

Unless otherwise specified, equations and inequalities are to be solved over the real numbers.

Answer choice (E) NOTA means “none of these answers.”

1. Solve: $x + 1 > 2$
(A) $x > 1$ (B) $x < 1$ (C) $x > 3$ (D) $x < 3$ (E) NOTA
2. Suppose $x = y + 1$ and $y = z - 1$. What is the value of x if $z = 1$?
(A) -1 (B) 0 (C) 1 (D) 2 (E) NOTA
3. If $3x = 9$, then what is $5x + 11$?
(A) 16 (B) 26 (C) 36 (D) 56 (E) NOTA
4. Solve: $3^{4x} = \tan \frac{\pi}{6}$
(A) $x = \frac{1}{2}$ (B) $x = -\frac{1}{2}$ (C) $x = \frac{1}{8}$ (D) $x = -\frac{1}{8}$ (E) NOTA
5. If $3x + 4 = 22$ and $6 - y = 12$, then what is $x + y$?
(A) 0 (B) $\frac{8}{3}$ (C) 12 (D) $\frac{44}{3}$ (E) NOTA
6. Solve for x over the complex numbers: $x^2 = i$
(A) $\frac{\sqrt{2}}{2} + \frac{\sqrt{2}}{2}i$ (B) $-\frac{\sqrt{2}}{2} - \frac{\sqrt{2}}{2}i$ (C) A and B (D) i (E) NOTA
7. $\sin^{-1}\left(\sin\left(\frac{7\pi}{6}\right)\right) =$
(A) $\frac{\pi}{6}$ (B) $\frac{5\pi}{6}$ (C) $\frac{7\pi}{6}$ (D) $\frac{11\pi}{6}$ (E) NOTA
8. If $x - 2y = 1$ and $x + y = 16$, then which of the following is *false*?
(A) $x - y = 6$ (B) $x + 2y = 21$ (C) $3x - y = 28$ (D) $5x - 11y = 30$ (E) NOTA
9. What is the sum of the 7th roots of 2?
(A) 2 (B) 14 (C) $7 \cdot \sqrt[7]{2}$ (D) 2^7 (E) NOTA
10. How many of the following inequalities is/are equivalent to $x^2 - 6x + 5 > 0$?
I. $-|x - 3| < -2$
II. $-x^2 + 6x + 5 < 0$
III. $1 < x < 5$
IV. $\frac{1}{10}|(3x - 9) + (4x - 12)i| > 1$
(A) 1 (B) 2 (C) 3 (D) 4 (E) NOTA

11. Let $S(x)$ denote the Shuaian logarithm of x , which is defined as $\log_{\pi} x$. The solution to $\frac{1}{\ln 2}[1 - S(\text{Arcsin } x)] = 2S(e)$ is $x = a$. What is the hundredths digit of a ?
- (A) 0 (B) 1 (C) 2 (D) 3 (E) NOTA
12. If $f(x) = 1 - 2x^2$, then which of the following is equivalent to $f(\sin \theta)$?
- (A) $\sin \theta$ (B) $\cos \theta$ (C) $\sin 2\theta$ (D) $\cos 2\theta$ (E) NOTA
13. Solve for x : $2^{6x} + 4^{9+3x} = 4 + 2^{20}$
- (A) $x = \frac{1}{3}$ (B) $x = \frac{2}{3}$ (C) $x = 2$ (D) $x = 4$ (E) NOTA
14. Suppose $A = \begin{bmatrix} 11 & 4 \\ 3 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 7 \\ 1 & 8 \end{bmatrix}$. Find the sum of the elements of matrix X if $AX = B$.
- (A) -111 (B) -45 (C) 45 (D) 111 (E) NOTA
15. Solve for x , where $[x]$ denotes the greatest integer less than or equal to x : $x = [x]$
- (A) {Real numbers} (B) {Integers}
 (C) {Natural numbers} (D) {Rational numbers}
 (E) NOTA
16. Suppose $f(x) = 1 - x^2$. Let x_1 and x_2 be the values of x for which $f(x) = a$, where a is an arbitrary constant. When x_1 and x_2 exist, what is $(x_1 + x_2)^2$?
- (A) 0 (B) $2 - 2a$ (C) a^2 (D) $4a^2$ (E) NOTA
17. Solve for x : $\ln x + \ln(3x) = 12 + \ln 3$
- (A) $\{e^3\}$ (B) $\{e^6\}$ (C) $\{e^3, e^{-3}\}$ (D) $\{e^6, e^{-6}\}$ (E) NOTA
18. Suppose $f(x) = x \sin \theta + \cos \theta$ and $0 < \theta < \frac{\pi}{2}$. What is $f^{-1}(x)$?
- (A) $x \sec \theta + \tan \theta$ (B) $x \sec \theta - \tan \theta$ (C) $x \csc \theta + \cot \theta$ (D) $x \csc \theta - \cot \theta$ (E) NOTA
19. How many of the following correctly describe the solution set of $\vec{u} \bullet \langle 9, 26 \rangle = 0$?
- I. All two-dimensional vectors \vec{u} that make an angle of 0° with $\langle 9, 26 \rangle$
 II. All vectors $\vec{u} = \langle u_1, u_2 \rangle$ such that $u_2 = \frac{9}{26}u_1$
 III. All two-dimensional vectors \vec{u} parallel to $\langle 9, 26 \rangle$
 IV. All two-dimensional vectors \vec{u} orthogonal to $\langle 9, 26 \rangle$
- (A) 0 (B) 1 (C) 2 (D) 3 (E) NOTA

