

MAO Nationals 2026

Theta Gemini

1) What is the sum of the digits in the expansion of 2026^2 ?

- A) 26 B) 28 C) 30 D) 32 E) NOTA

2) Suppose five Scrabble tiles with the letters A, A, B, B, C are in a jar, and are drawn out one by one. What is the probability that the letters are drawn out in alphabetical order?

- A) $\frac{1}{30}$ B) $\frac{1}{15}$ C) $\frac{2}{15}$ D) $\frac{1}{6}$ E) NOTA

3) Find the equation of a circle with radius 7 centered at (3, -2).

- A) $x^2 - 6x + y^2 + 4y - 36 = 0$ B) $x^2 - 6x + y^2 + 4y + 36 = 0$
C) $x^2 + 6x + y^2 - 4y - 62 = 0$ D) $x^2 + 6x + y^2 - 4y + 62 = 0$
E) NOTA

4) What is the area enclosed by the ellipse $4x^2 + 9y^2 - 48x + 72y + 144 = 0$?

- A) 24π B) 20π C) 18π D) 28π E) NOTA

5) List the following quantities, in order from largest to smallest, using the letters W, X, Y, and Z.

$$W = 75^2 \quad X = 1002^2 - 998^2 \quad Y = 76 \times 74 \quad Z = 2^{12}$$

- A) X,Y,Z,W B) W,X,Y,Z C) X,W,Y,Z D) W,Y,X,Z E) NOTA

6) What is the sum of the positive integral factors of 2026?

- A) 3028 B) 3032 C) 3038 D) 3042 E) NOTA

7) A 30° - 60° - 90° triangle has a side of length 2. What is the maximum area enclosed by the triangle?

- A) $\frac{\sqrt{3}}{2}$ B) $\frac{2\sqrt{3}}{3}$ C) $\sqrt{3}$ D) $\frac{3\sqrt{3}}{2}$ E) NOTA

8) Find the sum of the least nonnegative integers a and b that satisfy

$$\log_4(a) + \log_b(9) = \frac{5}{2}$$

$$\log_a(2) + \log_9(b) = \frac{3}{2}$$

- A) $\frac{5}{2}$ B) 5 C) $\frac{7}{2}$ D) 7 E) NOTA

9) What is the sum of all of the positive integers less than 200 that are divisible by 3 or 11 but not divisible by 33?

- A) 6435 B) 7128 C) 7821 D) 8514 E) NOTA

10) Regular octagon $ACBDEFGH$, with its vertices labeled in clockwise order, is drawn on the coordinate plane. The coordinates of A are $(4,0)$ and the coordinates of B are $(0, 4)$. If the coordinates of E are (p, q) , what is $q - p$?

- A) 8 B) 4 C) 0 D) -4 E) NOTA

11) Which of the following is equal to the sum of ${}_{13}C_4 + {}_{13}C_5 + {}_{13}C_6 + {}_{13}C_7 + {}_{14}C_6$?

- A) ${}_{16}C_6$ B) ${}_{15}C_6$ C) ${}_{16}C_5$ D) ${}_{15}C_7$ E) NOTA

12) The region inside an ellipse with equation $\frac{(x+5)^2}{16} + \frac{(y-3)^2}{4} = 1$ is completely revolved around the axis $5x - 12y = 17$ so as to create a torus. Find the volume, in cubic units, of that torus.

- A) $144\pi^2$ B) $96\pi^2$ C) $288\pi^2$ D) $72\pi^2$ E) NOTA

13) How many scoring sequences are possible if the Huskies won their soccer game 6-4 and they were never behind in the game?

- A) 64 B) 56 C) 81 D) 90 E) NOTA

14) Marie starts writing DALLASTEXAS over and over again. What will the 1000th letter that she will write?

- A) X B) L C) S D) A E) NOTA

15) What is the vertex (x, y) of the parabola $y = (x - 2)(x + 4)$?

- A) $(1, -9)$ B) $(-1, 9)$ C) $(2, -9)$ D) $(-2, -9)$ E) NOTA

16) Given $\frac{3}{x^2-x-2} = \frac{A}{x-2} + \frac{B}{x+1}$, where A and B are real, find A + B.

- A) 1 B) -1 C) 3 D) -3 E) NOTA

17) What is the inverse of the matrix $\begin{bmatrix} 1 & -1 & 8 \\ 1 & -4 & 4 \\ 0 & 3 & 2 \end{bmatrix}$?

