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

1. Matias Duarte is currently at the point $(5, 11)$ but would like to collect a lollipop located at the point $(4, -1)$. He needs to stop at the Ive river which is defined by the line $x = 0$ on the Cartesian Plane. What is the total distance he must travel from his initial point to the lollipop if he must stop at the river?
(A) 10 (B) $\sqrt{101}$ (C) $\sqrt{145}$ (D) 15 (E) NOTA

2. Aditya, Meit, Shardul, Kyle, Roehl, and Mr. Cullen are playing tennis with each other. Two people play in each game and each person will play three games with everyone else. How many total games will be played?
(A) 12 (B) 15 (C) 36 (D) 45 (E) NOTA

3. Kyle loves confirming the existence of triangles. He is given an equilateral triangle and is told that the area is $18\sqrt{3}$ square meters. What is the length of the triangle's inradius, in meters?
(A) $15\sqrt{3}$ (B) $30\sqrt{3}$ (C) $45\sqrt{3}$ (D) $75\sqrt{3}$ (E) NOTA

4. Azhar enjoys observing the relationship between time and speed. Shardul helps him by throwing a milk carton in the air. The position of the milk carton is modeled by the equation $f(t) = -2t^2 + 6t + 7$ where t is the elapsed time and $f(t)$ is the height of the carton above the ground. What is the highest position attained by the carton during its movement?
(A) $\frac{23}{2}$ (B) $\frac{17}{2}$ (C) $\frac{11}{2}$ (D) $\frac{9}{2}$ (E) NOTA

5. Aditya really loves logs; unfortunately, he got stumped on the following question: rewrite $\log_6 6552$ where $S = \log_6 27$, $H = \log_6 32$, $A = \log_6 49$, and $R = \log_6 13$.
(A) $S + H + A + R$ (B) $\frac{2}{3}S + \frac{1}{6}H + \frac{1}{2}A + 2R$ (C) $\frac{2}{3}S + \frac{3}{5}H + \frac{1}{2}A + R$
(D) $\frac{3}{2}S + \frac{5}{3}H + 2A + R$ (E) NOTA

6. Kyle yells "Voat.co!" to which Aditya response "Free Speech!" Find the number of permutations of $FREESPEECH$, ignoring any punctuation.
(A) $3,628,800$ (B) $1,814,400$ (C) $907,200$ (D) $151,200$ (E) NOTA

7. What is the area of a regular hexagon inscribed in a circle of radius 6?
(A) $72\sqrt{3}$ (B) $54\sqrt{3}$ (C) $\frac{72\pi}{\sqrt{3}}$ (D) $\frac{36\pi}{\sqrt{3}}$ (E) NOTA

8. Shardul has dug a 261-mile-long tunnel in the shape of a semi-cylinder with radius 9 feet. What is the side length of the largest cube that can fit in the tunnel, in feet, assuming it can touch the interior of the tunnel?
(A) $\frac{18\sqrt{5}}{5}$ (B) $\frac{36\sqrt{5}}{5}$ (C) 9 (D) 18 (E) NOTA

9. Jasmine is running in a race. The path she follows is modeled by the equation $x^2 + y^2 - 6x - 10y - 94 = 0$. If she must follow this path twice in order to complete the race, what is the total distance she must travel?
(A) $\pi\sqrt{94}$ (B) $2\pi\sqrt{94}$ (C) $8\pi\sqrt{2}$ (D) $32\pi\sqrt{2}$ (E) NOTA

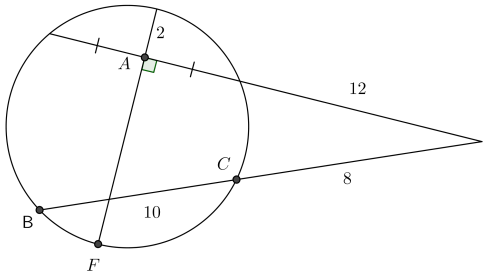
10. What is the inverse of the following statement? If Aditya has a Nexus, then he is a true warrior.
(A) If Aditya does not have a Nexus, then he is not a true warrior.
(B) If Aditya does not have a Nexus, then he is a true warrior.
(C) If Aditya is not a true warrior, then he does not have a Nexus.
(D) If Aditya is a true warrior, then he has a Nexus.
(E) NOTA

