

For all questions, answer choice (E) NOTA means that none of the given answers are correct. Diagrams are not necessarily drawn to scale. Let $i = \sqrt{-1}$. Good Luck!

- Pamela finds the sum, in feet, of the surface area of a sphere with diameter 5 feet and the lateral surface area of a cylinder with a height of 4 feet and diameter 5 feet. What is her answer? (*Given that she is correct.*)

(A) 20π (B) 45π (C) 64π (D) 140π (E) NOTA
- Find the sum of all values of x that satisfy the equation $\sqrt{7x+3} = x+2$.

(A) 1 (B) -1 (C) -3 (D) 3 (E) NOTA
- A plane intersects a sphere of radius 7 inches such that the cross section of the intersection is a circle of radius 3 inches. What is the shortest distance, in inches, from any point on the surface of the sphere to the center of the circle created by the intersection?

(A) $2\sqrt{10}$ (B) $\sqrt{58}$ (C) $7 - 2\sqrt{10}$ (D) 40 (E) NOTA
- If I place three points randomly on a circle of radius 4, what is the probability that the three points form an acute triangle?

(A) $\frac{1}{4}$ (B) $\frac{16}{25}$ (C) $\frac{3}{4}$ (D) 1 (E) NOTA
- Simplify the following fraction:

$$\frac{n!(n+2)!}{(n+1)!(n-1)!}$$

(A) $\frac{(n-1)^2}{n(n+2)}$ (B) $\frac{n(n+2)}{(n+1)(n-1)}$ (C) $\frac{n(n+2)}{(n-1)}$ (D) $n(n+2)$ (E) NOTA
- How many rectangles are there on a 9×9 checkerboard?

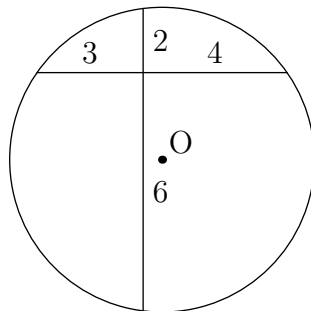
(A) 1296 (B) 2025 (C) 2401 (D) 2450 (E) NOTA
- x and y are directly proportional and z is inversely proportional to x . Find z when $x = 4$ and $y = 6$, if $z = \frac{64}{3}$ when $x = 3$ and $y = 4$.

(A) $\frac{3}{4}$ (B) $\frac{64}{3}$ (C) $\frac{1}{24}$ (D) 124 (E) NOTA
- Let $f(x) = \frac{x}{5} + 1$. Find the area bounded by the lines $x = -5$, $x = 5$, $y = 0$, and $f(x)$.

(A) 10 (B) 20 (C) 40 (D) 80 (E) NOTA
- Which of the following points is not necessarily on Euler's Line in an isosceles triangle?

(A) Centroid (B) Circumcenter (C) Orthocenter (D) Incenter (E) NOTA

10. Which of the following is true in Euclidean geometry?
- (A) If two lines do not intersect, they are parallel
 (B) A triangle has two sides
 (C) SSA is a way to prove triangle similarity
 (D) The area of a triangle equals half of the perimeter times the radius of an inscribed circle
 (E) NOTA
11. How many integer values of x satisfy the inequality $-6 < \frac{7x - 3}{4} \leq 7$?
- (A) 20 (B) 16 (C) 12 (D) 8 (E) NOTA
12. What is the minimum of the graph of $f(x) = |x - 200| + |x + 200| + |x - 300|$?
- (A) 300 (B) 500 (C) 600 (D) 900 (E)NOTA
13. Barret is contracted to construct a square yard of side length 20 feet to contain two pigs on a farm. After the yard is done being constructed, Teja, the farmer, ties each pig to opposite corners of the yard with a rope of length 20 feet. Given that the pigs are inside the square yard, what is the ratio of the common space that they utilize to the area of the yard?
- (A) $100\pi - 200$ (B) $200\pi - 400$ (C) $\frac{\pi - 2}{2}$ (D) $\frac{\pi - 2}{4}$ (E) NOTA
14. How many integer values of x satisfy the inequality $(\sqrt{x} - \sqrt{7396})^2 < 1$? (Hint: $\sqrt{7396} = 86$.)
- (A) 343 (B) 446 (C) 447 (D) 7568 (E) NOTA
15. How many distinct ways can the letters of the word "SUMKATSLAP" be arranged?
- (A) 907200 (B) 90720 (C) 10080 (D) 1260 (E) NOTA
16. I recently got bored and decided to put Alex and Mihir in a circular arena to see what would happen. As I traced their paths on a map, I noticed that they resembled two intersecting perpendicular lines as shown below.