A) $\begin{bmatrix} \frac{10}{3} & -\frac{13}{3} & \frac{14}{3} \\ \frac{1}{3} & \frac{1}{3} & \frac{2}{3} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \end{bmatrix}$ B) $\begin{bmatrix} -\frac{10}{3} & \frac{13}{3} & \frac{14}{3} \\ -\frac{1}{3} & \frac{1}{3} & \frac{2}{3} \\ \frac{1}{2} & -\frac{1}{2} & -\frac{1}{2} \end{bmatrix}$ C) $\begin{bmatrix} 1 & \frac{13}{3} & \frac{14}{3} \\ 0 & \frac{1}{3} & \frac{2}{3} \\ 0 & -\frac{1}{2} & \frac{1}{2} \end{bmatrix}$

D) $\begin{bmatrix} \frac{10}{3} & 0 & \frac{14}{3} \\ \frac{1}{3} & -\frac{1}{4} & \frac{2}{3} \\ \frac{1}{2} & 0 & -\frac{1}{2} \end{bmatrix}$ E) NOTA

18) Sam is buying candy. Two chocolate bars, three gobstoppers, and five jawbreakers cost \$1.84. Seven chocolate bars, five gobstoppers, and four jawbreakers cost \$3.20. Four chocolate bars, seven gobstoppers, and seven jawbreakers cost \$3.56. If Sam wants to buy three of each type of candy how much will it cost?

- A) \$0.87 B) \$1.44 C) \$1.53 D) \$1.77 E) NOTA

19) Find y so that $\begin{vmatrix} 1 & 4 & 7 \\ 2 & y & 5 \\ -1 & 7 & -2 \end{vmatrix} = 0$

- A) 10 B) $\frac{51}{5}$ C) 11 D) $\frac{59}{5}$ E) NOTA

20) Simplify: $\frac{1}{\ln(\sqrt{e})} \times \ln\left(\frac{1}{\sqrt{e}}\right) \times \ln(e^2)$

- A) 4 B) $\frac{1}{2}$ C) 2 D) -2 E) NOTA

21) The probability that Sam gets an A in math is .6, the probability Jill gets an A in math is .8 and the probability Jeremy gets an A in math is .2. Given that these are independent events, what is the probability that only one of them gets an A in math?

- A) .124 B) .268 C) .342 D) .368 E) NOTA

22) An isosceles trapezoid is inscribed in a circle of radius 17. The longer base is a distance 8 away from the center of the circle, and the shorter base of the trapezoid has length 10. The two bases are on opposite sides of the circle's diameter that is parallel with those bases. What is the area enclosed by the trapezoid?

- A) $640\sqrt{66}$ B) 680 C) $160 + 40\sqrt{66}$ D) $108 + 27\sqrt{66}$ E) NOTA

23) At any point when Mr. Smith's wife is having a baby, the probability that the baby will be a boy is equal to the probability the baby will be a girl. If Mr. Smith's wife had 12 children, what is the probability that they had more boys than girls?

- A) $\frac{395}{1024}$ B) $\frac{396}{1024}$ C) $\frac{793}{2048}$ D) $\frac{795}{2048}$ E) NOTA

24) If A = the sum of the odd integers between 10 and 100, and B = the sum of the even integers between 101 and 201, by how much is B greater than A ?

- A) 5070 B) 5075 C) 6070 D) 6075 E) NOTA

25) The repeating decimal $0.26666\dots$, where only the 6 is repeated infinitely, is equal to the simplified fraction $\frac{a}{b}$, where a and b are relatively prime positive integers. What the value of a ?

- A) 2 B) 3 C) 4 D) 5 E) NOTA

26) Suppose A and B are digits for which the product of the two-digit numbers $2A$ and AB is 1,971. Find the sum of A and B .

- A) 8 B) 9 C) 10 D) 11 E) NOTA

27) How many even five-digit palindromes are there?

- A) 1000 B) 500 C) 400 D) 100 E) NOTA

28) Tom and Zach love to play Scrabble. The probability of Tom winning when he plays Scrabble with Zach is $\frac{3}{5}$, and they never tie. Tom and Zach plan a Scrabble tournament, the winner of which will be the first person to win three games. What is the probability of Tom winning this tournament in exactly five games?

- A) $\frac{1422}{3125}$ B) $\frac{648}{3125}$ C) $\frac{2133}{3125}$ D) $\frac{237}{625}$ E) NOTA

29) In the expansion of $(2x - 3y)^{10}$, what is the coefficient of the $x^2 y^8$ term?

- A) -721710 B) -1443420 C) 721710 D) 1443420 E) NOTA

30) Find the sum of the absolute values of the solutions to the equation:

$$x^4 - 2x^3 - 33x^2 + 50x + 200 = 0$$

- A) 16 B) 17 C) 18 D) 20 E) NOTA