

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

- The perimeter of a square fountain is 60 meters. The square path completely surrounding the fountain has an area of 400 square meters. How many meters would the perimeter of the outer edge of the path be?  
(A) 100 (B) 75 (C) 225 (D) 50 (E) NOTA
- Triangle  $ABC$  has vertices at  $(4, 5)$ ,  $(18, 5)$ , and  $(9, 17)$ . The centroid of the triangle sits at point  $(D, E)$ . What is  $D + E$ ?  
(A) 29 (B)  $\frac{140}{13}$  (C)  $\frac{58}{3}$  (D)  $\frac{161}{17}$  (E) NOTA
- There is a triangle with side lengths 5, 7, and 8. The circumference of a circle that is circumscribed around that triangle can be expressed as  $a\pi\sqrt{b}$ , where  $b$  is a squarefree, positive integer. What is the average of  $a$  and  $b$ ?  
(A)  $\frac{11}{2}$  (B)  $\frac{23}{6}$  (C)  $\frac{15}{2}$  (D)  $\frac{17}{2}$  (E) NOTA
- Poles of heights 45 feet and 10 feet sit 24 feet apart. A wire is attached from the top of the pole on the left to the bottom of the pole on the right, while another wire is attached from the top of the pole on the right to the bottom of the pole on the left. At what height do the two wires intersect? Round your answer to the nearest whole number.  
(A) 10 (B) 22 (C) 22.3 (D) 8 (E) NOTA
- Tanmay got bored of normal chess so he decided change the locations of all the pieces. In how many ways can Tanmay place 32 chess pieces on a  $8 \times 8$  board, assuming that the different types chess pieces are indistinguishable. For example, the 8 white pawns are different from the 8 black pawns.  
(A) 64 (B) 32! (C)  $\frac{64!}{(32!)^2}$  (D)  $\frac{64!}{(32!)^2 8!(2!)^2 (2!)^2}$  (E) NOTA
- There are 2 circles with radii of 10 inches and 4 inches. The centers are 12 inches apart and there is a rope in a pulley system that goes around the outside edges of both circles tightly. What is the total length of the rope?  
(A)  $12\sqrt{3}$  (B)  $8\pi + 12\sqrt{3}$  (C)  $12\pi + 12\sqrt{3}$  (D)  $16\pi + 12\sqrt{3}$  (E) NOTA
- In triangle  $ABC$ ,  $\angle ABC = 135^\circ$ ,  $AB = 7$ , and  $BC = 8$ . If  $AC^2$  can be expressed as  $a - \sqrt{b}$  for positive integers  $a, b$ , then what is the value of  $\sqrt{57a - b}$ ?  
(A) 12 (B) 13 (C) 14 (D) 15 (E) NOTA
- There is a  $5 \times 6$  grid made up of 30  $1 \times 1$  squares. What is the number of rectangles found in this grid?  
(A) 260 (B) 196 (C) 300 (D) 30 (E) NOTA
- The measures of the interior angles of a convex octagon form an arithmetic sequence. How many possible arithmetic sequences are possible, if all the angle degrees are positive integers?  
(A) 10 (B) 9 (C) 8 (D) 7 (E) NOTA
- Shrung's house is in the shape of the regular octagon and his house is on a circular island that passes through every vertex of his house. What is the area of the island, if Shrung's house has a side length of  $2\sqrt{2}$ ?  
(A)  $8\pi + 4\pi\sqrt{2}$  (B)  $32 + 32\sqrt{2}$  (C)  $32 + 16\pi\sqrt{2}$  (D)  $32\pi$  (E) NOTA
- Pentagons  $A$  and  $B$  are regular. Pentagon  $A$  has a side length of 4 meters and pentagon  $B$  has a side length of  $\frac{34}{5}$  meters. Pentagon  $B$ 's area is approximately 79.55 square meters. Which of the following is closest to the area of pentagon  $A$ ?  
(A) 26.5 (B) 27.5 (C) 28.5 (D) 29.5 (E) NOTA