Given that all measurements refer to feet, what is the circumference of this circle in feet?

- (A) $\pi\sqrt{53}$ (B) $2\pi\sqrt{53}$ (C) $\pi\sqrt{65}$ (D) $2\pi\sqrt{65}$ (E) NOTA

17. Evaluate the sum $\frac{3}{4} + \frac{1}{2} + \frac{5}{16} + \frac{3}{16} + \frac{7}{64} + \frac{5}{128} + \dots$

- (A) $\frac{9 + \sqrt{51}}{2}$ (B) $\frac{9 + \sqrt{51}}{4}$ (C) 2 (D) 4 (E) NOTA

For questions 18 and 19, let $f(x) = \begin{cases} 4x^3 - 3, & \text{if } x \geq 5 \\ x + 4, & \text{if } x < 5 \end{cases}$

18. What is the value of the function when $x = 5$?

- (A) 9 (B) 479 (C) 497 (D) 500 (E) NOTA

19. For each true statement add 5 and for each false statement subtract 1 to get the final answer (beginning with an initial value of 0).

- I. The function is continuous.
 II. The function is piecewise.
 III. The function is one-to-one.
 IV. The function is even.
 V. The function is odd.

- (A) -5 (B) 13 (C) 1 (D) 7 (E) NOTA

20. What is the area of a triangle with an inradius of 4 and perimeter of 7?

- (A) 7 (B) 14 (C) 28 (D) 56 (E) NOTA

21. Solve the following equation for x in terms of y , $4 = \frac{x^2 y^3}{3}$.

- (A) $x = \frac{12}{y^3}$ (B) $y = \sqrt{12x^3}$ (C) $x = \sqrt{12y^3}$ (D) $y = \sqrt[3]{12x^2}$ (E) NOTA

22. Given a triangle with integer side lengths, one leg of length 2 feet, another of length 3 feet and one leg that is unknown, what is the largest inradius that can be formed?

- (A) $\frac{\sqrt{15}}{6}$ (B) $\frac{\sqrt{2}}{2}$ (C) $\frac{3\sqrt{7}}{14}$ (D) $\frac{3\sqrt{2}}{4}$ (E) NOTA

23. Evaluate $\sin 30^\circ \cos 60^\circ$.

- (A) $\frac{3}{4}$ (B) $\frac{\sqrt{3}}{4}$ (C) $\frac{\sqrt{6}}{4}$ (D) $\frac{1}{6}$ (E) NOTA

24. Find the inverse function of $f(x) = \frac{1}{5x + 7}$.

- (A) $f^{-1}(x) = 5x + 7$ (B) $f^{-1}(x) = \frac{1 - 7x}{5x}$ (C) $f^{-1}(x) = \frac{1 + 7x}{5x}$ (D) $f^{-1}(x) = \frac{1}{5x - 7}$ (E) NOTA

25. How many real roots does the equation $y = x^2 + x + 1$ have?

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

26. What is the product of all of the values of x that satisfy the following equation,
 $(x - 4)(x + 2)(x - 1) + (x - 4)(x - 4)(x - 1) - (x - 2)(x - 1)(x - 4) = 0$?
- (A) 0 (B) 4 (C) 8 (D) -8 (E) NOTA
27. Simplify $2013i^{2013}$.
- (A) 2013 (B) $2013i$ (C) -2013 (D) $-2013i$ (E) NOTA
28. What is the determinant of the following matrix? $\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 2 \end{bmatrix}$
- (A) 1 (B) 2 (C) 3 (D) 6 (E) NOTA
29. What is the area that is determined by $x^2 + y^2 - 8x + 6y + 10 = 1$?
- (A) 9 (B) 16 (C) 9π (D) 16π (E) NOTA
30. If a \clubsuit is defined as $a^2b + ab + ab^{-1}$, what is $2 \clubsuit 3$?
- (A) $\frac{51}{2}$ (B) 28 (C) $\frac{51}{3}$ (D) $\frac{56}{3}$ (E) NOTA