

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

- If $a \# b = a^b \bullet b$ and $a \$ b = 2a - 2^b$, then what is $(3 \# 5) \$ 11$?
(A) 242 (B) 194 (C) 382 (D) 294 (E) NOTA
- Simplify the following expression: $\frac{n(n+1)!}{(n-1)!} \bullet \frac{n!}{(n^2-1)}$.
(A) $\frac{n}{(n-1)}$ (B) $\frac{n+1}{n!}$ (C) $\frac{n+1}{n-1}$ (D) $\frac{n-1}{n+1}$ (E) NOTA
- Mihir was standing next to a 32 feet tall tree when the shadow of the tree became 112 feet long. At that exact moment, Tommy measured the length of Mihir's shadow and found that it was 21 feet long. How tall is Mihir? (All answers are in inches.)
(A) 72 (B) 6 (C) 75 (D) 36 (E) NOTA
- A class of 31 people were each given back their math tests. On the top were two numbers. The first number was their rank based on their score (the person with the highest score would have a 1) and the second number was their score. Later on, Ifrah found out that all the scores were in arithmetic progression. If Ifrah had the highest score of 98 and her friend, Jenny, had the numbers 25 and 62 on her test, then what was the lowest score in the class?
(A) 42 (B) 48 (C) 53 (D) 55 (E) NOTA
- Given that $f(x) = \frac{5x-1}{12+2x}$, find $f^{-1}(x)$, the inverse of $f(x)$.
(A) $\frac{12+2x}{5x-1}$ (B) $\frac{12x+1}{5-2x}$ (C) $\frac{5+2x}{12-x}$ (D) $\frac{5-12x}{1+2x}$ (E) NOTA
- Find $|20 - 99i|$.
(A) 79 (B) 101 (C) 119 (D) 201 (E) NOTA
- Let $g(m, a, t, h) = 2m + 10a - t^2 + 2h^2$. Find x if $g(15, x, 2, 1)$ equals 48.
(A) -25 (B) 4 (C) -100 (D) 2 (E) NOTA
- Find the center of $25x^2 - 100x + 64y^2 + 640y + 100 = 0$.
(A) (2,-5) (B) (-2,5) (C) (5,-8) (D) (-5,8) (E) NOTA
- Stacy rows a 20 ft boat at a constant speed of 1 mph. She is competing in a 3500 ft race. She starts with the front of her boat touching the starting line. She finishes the race when the back of her boat passes the finish line. How many minutes does it take Stacy to complete the race? (1 mile=5280 ft)
(A) 20 (B) 30 (C) 40 (D) 50 (E) NOTA

10. If $A = \begin{bmatrix} 7 & -1 \\ 8 & 2 \end{bmatrix}$, $B = \begin{bmatrix} 1 & 0 \\ 3 & -4 \end{bmatrix}$, and $C = \begin{bmatrix} 2 & -1 \\ -5 & 2 \end{bmatrix}$, find $A \times B + C$
- (A) $\begin{bmatrix} 9 & -2 \\ -16 & 9 \end{bmatrix}$ (B) $\begin{bmatrix} 7 & -1 \\ -11 & 11 \end{bmatrix}$ (C) $\begin{bmatrix} -22 & 2 \\ 22 & 14 \end{bmatrix}$ (D) $\begin{bmatrix} 6 & 3 \\ 9 & -6 \end{bmatrix}$ (E) NOTA
11. The eccentricity(e) of a parabola always is
- (A) 0 (B) $0 < e < 1$ (C) 1 (D) $e > 1$ (E) NOTA
12. Carrie bought a pack of gum and a bottle of water at a café in Boston. The total cost was \$2.25. Carrie only had pennies, dimes, and quarters to pay for her bill. In how many ways could Carrie have paid her bill?
- (A) 120 (B) 100 (C) 60 (D) 50 (E) NOTA
13. Find the minimum value of $\log_2(x^3 - 7x^2 + 19x - 13) - \log_2(x - 1)$.
- (A) 5 (B) 4 (C) 3 (D) 2 (E) NOTA
14. Find the value of $A^2 + 2AB + B^2$ if $\frac{2x - 5}{x^2 - 2x - 8} = \frac{A}{x + 2} + \frac{B}{x - 4}$.
- (A) 4 (B) $\frac{13}{4}$ (C) $\frac{5}{2}$ (D) $\frac{3}{2}$ (E) NOTA
15. Find the sum of the following infinite geometric sequence, $\frac{2}{3} + \frac{2}{9} + \frac{2}{27} + \frac{2}{81} + \dots$
- (A) $\frac{1}{2}$ (B) $\frac{15}{16}$ (C) $\frac{3}{8}$ (D) $\frac{13}{15}$ (E) NOTA
16. Ms. Funk gave Carolyn a math problem for her birthday present. The problem asked Carolyn to find the slopes of the asymptotes of the conic $16x^2 - 256x - 25y^2 - 100y + 924 = 400$. Carolyn needs your help. What are the slopes of the asymptotes?
- (A) $\pm \frac{4}{5}$ (B) $\pm \frac{2}{3}$ (C) $\pm \frac{1}{3}$ (D) $\pm \frac{2}{5}$ (E) NOTA
17. What is the third term when $(2\sqrt{2}x - 5\sqrt{3}y)^6$ is expanded and like terms are added?
- (A) $72000x^4y^2$ (B) $-120000x^3y^3$ (C) $38400x^4y^2$ (D) $-37500x^3y^3$ (E) NOTA
18. How many of the following functions are even functions?
- $f(x) = 5x^2$
 - $f(x) = \frac{1}{x^2 - 5}$
 - $f(x) = x^3 - x$
 - $f(x) = 3^x$
- (A) 0 (B) 1 (C) 2 (D) 3 (E) NOTA

