For all questions, answer choice (E) NOTA means that none of the given answers is correct. i is defined as $\sqrt{-1}$. DNE stands for Does Not Exist. Good Luck!

1. What is the value of the square root of 2^{16}?

    (A) 2^8 (B) 2^4 (C) 2^{14} (D) 2^2 (E) NOTA

2. Let ζ equal the complex number $3+4i$. Let ϕ equal the complex conjugate of $3+4i$. Which of the following is equal to $\zeta \cdot \phi$?

    (A) 25   (B) $15 + 20i$ (C) $-7 + 24i$ (D) 5   (E) NOTA

3. Find the coefficient of the x^3y^2 term of the expansion of $(2x - 3y)^5$.

    (A) -720 (B) 720   (C) -1080 (D) 1080   (E) NOTA

4. Find the slope of line that is perpendicular to the line $13x + 91y = 73$ and goes through the point $(5, 14)$.

    (A) $-\dfrac{1}{7}$ (B) $-\dfrac{13}{91}$ (C) $\dfrac{1}{7}$ (D) -7 (E) NOTA

5. Given the arithmetic sequence $1, 9, 17, \ldots$, find the arithmetic mean of the 25th and 29th terms.

    (A) 209   (B) 217   (C) 418   (D) 434   (E) NOTA

6. If $f(x) = 4x^2 + 6$ and $g(x) = \sqrt{4x^3 + 2x^2 + 18x - 12}$ and $h(x) = \dfrac{x^2}{14} - \dfrac{4}{7}$, evaluate $f(g(h(6)))$.

    (A) 262   (B) 330   (C) 150   (D) 202   (E) NOTA

7. Suppose $f(x)$ is a quadratic polynomial such that $f(0) = 7$, $f(1) = \dfrac{73}{8}$, and $f(2) = \dfrac{61}{4}$. What is $f(8)$?

    (A) 136   (B) 124   (C) $\dfrac{269}{2}$ (D) $\dfrac{551}{4}$ (E) NOTA

8. If $a = 12 + 35i$, then evaluate $|a|$.

    (A) 43   (B) 35   (C) 1849   (D) 1369   (E) NOTA

9. Find the remainder when $2x^3 - 5x^2 - x - 4$ is divided by $x - 3$.

    (A) 16   (B) -1 (C) 10   (D) 2   (E) NOTA

10. Find the equations of all of the asymptotes of the function

$$f(x) = \frac{x^3 - 15x^2 + 68x - 96}{3x^3 - 29x^2 + 85x - 75}.$$

    (A) $x = 3$, $x = 5$, $x = -2$, $y = \dfrac{1}{3}$
    (B) $x = 3$, $x = 5$, $x = 8$
    (C) $x = 3$, $x = \dfrac{5}{3}$, $x = 8$, $y = \dfrac{1}{3}$
    (D) $x = 5$, $x = \dfrac{5}{3}$, $y = \dfrac{1}{3}$
    (E) NOTA

11. If $43x + 15 = x^3 - 27$, which of the following is a possible value of x?

    (A) 11   (B) 9   (C) 7   (D) 5   (E) NOTA

12. Find the sum of the distinct prime factors of $(2^{10} - 1) \cdot 299$.

    (A) 5   (B) 244   (C) 81   (D) 93   (E) NOTA

13. Find the sum of the coefficients of $(2x - 3y)^5$.

    (A) 3125   (B) -3125 (C) 1   (D) -1 (E) NOTA

14. Find the minimum value of $f(x) = 17x^2 - 8x + 23$.

    (A) $\dfrac{373}{17}$ (B) $\dfrac{371}{17}$ (C) $\dfrac{4}{17}$ (D) DNE   (E) NOTA

15. The sum of the solutions to the equation $|16 - 4x| + |x - 3| = |-5|$ can be expressed in the form $\dfrac{J}{K}$, where J and K are relatively prime integers. Find the absolute value of $J + K$.