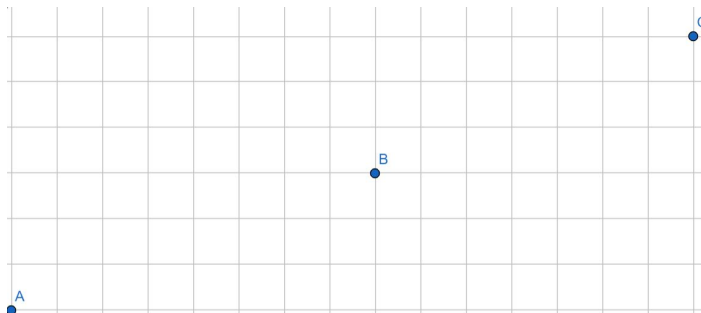
12. What is the inverse of the contrapositive of the inverse of the converse of “If she sells sea-shells on the sea-shore, then I’m sure she sells sea-shore shells.”
- (A) If she sells sea-shells on the sea-shore, then I’m sure she sells sea-shore shells  
 (B) If she doesn’t sell sea-shells on the sea-shore, then I’m not sure if she sells sea-shore shells  
 (C) If I’m not sure she sells sea-shore shells, then she doesn’t sell sea-shells on the sea-shore  
 (D) If I’m sure she sells sea-shore shells, then she sells sea-shells on the sea-shore  
 (E) NOTA

13. The table below contains 9 consecutive numbers and are arranged in a way so that the sum of every individual row, column, and diagonal are the same. What is the sum of the numbers in the grids marked  $A$ ,  $B$ ,  $C$ , and  $D$ ?

22		A
	B	19
18	C	D

- (A) 61                      (B) 90                      (C) 59                      (D) 93                      (E) NOTA
14.  $ABCD$  is a cyclic quadrilateral consisting of two right triangles that share a hypotenuse. All side lengths and the diameter of the circumcircle are integers. If  $BC = 15$  and  $CD = 24$ , what is the length of the diagonal that is not the shared hypotenuse of the right triangles?
- (A)  $\frac{117}{5}$                       (B) 23                      (C)  $\frac{32}{15}$                       (D) Cannot be determined                      (E) NOTA
15. In  $\triangle ABC$ , let  $\angle B = 90^\circ$ . Let  $D$  be the foot of the altitude from  $B$  onto  $AC$ . If  $BD = 6$  and  $AD = 4$ , find  $DC$ .
- (A) 4                      (B) 9                      (C) 6                      (D) 10                      (E) NOTA
16. A regular hexagon and equilateral triangle have equal perimeters. If the area of the equilateral triangle is  $4\sqrt{3}$  square inches, what is the length of the apothem of the hexagon, in inches?
- (A)  $2\sqrt{3}$                       (B)  $\sqrt{3}$                       (C) 3                      (D)  $4\sqrt{3}$                       (E) NOTA
17. Eric wakes up and checks the time on his watch. However, his watch malfunctions and instead of showing him the current time, it shows him the current angle between the hour hand and minute hand on an analog clock. Instead of checking the clock in the other room, he calculates that it would more efficient to solve for the time. If the angle between the hour hand and minute hand is 111 degrees. Which of the following times could be the time that Eric wakes up at?
- (A) 7 : 20 AM                      (B) 6 : 31 AM                      (C) 4 : 42 AM                      (D) 1 : 30 AM                      (E) NOTA
18. Ananya’s ostrich of negligible size is fenced in her hexagonal field, with side lengths of 10 meters. The ostrich is tied to one of the vertices by a rope of length of 20 meters. There is a gap at the 2 closest vertices and the ostrich is able to move freely through these vertices. The number of square meters of the land the ostrich can roam on is  $a\sqrt{b} + \frac{c\pi}{d}$ , where  $a, b, c, d$  are positive integers,  $\gcd(c, d) = 1$ , and  $b$  is squarefree. What is the value of  $a + b + c + d$ ?
- (A) 256                      (B) 331                      (C) 496                      (D) 556                      (E) NOTA
19. A 3-D convex polyhedron has 100 faces and 160 edges. How many vertices does it have?
- (A) 158                      (B) 8                      (C) 60                      (D) 84                      (E) NOTA

