

For all questions, answer choice (E) NOTA means that none of the given answers is correct. Good Luck!

- Find the equation of the line with a slope of  $\frac{2}{3}$  that passes through the point  $(-5, 4)$ .  
 (A)  $2x - 3y = 22$  (B)  $2x + 3y = 7$   
 (C)  $3x + 2y = 2$  (D)  $3x - 2y = -22$  (E) NOTA
- Find the discriminant of  $2x^2 + 3 + 7x$ .  
 (A) 5 (B) 25 (C)  $-47$  (D) 7 (E) NOTA
- Find the value of  $|5 - 12i|$ .  
 (A) 7 (B) 13 (C) 49 (D) 169 (E) NOTA
- Let  $f(x) = \frac{1}{3}x + 7$ . Find  $f^{-1}(x)$ .  
 (A)  $f^{-1}(x) = \frac{1}{3}x - 7$  (B)  $f^{-1}(x) = \frac{1}{3}x - 21$   
 (C)  $f^{-1}(x) = 3x - 21$  (D)  $f^{-1}(x) = 3x - 7$  (E) NOTA
- Let  $a = \log 2$ ,  $b = \log 3$ , and  $c = \log 7$ . Find  $\log \frac{147}{36}$  in terms of  $a$ ,  $b$ , and  $c$ .  
 (A)  $-2a - 3b + 2c$  (B)  $-2a - b + 2c$   
 (C)  $a + 2b + c$  (D)  $3a + b - 2c$  (E) NOTA
- If  $x + \frac{1}{x} = 3$ , then what is the value of  $x^3 + \frac{1}{x^3}$ ?  
 (A) 18 (B) 24 (C) 27 (D) 30 (E) NOTA
- Find the values of  $x$  such that  $6x^3 - x^2 - 10x - 3 > 0$ .  
 (A)  $(-1, \frac{-1}{3}) \cup (\frac{3}{2}, \infty)$  (B)  $(-\infty, \frac{-1}{3}) \cup (\frac{3}{2}, \infty)$   
 (C)  $(-1, \frac{3}{2}) \cup (3, \infty)$  (D)  $[-1, \frac{3}{2}] \cup (3, \infty)$  (E) NOTA
- What is the eccentricity of  $4\sqrt{5}x^2 - 17x + y + \frac{1}{8} = 0$ ?  
 (A) 0 (B)  $\frac{1}{2}$  (C) 1 (D) 2 (E) NOTA
- Shardul is famous for his special beard-growing powers. The volume of his beard varies directly with the cube of the hours he studies math, and varies inversely with the number of cookies he receives during lunch. Last week, Shardul studied two hours of math, received 4 cookies, and had a beard with a volume of  $150\text{cm}^3$ . When Shardul studies math for 3 hours and receives 5 cookies during lunch, what is the volume of his beard?  
 (A)  $180\text{cm}^3$  (B)  $225\text{cm}^3$   
 (C)  $375\text{cm}^3$  (D)  $405\text{cm}^3$  (E) NOTA
- What is the graph of  $4x^2 + 9y^2 + 12xy + 12x + 18y + 9 = 0$ ?  
 (A) parabola (B) ellipse (C) hyperbola (D) 2 parallel lines (E) NOTA
- If  $\sqrt{23 - \sqrt{408}} = \sqrt{a} - \sqrt{b}$ , then what is  $a - b^2$ ?  
 (A)  $-283$  (B)  $-19$  (C) 11 (D) 19 (E) NOTA