    (A) 43   (B) 57   (C) 73   (D) 169   (E) NOTA

16. For how many positive integers n is $n^2 + 4n - 5$ a prime number?

    (A) 0   (B) 1   (C) 2   (D) Infinitely many   (E) NOTA

17. Siddarth, Awnish, and Abhi are three brothers who really want the new Xbox One. When they asked their Dad for money, he gave them a challenge. He told them to come up with a riddle that their uncle (a world renowned mathematician) could not solve in under 10 seconds. Awnish suggested that they try a "what can pass through this door" riddle, but Abhi and Siddarth said that it would be too easy. They finally agreed on a riddle (using fake ages so it wouldn't be too easy) that their uncle wouldn't be able to solve in under 10 seconds. Assume you are the uncle, and your task is to solve the riddle and save your brother from spending \$500 on an Xbox One. This is their riddle: Awnish is twice as old as Abhi. One year ago, Siddarth's age was four times Abhi's age. In one year, Siddarth's age will be 2 more than triple Abhi's age. What will Abhi's age be in 6 years?

    (A) 19   (B) 15   (C) 13   (D) 7   (E) NOTA

For problems 18 and 19 use the following information:
Consider three functions $f(x)$, $g(x)$, and $h(x)$, such that

$$f(x) = 2x + 4, \ g(x) = 7x - 1, \ h(x) = 12x - 13$$

18. Evaluate $f(h(g(4)))$.

    (A) 492   (B) 983   (C) 626   (D) 683   (E) NOTA

19. Evaluate $g^{-1}(h(f^{-1}(8)))$.

    (A) $\dfrac{18}{7}$ (B) $\dfrac{12}{7}$ (C) $\dfrac{17}{7}$ (D) $\dfrac{13}{7}$ (E) NOTA

20. Find the sum of the fourth pentagonal number and the third triangular number (assuming 1 is the first pentagonal and triangular number).

    (A) 21   (B) 17   (C) 33   (D) 28   (E) NOTA

21. A certain conic has the definition of being the locus of all points such that the absolute value of the difference of the distances between two fixed points is always constant. Which statement about its eccentricity, e, is true?

    (A) $e = 0$ (B) $0 < e < 1$ (C) $e = 1$ (D) $1 < e$ (E) NOTA

22. The equation of a certain conic is $8x^2 - 112x + y + 545 = 117$. Let A be the distance between the vertex and the origin, let B be the length of the latus rectum, and let C be the x-coordinate of the vertex. What is $A + B + C$?

    (A) $\dfrac{1025}{16}$ (B) $\dfrac{1025}{32}$ (C) $\dfrac{513}{32}$ (D) $\dfrac{513}{64}$ (E) NOTA

23. Let a 3-digit positive integer be considered harmonic if it has 3 distinct digits which when read from left to right form a geometric sequence. What is the sum of the largest harmonic number, the smallest harmonic number, and the largest prime divisor of 2013?

    (A) 1149   (B) 1088   (C) 1759   (D) 2013   (E) NOTA

24. What is the units digit of $2^{2013} + 5^{79} + 7^{2012} + 19^{2014}$?

    (A) 1   (B) 4   (C) 7   (D) 9   (E) NOTA

25. Find the number of distinct ways to arrange the letters in the word "TALLAHASSEE".

    (A) 831600   (B) 39916800   (C) 827200   (D) 779400   (E) NOTA

26. A certain polynomial has the equation $7x^5 - Ax^4 + Bx^3 + 81x^2 + 19x + 87$. If the sum of the squares of its roots is equal to 113 and $B = 392$, find the sum of all possible values of $A + B$.

    (A) 784   (B) 673   (C) 497   (D) 0   (E) NOTA

27. A tanker carrying a 12 foot wide load is approaching a semi-elliptical tunnel that is 16 feet wide at the bottom and 12 feet tall from the ground at its highest point. What is the maximum height in feet that the truck can have in order for the truck to fit into the tunnel?

    (A) $3\sqrt{3}$ (B) 12   (C) $6\sqrt{3}$ (D) 6   (E) NOTA

28. Evaluate $(1 + i)^{2013} - (1 - i)^{2013}$.

    (A) 0   (B) 2^{1007} (C) -2^{1007} (D) $-2^{1007}i$ (E) NOTA

29. Calculate the value of $\sqrt{101 \cdot 99 \cdot 97 \cdot 95 + 16}$.

    (A) 9629   (B) 9314   (C) 9409   (D) 9599   (E) NOTA

30. Find the number of digits in the number 2401^{126} (Assume that $\log 7 = 0.8451$).

    (A) 428   (B) 427   (C) 426   (D) 425   (E) NOTA