

MBMT Jacobi Guts Round — Set 1

March 8, 2026

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1. [3] Sam, Bill, and David went to an all-you-can-eat sushi restaurant and ate 70 pieces of sushi in total. Sam says he ate a prime number of pieces of sushi. David says that he ate 25 pieces of sushi. Bill says that the number of pieces he ate is divisible by 13. How many pieces of sushi did Sam eat?
2. [3] What is the sum of all two-digit numbers whose digits multiply to 20?
3. [3] A square has the same area and perimeter. What is its length?
4. [3] A fair 6-sided die is rolled once onto a table so that one of the faces is facing the table. What is the probability that the sum of the numbers on each of the 5 visible faces is odd?
5. [3] Two brothers, Yao and Yur, are comparing their ages. When they add their ages together, they get 15. When they multiply them together, they get a perfect square. What is the age of the younger brother?

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6. [4] The surface area of a cube is multiplied by 4 to form another cube. By what factor is the volume of the cube multiplied?
7. [4] A palindrome is a number that is read the same forwards and backwards. For example, 11, 121, and 1331 are all palindromes. What is the only 3 digit palindrome that is divisible by 45?
8. [4] Louie the cat has 3 bowls of milk. The first bowl has twice as much milk as the second bowl, and the third bowl has 6 more ounces of milk than the second bowl. If Louie pours all the milk together into one bowl, he has 30 ounces of milk in total. How many ounces of milk were in the first bowl?
9. [4] Jeremy's school cafeteria offers 3 categories on their menu: 2 choices for hot food, 3 choices for sides, and 2 choices for drinks. How many different orders can Jeremy get for lunch if he can only pick at most one item from each category (Jeremy may choose to eat nothing)?
10. [4] Isosceles triangle $\triangle ABC$ with $AB = AC$ has $\angle BAC = 24^\circ$, and a point X is chosen on the interior of segment $\overline{AC}$ such that $BX = BC$. What is the measure of angle $\angle BXA$?

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11. [5] The four digit number $\underline{MBMT}$ is divisible by 10, 11, and 12. What is the value of $M + B + T$?
12. [5] A number is *cultured* if it is prime, and leaves a remainder of 2 when divided by 13. What is the sum of all two-digit *cultured* numbers?
13. [5] Winter has a pink marker, a blue marker, and a black marker. Each time she writes one letter of a word, she has to pick a different colored marker before she continues writing the word. In how many different ways can she color the word “*WHIPLASH*”?
14. [5] The first 2027 positive odd integers are arranged in a sequence in such a way that each number is the average of the two numbers adjacent to it in the sequence. What is the smallest possible value of the 1014th term of this sequence?
15. [5] Two externally tangent circles with radii 8 and 12 have centers X and Y respectively, and they intersect at a single point Z . A point O is chosen on the common tangent line to the two circles passing through Z so that $OY = OX + 1$. What is the value of $OX + OY$?

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16. [7] Kele is struggling on a true or false brain rot test. If the test has 7 questions in total, what is the probability that Kele randomly guesses at least 6 questions correct?
17. [7] Let the Fibonacci sequence be defined by first term $F_1 = 1$, second term $F_2 = 1$, and n th term $F_n = F_{n-1} + F_{n-2}$. How many of the first 2026 terms of the Fibonacci sequence are odd?
18. [7] A square and a circle share the same center, and the ratio of the square's side length to the circle's radius is $\sqrt{3}$. What fraction of the square's perimeter lies within the circle?
19. [7] Let

$$f(x) = (x - 1)(x - 4)(x - 9)(x - 16)(x - 25) \cdots (x - 2025^2).$$

The value of $f(2026^2)$ can be expressed as $n!/k$ for some integers n and k , where k is minimized. What is the value of $n + k$?

20. [7] Thomas chooses three unique points at random from the vertices of a regular 2026-gon. What is the probability that the triangle formed by those three points is obtuse?

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21. [9] Let $ABCD$ be a square with side length 24. Points E and F are chosen on segment $\overline{CD}$ such that $CE = DF = 10$. A circle tangent to segments $\overline{AF}$ and $\overline{BE}$ is centered at O , the center of the square. What is the radius of this circle?
22. [9] Let $f(n)$ output the sum of the first n positive integers, where n is positive. Let S be the set of all integers k such that $f(k)$ is a perfect square. What is the sum of the 3 smallest numbers in S ?
23. [9] Grogg places 3 lamps around a circle and turns exactly one of them on. After every second, the lamp directly clockwise to any lamp that is on will turn either on or off with equal probability. What is the expected number of seconds that pass until all of the lamps are on at once?
24. [9] Evaluate the sum

$$\sum_{a=-9}^9 \sum_{b=-9}^9 \max(|a-b|, |a+b|).$$

25. [9] Square $ABCD$ has a side length of 12. A point P is drawn such that $AP = 6$ and $\angle BPD = 135^\circ$. Let the line containing all such points P be ℓ , and let X be the point on ℓ such that the length of $\overline{AX}$ is minimized. What is the length of segment $\overline{CX}$?

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26. [12] Six points A, B, C, D, E , and F are chosen at random along the circumference of a unit circle. Estimate the expected value of the area of the intersection of triangles $\triangle ABC$ and $\triangle DEF$.
27. [12] Let $!n! = n! \times (n-1)! \times \cdots \times 1!$ (where $m! = m \times (m-1) \times \cdots \times 1$). Estimate the number of trailing zeroes at the end of $!2026!$.
28. [12] A weighted 20 sided die has the numbers 1 through 20 written on its faces. The probability of rolling any face is proportional to the number on the face. Estimate the expected number of rolls it will take to roll each number 1 through 20 at least once.
29. [12] A real number x is chosen at random on the closed interval $[0, 1]$. Estimate the expected value of

$$\sum_{n=1}^{2026} \frac{\{nx\}}{\lceil nx \rceil}$$

where $\{x\}$ denotes the fractional part of x and $\lceil x \rceil$ denotes the least integer greater than x .

30. [12] For some integer x , let $k(x)$ denote the number of positive divisors of x multiplied by the sum of the positive divisors of x . For example, $k(12) = 6 \cdot 28 = 168$, as it has 6 divisors and they sum to 28. Let $\mathbb{N}$ denote the set of all natural numbers. Estimate

$$\sum_{x \in \mathbb{N}} \frac{k(x)}{x^3}.$$