19. Find $16x + 25y + 36z$ if

$$\begin{aligned}x + 4y + 9z &= 10 \\4x + 9y + 16z &= 120 \\9x + 16y + 25z &= 1230\end{aligned}$$

- (A) 12340 (B) 10201 (C) 6770 (D) 3340 (E) NOTA

20. α , β , and Ω are the roots of $6x^3 - 49x^2 + 46x + 21 = 0$. What is $\alpha^2 + \beta^2 + \Omega^2$?

- (A) $\frac{2401}{36}$ (B) $\frac{2125}{36}$ (C) $\frac{1849}{36}$ (D) $\frac{1573}{36}$ (E) NOTA

21. What is $\frac{x + \sqrt{x^2 - 1}}{x - \sqrt{x^2 - 1}} - \frac{x - \sqrt{x^2 - 1}}{x + \sqrt{x^2 - 1}}$, when $x = \frac{2}{\sqrt{2}}$?

- (A) $2\sqrt{2}$ (B) $4\sqrt{2}$ (C) $6\sqrt{2}$ (D) $8\sqrt{2}$ (E) NOTA

22. What is the remainder when $x^4 + 2x^3 - 13x^2 - 14x + 24$ is divided by $(x + 5)$?

- (A) 504 (B) 496 (C) 256 (D) 144 (E) NOTA

23. Stephen's music store has CDs and DVDs on sale this week. All CDs cost the same and all DVDs cost the same. Awnish bought 3 CDs and 5 DVDs for \$15.44. Teja bought 4 CDs and 7 DVDs for \$21.37. How much does one DVD cost?

- (A) \$1.23 (B) \$1.44 (C) \$2.35 (D) \$2.50 (E) NOTA

24. Let $f(x) = n^2 - 3n + 6$. Evaluate $\sum_{n=0}^{16} f(n)$.

- (A) 1190 (B) 2274 (C) 3351 (D) 4461 (E) NOTA

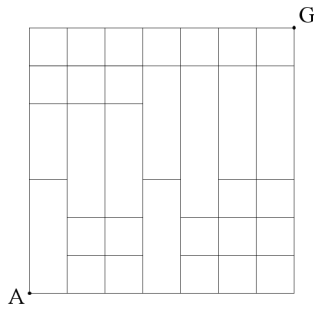
25. Using Descartes' Rule of Signs, find the maximum number of possible negative solutions of $2x^6 + 5x^4 - x^3 - 12x^2 + 23x - 30 = 0$.

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

26. Simplify: $2^{\log_4 16} + 3^{\log_{\frac{1}{3}} \frac{1}{14}} - 5^{\log_{\sqrt{5}} 2}$.

- (A) 65 (B) 59 (C) 73 (D) 44 (E) NOTA

27. How many different can Abhinav take to meet up with Grace, if he can only travel up and to the right on the diagram below? (Abhinav is point A and Grace is Point G)



- (A) 345 (B) 286 (C) 245 (D) 199 (E) NOTA
28. Siddarth enjoys travelling very much. During his travels, Siddarth had to pass through a small, semi-elliptical tunnel with height $4\sqrt{3}$ feet and width 16 feet. Siddarth owns a Hummer which is shaped like a rectangular prism and he knows that it is 8 feet wide. What is the greatest possible height of his Hummer if it safely passed through the tunnel unscratched?
- (A) 4 (B) 5 (C) 6 (D) 7 (E) NOTA
29. Find the sum of the integers contained in the domain of $y = \frac{\sqrt{|x| - 5}}{x^2 + 2x - 15}$.
- (A) ∞ (B) $-\infty$ (C) -2 (D) 0 (E) NOTA
30. Complete the following sentence with the output of $f\left(\frac{(1+i)^{2013}}{(1-i)^{2011}} + \frac{(1-i)^{2013}}{(1+i)^{2011}}\right)$, given that

$$f(x) = \begin{cases} \textit{incredible}, & x \leq 1 \\ \textit{awesome}, & 1 < x \leq 5 \\ \textit{wonderful}, & 5 < x \leq 10 \\ \textit{marvelous}, & x > 10 \end{cases}$$

The writer of this test is

- (A) incredible (B) awesome (C) wonderful (D) marvelous (E) NOTA