12. Which best describes the graph of  $|z - 4 + 3i| = 6$  in the complex plane assuming that  $z = a + bi$ ?
- (A) two points                      (B) one line                      (C) two lines                      (D) a circle                      (E) NOTA
13. For the following equation:
- $$\frac{A}{x-4} - \frac{2B}{x+3} = \frac{11x+5}{x^2-x-12}$$
- Find the value of  $B^A$ .
- (A) -49                      (B) 49                      (C) -128                      (D) 128                      (E) NOTA
14. Find the distance between the centers of the following two conics:
- $$\begin{aligned} 2x^2 + 2y^2 - 8x - 16y + 38 &= 0 \\ 16x^2 + 9y^2 + 32x - 36y - 92 &= 0 \end{aligned}$$
- (A) 2                      (B)  $\sqrt{5}$                       (C)  $\sqrt{13}$                       (D)  $\sqrt{37}$                       (E) NOTA
15. Find the sum of all the real solutions to the following expression:  $(x^2 + x - 3)^{(x^2+x-6)} = 1$ .
- (A) -3                      (B) 3                      (C) -1                      (D) 1                      (E) NOTA
16. For the following:
- $$\begin{bmatrix} -7 & 4 \\ 8 & -3 \end{bmatrix} \begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} 10 & -1 \\ -2 & -13 \end{bmatrix}$$
- Find the value of  $A + B + C + D$ .
- (A) -6                      (B) 8                      (C) -2                      (D) 22                      (E) NOTA
17. Let  $\phi = \prod_{i=1}^{50} 9^i$ . Find the value of  $\log_3 \phi$ .
- (A) 1275                      (B) 2550                      (C) 5100                      (D) 10200                      (E) NOTA
18. Kyle wants to be the very best - like no one ever was! So when he catches the bouncing Pokemon, Spoink, he drops it from a height of 600 feet. The Spoink travels infinitely, and has the ability to rebound back at  $\frac{1}{x}$  of the height of each bounce. The Spoink travels a total of 1200 feet. What is the value of  $x$ ?
- (A)  $\frac{1}{3}$                       (B)  $\frac{1}{2}$                       (C) 2                      (D) 3                      (E) NOTA
19. Given the sequence 6, 25, 56, 99, 154... What is the 10<sup>th</sup> term?
- (A) 609                      (B) 652                      (C) 705                      (D) 736                      (E) NOTA
20. Let  $g(x) = 2x^3 - 7x^2 + Ax - 2$  such that the roots make up a geometric progression. What is the value of A?
- (A) -15                      (B) -7                      (C) 7                      (D) 15                      (E) NOTA
21. Rickards' Mu Alpha Theta Team is selling pineapples for a fundraiser. They sell 750 servings of pineapple at \$0.50 each. If prices are raised by \$0.05 per serving, then sales decrease by 10 servings. At what price should the pineapple be sold in order to receive maximum profit?
- (A) \$0.55                      (B) \$0.60                      (C) \$0.65                      (D) \$0.70                      (E) NOTA

22. Let  $x^2 = 4y + 13$  and  $y^2 = 4x + 13$ . Assuming that  $x$  and  $y$  are distinct real numbers, find the value of  $|xy|$ .
- (A) 10 (B) 3 (C) 13 (D) 5 (E) NOTA
23. Let  $f(x) = \frac{x}{\sqrt{x^2+1}}$ . Find  $f^{99}(1)$ .
- (A)  $\frac{1}{9}$  (B)  $\frac{1}{14}$  (C)  $\frac{1}{10}$  (D)  $\frac{1}{12}$  (E) NOTA
24. Let  $f\left(\frac{1}{1-x}\right) + 2f(x) = x^2$ . What is the value of  $f\left(\frac{1}{2}\right)$ ?
- (A)  $-\frac{23}{10}$  (B)  $-\frac{2}{3}$  (C)  $\frac{19}{12}$  (D)  $\frac{5}{3}$  (E) NOTA
25. What is the hundreds digit of the coefficient of the  $xyz^2z^2$  term of  $(3x + y + 2z)^6$ ?
- (A) 0 (B) 7 (C) 6 (D) 9 (E) NOTA
26. Let  $f\left(\frac{x^2}{2} - 1\right) = -2x^4 - 5x^2 + 10$ . What is  $f(x^2 + 1)$ ?
- (A)  $-8x^4 - 42x^2 - 42$  (B)  $-x^4 - x^2 - 4$   
 (C)  $x^4 + x^2 - 3$  (D)  $8x^4 + 42x^2 + 42$  (E) NOTA
27. Let  $\frac{a}{b} = \frac{1}{2^1} + \frac{2}{3^2} + \frac{3}{2^3} + \frac{4}{3^4} + \frac{5}{2^5} + \dots$ . What is the value of  $a - b$ ?
- (A) 113 (B) 401 (C) 689 (D) A solution does not exist (E) NOTA
28. Find the sum of the squares of the reciprocals of the roots of  $f(x) = 5x^3 + 4\sqrt{3}x^2 + 3x - 6\sqrt{3}$ .
- (A)  $-\frac{12}{17}$  (B)  $\frac{12}{17}$  (C)  $-\frac{17}{12}$  (D)  $\frac{17}{12}$  (E) NOTA
29. Jasmine and Aditya love to compete! Jenny challenges them to solve for the sum and the product of the roots of the quadratic equation,  $ax^2 + by + c = 0$ , whose coefficients are relatively prime. When Jasmine solves the problem, she gets the correct answer for the product, but not the sum. When Aditya solves the problem, he gets the correct answer for the sum, but not the product. Jasmine finds that the sum is 2, and the product is  $\frac{5}{2}$ . Aditya finds that the sum is  $\frac{-3}{2}$ , and that the product is 3. What could be a value of  $a+b+c$ ?
- (A) -5 (B) 3 (C) 10 (D) 4 (E) NOTA
30. Let  $A = \sqrt{1 + \frac{1}{1^2} + \frac{1}{2^2}} + \sqrt{1 + \frac{1}{2^2} + \frac{1}{3^2}} + \dots + \sqrt{1 + \frac{1}{2013^2} + \frac{1}{2014^2}}$
- Given that  $[x]$  denotes the greatest integer function, that is the greatest integer less than or equal to  $x$ , what is the value of  $[A]$ ?
- (A) 2012 (B) 2013 (C) 2014 (D) 2015 (E) NOTA