11. Meit and Rida are having an arm wrestling contest. If the amount of power being released by Rida is modeled by the function $P(t) = 3t^2 - 6t + 31$ and the amount of power being released by Meit is modeled by the function $P(t) = 4t^2 - 16t + 7$, where t is the time elapsed in seconds, at what time will both Meit and Rida be releasing the same amount of power? Assume that t equals 0 when the contest begins.
(A) 4 (B) 6 (C) 10 (D) 12 (E) NOTA

12. An item in a matrix can be written as $a_{i,j}$ where i represents the row number the item is in and j represents the column number the item is in. In a particular 4×4 matrix, $a_{1,1}$ equals 0, meaning the upper left item in the array is a 0. Each term after the first term in a row can be calculated using the formula $a_{i,j} = 2(a_{i,j-1}) + 1$. If the four terms in the first column of the matrix, beginning with 0, form an arithmetic sequence with common difference 2, what is the sum of the terms in the third row of the matrix?
(A) 12 (B) 28 (C) 65 (D) 71 (E) NOTA

13. When tossing milk cartons, John has a 0.8 chance of missing the bin. If John tosses 5 milk cartons, what is the probability that John will make three of them into the bin?
(A) $\frac{42}{625}$ (B) $\frac{32}{625}$ (C) $\frac{18}{625}$ (D) $\frac{8}{625}$ (E) NOTA

14. Find the length of segment AF given the following information in the diagram below (BC = 10):

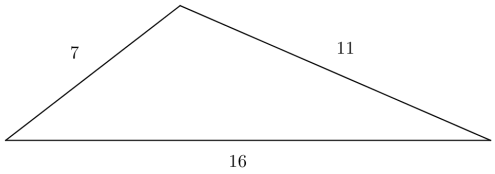


(A) 18 (B) $\frac{9}{2}$ (C) 4 (D) $\frac{5}{2}$ (E) NOTA

15. Kyle wants to dock his ship in Aditya's port but he must solve Aditya's riddle first: "What point is found when the altitudes of a triangle meet each other?" What is the answer to Aditya's riddle?
(A) Orthocenter
(B) Circumcenter
(C) Incenter
(D) Centroid
(E) NOTA

16. Simplify the following expression: $\frac{2^{n+3} - 4(2^n)}{2^{n+4}}$.
(A) $\frac{3}{2}$ (B) $\frac{3}{4}$ (C) $\frac{2}{3}$ (D) $\frac{1}{4}$ (E) NOTA

17. Roehl created a triangular frame for his building event, as shown below. What is the altitude to the side of length 16 given the other side lengths indicated in the diagram? Note that the diagram is not to scale.



(A) 34 (B) 17 (C) $\sqrt{255}$ (D) $\frac{\sqrt{255}}{4}$ (E) NOTA

18. What is the sum of the squares of the roots of the equation $f(x) = 4x^2+16x-9$ divided by the sum of the reciprocals of the roots of the equation $f(x) = 5x^2 - 15x + 12$?
(A) $\frac{164}{5}$ (B) $\frac{82}{5}$ (C) 10 (D) 5 (E) NOTA

19. At a meeting of 8 delegates, conflict arose over the seating arrangement. At the end of the meeting, it was determined that Jack would have to sit next to Jill. Assuming that Jack and Jill are part of the 8 delegates, how many seating arrangements are possible?
(A) 7! (B) $2 \times 7!$ (C) 6! (D) $2 \times 6!$ (E) NOTA

20. Asymptotic behavior is exhibited by functions as they tend toward values which cannot be obtained, due to domain and range restrictions. Find the equation of the line that is perpendicular to the following function's oblique asymptote, and passes through the point (1,2): $f(x) = \frac{3x^3 - 9x^2 - 18x + 24}{x^2 - 3x + 2}$.
(A) $y = -3x + 5$ (B) $y = 3x - 1$ (C) $y = -\frac{1}{3}x + \frac{7}{3}$ (D) $y = \frac{1}{3}x + \frac{5}{3}$ (E) NOTA