20. Suppose $0 < \theta < \frac{\pi}{2}$. Solve for x : $2x^2 \cot \theta + \sin 2\theta = 4x$
- (A) $\{\tan \theta \pm \sec \theta \mp \cos \theta\}$ (B) $\{\cot \theta \pm \cos \theta\}$
(C) $\{\pm \sin \theta\}$ (D) $\{\pm \tan \theta\}$
(E) NOTA
21. Solve for a , if the equation $x^2 + 2ax = 3a$ has two imaginary solutions.
- (A) $-3 < a < 0$ (B) $a < -3$ or $a > 0$
(C) $0 < a < 3$ (D) $a < 0$ or $a > 3$
(E) NOTA
22. Let R be the region containing all points (x, y) that satisfy $x^2 > 9 - y^2$ and $|2x| + |y| < 10$. Find the tenths digit of $\cos A$, where A is the area of R .
- (A) 3 (B) 4 (C) 8 (D) 9 (E) NOTA
23. Suppose n is an integer greater than 3. Which of the following is *false*?
- (A) $1 + 2 + 3 + \dots + n = \frac{1}{2}n(n + 1)$ (B) $1 + 3 + 5 + \dots + (2n - 1) = n^2$
(C) $2 + 4 + 6 + \dots + 2n = n^2 + 1$ (D) $1^2 + 2^2 + 3^2 + \dots + n^2 = \frac{1}{6}n(n + 1)(2n + 1)$
(E) NOTA
24. Solve for x : $1 + \sin^2 x + \sin^4 x + \sin^6 x + \dots = 1 + \tan^2 x$
- (A) \emptyset (B) $\{x \mid x \neq \frac{n\pi}{2}\}$, for all odd integers n
(C) $\{n\pi\}$, for all integers n (D) \mathbb{R}
(E) NOTA
25. Suppose $0 < a < c$. Solve for x : $ax + b < cx + d$
- (A) $(-\infty, \frac{b-d}{a-c})$ (B) $(-\infty, \frac{d-b}{a-c})$ (C) $(\frac{b-d}{a-c}, \infty)$ (D) $(\frac{d-b}{a-c}, \infty)$ (E) NOTA
26. How many of the following equations have the same solution set as $\sin(\pi x) = 0$?
- I. $\cos^2(\pi x) = 1$
II. $x(x - 1)(x - 2)(x - 3) \dots = 0$
III. $\cos \frac{\pi(2x+1)}{4} - \sin \frac{\pi(2x+1)}{4} = 0$
IV. $\ln(1 + \tan^2(\pi x)) = 0$
- (A) 1 (B) 2 (C) 3 (D) 4 (E) NOTA

