

- If α and β are two roots of the equation $5x^2 - 2x - 1 = 0$, what is $\frac{1}{\alpha} + \frac{1}{\beta}$?
A) $\frac{1}{2}$ B) $-\frac{1}{2}$ C) -2 D) 2 E) NOTA
- If $\tan x + \tan y = 6$ and $\cot x + \cot y = 3$, what is $\tan(x + y)$?
A) -6 B) -5 C) 5 D) 6 E) NOTA
- Suppose that $f(4 - x) = 2x^2 - x - 7$ and $f(x) = px^2 + qx + r$. What is $p + q + r$?
A) -6 B) 8 C) 14 D) -4 E) NOTA
- If a_n is a geometric sequence with $a_1 = 2$ and $a_5 = 18$, find the sum $a_1 + a_3 + a_5 + a_7$.
A) 80 B) 72 C) 36 D) 27 E) NOTA
- Simplify the product: $\tan 10^\circ \tan 20^\circ \tan 30^\circ \cdots \tan 80^\circ$
A) $\frac{1}{2}$ B) 1 C) $\frac{1}{3}$ D) 3 E) NOTA
- Let $f(x) = \log_2(x + \sqrt{x^2 + 1})$. If $f(a) = b$, what is $f(-a)$?
A) a B) $a + b$ C) b D) $-b$ E) NOTA
- Find the value of $\sqrt{1 + \sqrt{1 + \sqrt{1 + \cdots}}}$.
A) 2 B) $\frac{1+\sqrt{5}}{2}$ C) $\frac{1+\sqrt{5}}{4}$ D) $\sqrt{2}$ E) NOTA
- Two numbers, x and y , are selected at random from the interval $[0,2]$. What is the probability that $y \leq x + 1$?
A) $\frac{7}{8}$ B) $\frac{3}{4}$ C) $\frac{2}{3}$ D) $\frac{1}{2}$ E) NOTA
- How many real solutions are there to the equation $|2x - 3| + |5 - 2x| = 2$?
A) 1 B) 2 C) 3 D) 4 E) NOTA
- If $\csc x - \cot x = 7$, what is $\csc x + \cot x$?
A) 1 B) 3 C) $\frac{1}{3}$ D) $\frac{1}{7}$ E) NOTA
- How many distinct prime factors are there in $999,999$?
A) 3 B) 4 C) 5 D) 6 E) NOTA
- If $2 + 3i$ and $1 + 4i$ are two roots of the equation $x^4 + ax^3 + bx^2 + cx + d = 0$ where a, b, c, d are integers, what is the value of $a + b + c + d$?
A) 145 B) 159 C) 221 D) 230 E) NOTA

13. Consider a rational function $f(x) = \frac{ax+b}{cx+d}$ where $a, b, c,$ and d are relatively prime integers with $c > 0$. If f has its inverse function $f^{-1}(x) = \frac{x+4}{2x+1}$, what is $a + b + c + d$?
- A) 5 B) -5 C) 4 D) -4 E) NOTA
14. How many solutions to the equation $\sin^4 x + \cos^4 x = 1$ are there in the interval $[0, 2\pi)$?
- A) 4 B) 5 C) 6 D) 7 E) NOTA
15. Suppose that two positive numbers x and y satisfy $\log_y x + \log_x y = \frac{10}{3}$ and $xy = 81$. What is the value of $x + y$?
- A) 27 B) 30 C) 36 D) 49 E) NOTA
16. How many 4-digit numbers are there whose digit sum equals 10?
- A) 200 B) 219 C) 220 D) 286 E) NOTA
17. Suppose that $f(x)$ is a monic polynomial of degree 3 such that $f(1) = 1, f(2) = 4, f(3) = 9$. Find the value of $f(4)$.
- A) 16 B) 20 C) 22 D) 29 E) NOTA
18. Which of the following is equal to $\sqrt[3]{9 - 4\sqrt{5}} + \sqrt[3]{9 + 4\sqrt{5}}$?
- A) $2\sqrt[3]{3}$ B) $2\sqrt{5}$ C) 4 D) 3 E) NOTA
19. Find the sum of the solutions to the equation $2^{\sin^2 x} + 5 \cdot 2^{\cos^2 x} = 7$ where x is in the interval $(0, 2\pi)$.
- A) $\frac{\pi}{2}$ B) π C) $\frac{3\pi}{2}$ D) 2π E) NOTA
20. What is the remainder when $1! + 2! + 3! + \dots + 2018!$ is divided by 7?
- A) 4 B) 5 C) 6 D) 0 E) NOTA
21. If a_n is an increasing arithmetic sequence satisfying $a_5 + a_9 = 0$ and $|a_6| = |a_7| + 2$, what is a_1 ?
- A) -12 B) -10 C) -8 D) -6 E) NOTA
22. If x is a positive real number such that $\sin(\arctan(\frac{x}{2})) = \frac{x}{3}$, what is the value of x ?
- A) 1 B) 2 C) $\sqrt{5}$ D) $\sqrt{6}$ E) NOTA
23. Let a_n be a sequence of positive, distinct integers. Suppose that a_1, a_2, a_3 form an arithmetic sequence, while a_2, a_3, a_4 form a geometric sequence with an integer common ratio. If $a_4 - a_1 = 30$, what is the lower possible value of $a_1 + a_2 + a_3 + a_4$?
- A) 24 B) 33 C) 36 D) 46 E) NOTA

24. Assume that the system of equations $\begin{bmatrix} 2 & 6 \\ 2 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = k \begin{bmatrix} x \\ y \end{bmatrix}$ has a solution $\begin{bmatrix} x \\ y \end{bmatrix}$ with $x^2 + y^2 = 1$.
What is the sum of all possible values of k ?
- A) 1 B) 3 C) 5 D) 10 E) NOTA
25. Find the remainder when $3^{21} + 7^{21}$ is divided by 25.
- A) 0 B) 3 C) 8 D) 10 E) NOTA
26. If $z = \cos \frac{2\pi}{5} + i \sin \frac{2\pi}{5}$, what is the value of $(1 - z)(1 - z^2)(1 - z^3)(1 - z^4)$?
- A) 2 B) 3 C) 4 D) 5 E) NOTA
27. When $\sqrt{15 \cdot 17 \cdot 19 \cdot 21 + 16}$ is simplified, it is a three-digit integer. What is the sum of the digits?
- A) 9 B) 12 C) 15 D) 18 E) NOTA
28. What is the largest integer less than or equal to the sum $\sum_{n=1}^{2018} \log_2 \left(1 + \frac{1}{n}\right)$?
- A) 10 B) 11 C) 12 D) 13 E) NOTA
29. If a, b, c are positive real numbers such that $a^3 + b^3 + c^3 = 3abc$, what is the value of $\frac{(a+b)(b+c)(c+a)}{abc}$?
- A) 8 B) 4 C) 2 D) 1 E) NOTA
30. If a nonzero 2×2 matrix $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ satisfies $A^2 = A$ and $A \neq \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, which of following statements about A is NOT true?
- A) $ad - bc = 0$
B) $a + d = 1$
C) $A^{2018} = A$
D) $A^T = A$
E) NOTA