21. The derivative of a function can be found using a shortcut known as the power rule. For each term in a function, the coefficient is multiplied by the power of x and then the power of x is decreased by 1. For example, the first derivative of $f(x) = 8x^3$ would be $24x^2$. The n^{th} derivative can be found by taking the derivative of the $n-1^{th}$ derivative. Using this definition of the power rule, find the second derivative of $f(x) = 5x^4 + 16x^3 - 5x^2 + 9x - 8$.
(A) $5x^2 + 16x - 5$ (B) $20x^3 + 48x^2 - 10x + 9$ (C) $60x^2 + 96x - 10$
(D) The second derivative does not exist. (E) NOTA

22. A tunnel is constructed to transport goods under a river. The pressure of the water on an object varies directly with the square of the depth of the object under the water surface. At a depth of 9 meters, the water pressure is 21 atmospheres. If the tunnel is to be placed at a depth of 18 meters, how much water pressure will the tunnel need to withstand, in atmospheres?
(A) 42 (B) 84 (C) $\frac{128}{9}$ (D) $\frac{256}{9}$ (E) NOTA

23. After completing the tunnel, a telescope was transported to the other side. The telescope was comprised of a cylinder with a hemisphere on the top. The cylinder had a radius of 5 feet and a height of 6 feet and the hemisphere had a radius of 5 feet. What is the volume of the telescope, in cubic feet?
(A) $\frac{700\pi}{3}$ (B) $\frac{450\pi}{3}$ (C) $\frac{250\pi}{3}$ (D) 150π (E) NOTA

24. The population growth of Mountain Valley can be modeled by the function $P(t) = P_0e^{0.1t}$ where P_0 is the initial population and t is the number of years that have passed. After how many years will the population double from the initial population?
(A) $\frac{\ln 2000}{0.1}$ (B) $\frac{\ln 2000}{1000}$ (C) $\frac{\ln 1000}{0.1}$ (D) $\frac{\ln 1000}{1000}$ (E) NOTA

25. Wenxin is rowing towards a lighthouse. Originally, she observes that her angle of elevation to the top of the tower is 30°. After she rows 2 miles, her angle of elevation to the top of the tower is 60°. What is the height of the tower in miles?
(A) $\frac{\sqrt{3}}{2}$ (B) $\sqrt{3}$ (C) $2\sqrt{3}$
(D) Not enough information (E) NOTA

26. When $(3A + 6B - 9C + 4D)^6$ is expanded, let M be the sum of the coefficients and let D be the number of terms in the simplified expansion. What is $M + D$?
(A) 28 (B) 34 (C) 4200 (D) 4222 (E) NOTA

27. While applying for the Rickards Swag Squad, Jasmine was asked the following question: what is the directrix of $x = 3y^2 + 6y - 5$? Help her get in by answering the question!
(A) $y = -\frac{97}{12}$ (B) $y = -\frac{13}{12}$ (C) $x = -\frac{97}{12}$ (D) $x = -\frac{13}{12}$ (E) NOTA

28. Suppose you are taking a 15 question test. You earn 6 points for each correct answer, lose 1 point for each incorrect answer, and earn 0 points for each unanswered question. What is the lowest unattainable score possible after taking the test, assuming that the score must be an integer greater than -16?
(A) 55 (B) 61 (C) 67 (D) 73 (E) NOTA

29. What is the lateral area of the frustum formed by truncating a cone, with height 10 and radius 5, along the plane that bisects the height and is parallel to the base?
(A) $\frac{25\pi\sqrt{2}}{4}$ (B) $\frac{25\pi\sqrt{2}}{2}$ (C) $\frac{75\pi\sqrt{2}}{4}$ (D) $\frac{75\pi\sqrt{2}}{2}$ (E) NOTA

30. What is the sum of the terms of the following infinite series: $\frac{1}{5} + \frac{3}{25} + \frac{5}{125} + \frac{7}{625} + \ldots$?
(A) 5 (B) $\frac{3}{8}$ (C) $\frac{1}{5}$
(D) Not enough information (E) NOTA