{|S-e|}{2000} \right\rfloor\right)$ points.