20. There is a pool that can hold  $40\pi$  cubic meters of water. The water from the pool is being drained into a cylindrical tank at a rate of  $2\pi$  cubic meters per hour. The cylindrical tank's base is a circle with radius 2 meters and it has a height of 12 meters. The tank is standing up with a circular base on the ground. If the pool was originally at 90% capacity and has been draining for 5 hours, what is the height of the water in the cylindrical tank? Express your answer in centimeters.
- (A) 2.5                      (B) 250                      (C) 1.5                      (D) 150                      (E) NOTA
21. Karthik is scuba diving and has a tank consisting of a hemisphere on top of a cylinder, with both parts sharing the same base. The circular base has a radius of 3 feet. The cylinder makes up  $\frac{5}{6}$  of the scuba tank's total height. Karthik submerges at 1 : 05 p.m. and begins to use the oxygen in the tank at a rate of  $\frac{\pi}{2}$  cubic feet of oxygen per minute. Assuming the tank was completely full when Karthik submerged, at what time will he run out of oxygen in the tank?
- (A) 3 : 38 PM                      (B) 4 : 42 PM                      (C) 5 : 36 PM                      (D) 6 : 11 PM                      (E) NOTA
22. Shubham needs to run some errands and wants to know the shortest path he can take to complete all of them. He needs to go to the supermarket to buy some groceries, Rickards to pick up some books, and Tanmay's house to pick up his cricket bat that he forgot. Shubham's house sits at  $(4, 2)$ , the supermarket is at  $(10, 7)$ , Tanmay's house is at  $(6, 5)$ , and Rickards is at  $(15, 16)$ . What is the order of the places that Shubham should go if he wants to take the longest route possible (he like walking)? Assume he starts at his house, can only travel on the grid lines, and the final step is to return to his house.
- (A) Tanmay's house, Rickards, Supermarket  
 (B) Tanmay's house, Supermarket, Rickards  
 (C) Rickards, Tanmay's house, Supermarket  
 (D) Rickards, Supermarket, Tanmay's house  
 (E) There is a more optimal path than any of the 4 above.
23. Sruthi and Jenna decide to go on a jog starting at point  $A$  and they to get to point  $C$ . However, they must go through point  $B$  before continuing forward. To further challenge themselves, they decided they can only move toward the right or towards the top along the lines of the grid. How many ways can they get from point  $A$  to point  $C$ , satisfying these conditions?



- (A) 330                      (B) 54450                      (C) 6320                      (D) 64505                      (E) NOTA
24. Cyclic quadrilateral  $ABCD$  has diagonals intersecting at  $E$ .  $AE = 5$ ,  $CE = 9$ , and  $DE = 7$ . Compute  $BE$ .
- (A)  $\frac{45}{7}$                       (B)  $\frac{35}{9}$                       (C)  $\frac{3}{4}$                       (D) 7                      (E) NOTA
25.  $ABCD$  is a rhombus. Given that the coordinates of point  $A$  and  $C$  are  $(8, 10)$  and  $(12, 2)$  and that  $B$  lies on the  $x$ -axis. Find the sum of the abscissa and ordinate of  $D$ .
- (A) 18                      (B) 22                      (C) 12                      (D) 14                      (E) NOTA

26. The coordinates of triangle  $ABC$  are  $(-5, 12)$ ,  $(3, 4)$ , and  $(4, 6)$  respectively. Triangle  $ABC$  is reflected across the line  $y = 3x + 2$  to  $A'B'C'$  and then  $A'B'C'$  is reflected across the  $y$ -axis to  $A''B''C''$ . Find the sum of the coordinates of each of the vertices of  $A''B''C''$ .
- (A) 24                      (B)  $-24$                       (C)  $-11$                       (D) 12                      (E) NOTA
27. Akhil eats a  $\frac{\text{foot}}{\pi}$ -long at Subway for lunch. His sandwich is in the shape of a cylinder with a radius of  $2\sqrt{2}$  inches and a height of  $\frac{12}{\pi}$  inches. To save some for later, he cuts his subway into the maximum number of pieces using the least possible amount of cuts, such that the average volume of his pieces is  $\frac{24}{23}$  inches cubed. How many times did Akhil cut his sandwich?
- (A) 6                      (B) 7                      (C) 8                      (D) 10                      (E) NOTA
28. There exists a conic that can be graphed using the equation  $x^2 + y^2 - 4x + 6y = 3$ . Find the shortest distance from the center of the conic to the line  $y = -2x + 13$ .
- (A)  $\frac{12\sqrt{5}}{5}$                       (B)  $\frac{10\sqrt{15}}{5}$                       (C)  $\frac{8}{3}$                       (D)  $\frac{10\sqrt{2}}{3}$                       (E) NOTA
29. The diagonals of rectangle  $ABCD$  intersect at  $E$ . The length of  $AB$  is 5 and the length of  $BC$  is 12. Compute  $\sin(\angle AED)$ .
- (A)  $12/13$                       (B)  $5/13$                       (C)  $\frac{32}{17}$                       (D)  $\frac{120}{169}$                       (E) NOTA
30. In triangle  $ABC$ ,  $\angle ABC = 90^\circ$  and  $AD$  is an angle bisector, where  $D$  lies on side  $BC$ . If  $AB = 5x - 7$ ,  $BC = 2x + 9$ , and  $AC = 5x + 2$ . If  $x$  is an integer, what is the length of  $AD$ ?
- (A)  $\frac{8\sqrt{34}}{5}$                       (B) 17                      (C)  $\frac{4\sqrt{34}}{7}$                       (D)  $\frac{15}{7}$                       (E) NOTA