

Unless otherwise specified, all answers are to be in simplest radical and reduced form. The expression 0^0 evaluates to undefined. For all questions, answer choice (E) NOTA means that none of the given answers for a question is correct. Good luck and have fun!

1. If $x^2 - 7x + 12 = 0$, then what is the sum of all real values of x ?

(A) 3 (B) 4 (C) 7 (D) 12 (E) NOTA

2. If $\log_2(x - 4) = \log_4(4x - 16)$, what is the sum of all real values of x ?

(A) 4 (B) 8 (C) 12 (D) 16 (E) NOTA

3. If $(1 + i)^{8m} = 8^n$, which of the following accurately describes the relationship between m and n for m, n integers?

(A) $m = \frac{n}{3}$ (B) $m = \frac{n}{4}$ (C) $m = \frac{3n}{4}$ (D) $m = \frac{3n}{2}$ (E) NOTA

4. Given that

$$\frac{e^x + 1}{e^x - 1} = 2025$$

what is the value of x ?

(A) $\ln\left(\frac{2025}{1012}\right)$ (B) $\ln\left(\frac{1012}{1013}\right)$ (C) $\ln\left(\frac{1011}{1012}\right)$ (D) $\ln\left(\frac{1013}{1012}\right)$ (E) NOTA

5. How many real values of x exist such that $e^x = x$?

(A) 0 (B) 1 (C) 2 (D) 3 (E) NOTA

6. The a solution to $\log_{2025} \left(x^{\log_{2024}(2025)} \right) = x$ satisfies which of the following equations? Note: x does not have to be real.

- (A) $2024^x - x = 0$ (C) $4049^x - x = 0$ (E) NOTA
(B) $2025^x - x = 0$ (D) $4050^x - x = 0$

7. If it is known that $\log_2(a) + \log_2(b) \geq 8$, then the least value that can be taken on by $a + b$ is:

- (A) 16 (B) 32 (C) 48 (D) 64 (E) NOTA

8. For $x = \frac{1}{3}$, evaluate the following expression:

$$x^4 + x^3 + x^2 + x + 1$$

- (A) $\frac{81}{75}$ (B) 2 (C) $\frac{141}{27}$ (D) $\frac{121}{81}$ (E) NOTA

9. Given the following system of equations:

$$\begin{cases} x + 4y = 34 \\ 3x + 7y = 57 \end{cases}$$

What is the value of $x + y$?

- (A) 7 (B) 8 (C) 9 (D) 10 (E) NOTA

10. Solve this inequality:

$$\left| \frac{4x + 3}{x + 6} \right| > 1$$

- (A) $x < -2$ or $x > 1$ (C) $x < -1$ or $x > 1$ (E) NOTA
(B) $x < -\frac{9}{5}$ or $x > 1$ (D) $x < -\frac{3}{5}$ or $x > 1$

11. The probability of Jack winning any given game of Ultimate Frisbee™ is $\frac{4}{5}$. The probability of Yusuf winning any given integration bee is $\frac{9}{10}$. How many times greater is the probability of Yusuf winning exactly 4 out of 5 integration bees than Jack winning exactly 3 out of 5 Ultimate Frisbee™ games?

(A) $\frac{3^8}{2^{12}}$ (B) $\frac{3^9}{2^{12}}$ (C) $\frac{3^8}{2^{10}}$ (D) $\frac{3^9}{2^{10}}$ (E) NOTA

12. How many integers satisfy the inequality $||x| - 15| < 15$?

(A) 55 (B) 56 (C) 57 (D) 58 (E) NOTA

13. The number of terms in an arithmetic progression is even. The sum of the odd-numbered terms is 39 and the sum of the even-numbered terms is 62. If the common difference d and the number of terms n are both primes, and $d < n$, how many terms are in the arithmetic progression?

(A) 17 (B) 19 (C) 23 (D) 29 (E) NOTA

14. If $(a + b + c)^2 - (a^2 + b^2 + c^2) = 16$, what is the value of $ab + bc + ac$?

(A) 4 (B) 8 (C) 16 (D) 32 (E) NOTA

The following information will be useful for problems 15–18:

Mr. Rovere particularly likes the following cubic:

$$x^3 + 10x^2 + 4x + 1$$

The roots of the cubic above are a, b, c .

