

MBMT Brahmagupta Guts Round – Set 1

April 16, 2023

[start=(1)*5+1]

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- 1 [3] Martha is 5 years older than Mary. If Martha will be twice Mary's age in 2 years, how old is Mary right now?
- 2 [3] A 1000-gallon tank has two pipes. Pipe A can fill the tank in 15 hours. Every hour, pipe B drains 50 gallons from the tank. After how much time (hours) will the empty tank be filled up completely?
- 3 [3] Given that $x^2 + \frac{x}{3} = 10$, if x is prime, what is x ?
- 4 [3] If the Earth really was flat and a circle with radius 4 miles, and 75% of the surface area was ocean, what is the surface area NOT covered by ocean in square miles?
- 5 [3] Maggie wants to paint her bedroom blue-gray. To make blue-gray paint, she must mix one part blue paint with two parts white paint. If she has 12 liters of white paint, how much blue-gray paint will she have after she mixes in the right amount of blue paint?

MBMT Brahmagupta Guts Round – Set 2

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[start=(2)*5+1]

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- 6 [4] There are 100 students who go to Bontgomery Mlair. There are 50 students who are Swifties, and 75 students whose favorite subject is math. If there are 30 students who are both Swifties and love math, how many students are neither Swifties nor math lovers?
- 7 [4] Alex and Daniel are driving to school. If the parking lot has 10 adjacent parking spots in a line, how many different ways can Alex and Daniel park their cars such that they do not park next to each other?
- 8 [4] Let t be the answer to this question. If $x^2 + ax + b$ has exactly one real solution, t , and $a \neq b$, find the value of b .
- 9 [4] Bob has b roses. Bobeth has double the number of roses that Bob has. Boberta has $\frac{1}{4}b^2$ more roses than Bob. How many roses do all three of them have together if Bobeth and Boberta have the same number of roses? They all have at least one rose.
- 10 [4] Bonnie likes to collect stickers. On her birthday, she collects the same number of stickers as the age she is turning. While she was not given any before she was 5, she started by collecting 5 stickers at her 5th birthday. How many stickers will she have in total when she turns 24, including those she collects at her 24th birthday?

MBMT Brahmagupta Guts Round – Set 3

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[start=(3)*5+1]

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- 11 [5] How many numbers less than or equal to 75 are divisible by 2, 3, or 7?
- 12 [5] Find the area of the largest equilateral triangle that can be inscribed in a unit square.
- 13 [5] Taylor drops a surprise album from a height of 13 meters. If the height of each bounce is $\frac{2}{3}$ the height of the previous bounce, find the total vertical distance traveled by the album.
- 14 [5] Bob can do 5 pages of math homework in 3 hours. Jeff can do 5 pages of math homework in 4 hours. If Bob and Jeff worked together, how long would it take them to finish 35 pages of math homework?
- 15 [5] A "crescent" is made by putting a smaller circle inside a larger circle (shown below). The smaller circle's radius is $\frac{2}{3}$ of the larger circle's radius. If the larger circle has radius 9, what is the area of the crescent (shaded region)?

MBMT Brahmagupta Guts Round – Set 4

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[start=(4)*5+1]

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- 16 [7] How many ways are there to tile a 99×102 grid with octominoes the shape of 3×3 blocks with a single missing corner? A grid is considered tiled if it is covered with no gaps.
- 17 [7] In a parallelogram ABCD, $AB = 4$, $BC = 7$, and $\angle ABC = 75^\circ$. Find $AC^2 + BD^2$.
- 18 [7] Let $f(x)$ be the 1000-degree polynomial with all real roots. Given that f has five distinct double roots, twelve distinct triple roots, and no other multiple roots, how many times does $f(x)$ intersect the x -axis?
- 19 [7] Niklas Khil is pretty good at squaring stuff. He knows $(x + y)^2 = 4$, $(x + z)^2 = 5$, $(z + y)^2 = 9$, and $(x + y + z)^2 = 3/2 - \sqrt{5}/2$. He can do it all. Now adding three numbers? He's not so good at that. Help Niklas find what $x^2 + y^2 + z^2$ is equal to.
- 20 [7] Find positive integer x such that

$$45^3 + 54^3 = x^5 - 3^5$$

MBMT Brahmagupta Guts Round – Set 5

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[start=(5)*5+1]

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- 21 [9] You are making a circular necklace for your friend's birthday. You have 5 identical blue beads and 8 identical green beads. How many different necklaces can you make using all of these beads so that blue beads are not adjacent to each other? A necklace that is the same when flipped over is considered the same necklace.
- 22 [9] $(2024^2 + 2025) \cdot (2024^2 - 2023)$ can be written as $\frac{x^6-1}{x^2-1}$ for some positive real number x . What is $|x|$?
- 23 [9] How many triangles with positive area and integer side lengths less than 30 can be formed such that the side lengths form an increasing geometric sequence?
- 24 [9] Bradley rolls three 6-sided dice and records the three numbers. What is the probability that there is a non-degenerate triangle with these three side lengths?
- 25 [9] Wanda the Witch really hates kids. She especially despises them during Halloween, when their audacity and blatant disregard go through the roof. Wanda devises an evil plan to rid her of kids: she builds a magical entry with the illusion of a tray of candy, but unfortunate victims leave only with celery and disappointment. However, Wanda's magic sometimes malfunctions, so that 50% of the time children receive candy. From Wanda's experience, rumors scare kids away if more than 5 kids in a row have their hopes dashed with vegetables. What is the expected number of kids that Wanda will trick before no more kids ring her doorbell?

MBMT Brahmagupta Guts Round – Set 6

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[start=(6)*5+1]

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- 26 [12] What is the sum of the reciprocals of every non-zero correct answer across all problems appearing on either division of this year's MBMT given that the answer is positive? (This includes all 8 individual rounds, both team rounds, and both guts rounds.)
- 27 [12] Estimate $\log_{10}(2024!)$.
- 28 [12] A circle of radius 1 is circumscribed by an equilateral triangle which is circumscribed by another circle which is circumscribed by a square. This pattern continues of circumscribing circles and then regular n -gons up until $n = 8$. Find the sum of the areas of the even n -gons minus the sum of the areas of the odd n -gons.
- 29 [12] We've simulated 1,000 3D random walks, each consisting of ten steps of length one in a random direction. Estimate the total sum of the distances from the origin.
- 30 [12] Approximate $\binom{100}{0} + \binom{99}{1} + \dots + \binom{50}{50}$