15. What is the value of $a + b + c$?

- (A) 5 (B) -5 (C) 10 (D) -10 (E) NOTA

16. What is the value of $a^2 + b^2 + c^2$?

- (A) 8 (B) 44 (C) 92 (D) 143 (E) NOTA

17. Find the the value of

$$\frac{a+b}{c} + \frac{a+c}{b} + \frac{b+c}{a}$$

- (A) 20 (B) -23 (C) -52 (D) 24 (E) NOTA

18. What is the value of $a^3 + b^3 + c^3$? (Hint: Newton Sums)

- (A) 482 (B) -284 (C) 824 (D) -883 (E) NOTA

19. Given the following equation:

$$x^3 + 4x^3 - 3x^2 - 1 = x^4 + 6x^2 - 7x + 1$$

What is the sum of all real values of x that satisfy the equation above?

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

20. For $x, y, z \in \mathbb{R}$ which satisfy

$$\begin{cases} x^2 - 4y + 7 = 0 \\ y^2 - 6z + 14 = 0 \\ z^2 - 2x - 7 = 0 \end{cases}$$

What is the value of $x + y + z$?

- (A) 4 (B) 5 (C) 6 (D) 7 (E) NOTA

21. Find the value of n which satisfies $n + \log(n) = 10004$. What is the value of $n \bmod 6$?

- (A) 1 (B) 2 (C) 3 (D) 4 (E) NOTA

22. For an integral solution of the equation below, n , find a value of n which satisfies $(n+2)^2 + (n+3)^3 + (n+4)^4 = 2$. Which could be the value of $n \bmod 6$?

- (A) 5 (B) 4 (C) 2 (D) 1 (E) NOTA

23. What is the units digit of the sum $\sum_{n=0}^{2024} n!$?

- (A) 3 (B) 4 (C) 5 (D) 9 (E) NOTA

24. If $xy = 10$ and

$$x^2y + xy^2 + x + y = 77$$

What is the value of $x^2 + y^2$?

- (A) 8 (B) 10 (C) 12 (D) 4 (E) NOTA

- 25.** Three real numbers x, y, z are chosen such that $x^2 + y^2 + z^2 \leq r^2$ for some real number r . What is the probability that $|x| + |y| + |z| \leq |r|$?

(A) $\frac{1}{\pi}$ (B) $\frac{2}{\pi}$ (C) $\frac{3}{\pi}$ (D) $\frac{\sqrt{3}}{\pi}$ (E) NOTA

- 26.** Let $x, y, z \in \mathbb{R}$ such that

$$\log\left(\frac{x^3y}{z}\right) = 1$$

$$\log(x^8y^9) = 3$$

$$\log\left(\frac{xz^5}{y^2}\right) = 2$$

Find $\log(xyz)$.

(A) -1 (B) 0 (C) $\frac{1}{3}$ (D) $\frac{2}{3}$ (E) NOTA

- 27.** Compute the following product of a sum: $\prod_{n=2}^{2025} \left(\sum_{i=0}^{\infty} \frac{1}{n^i} \right)$

(A) 2025 (B) $\frac{2025}{2}$ (C) $\frac{2025}{4}$ (D) $\frac{2025}{8}$ (E) NOTA

28. Let m, n and p be three successive terms in a geometric sequence. If $m + n + p = 12$ and $mnp = 27$, what is $\frac{1}{m} + \frac{1}{p}$?

(A) 1

(B) $\frac{4}{3}$

(C) $\frac{2}{3}$

(D) $\frac{1}{3}$

(E) NOTA

29. For how many values of a is it true that the line $y = x + a$ passes through the vertex of parabola $y = x^2 + a^2$?

(A) 0

(B) 1

(C) 2

(D) 3

(E) NOTA

30. Which of the following is closest to the expression $e^\pi - \pi + 2$?

(A) 22

(B) 25

(C) 28

(D) 18

(E) NOTA