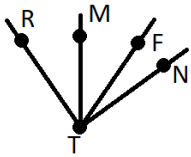


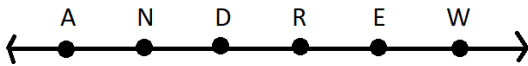
Important Instructions for this Test: Good luck, have fun, and as always: “NOTA” stands for “None of These Answers is correct.”

1. In the diagram below, $\angle RTF$ is bisected by \overline{TM} . $\angle MTR$ and $\angle MTN$ are complementary to one another. Given that $m\angle RTF = 70^\circ$, how many degrees is the $m\angle MTN$?



- A: 20° B: 35° C: 55° D: 70° E: NOTA

2. Andrew is bored in class one day and draws a line with points A, N, D, R, E, and W as shown in the order as presented in the figure below. Given that N is the midpoint of \overline{AD} , D is the midpoint of \overline{NE} , R is the midpoint of \overline{DW} , and E is the midpoint of \overline{RW} , then what is the ratio of $AN: NW$?



- A: 1:5 B: 1:6 C: 3:7 D: 3:10 E: NOTA

3. The distance between (a, b) and $(-a, -b)$ in the coordinate plane is 10. Given that a and b are non-negative integers, how many distinct coordinates exists for the ordered pair (a, b) ?

- A: 2 B: 4 C: 6 D: 8 E: NOTA

4. The following is a true statement: If Jakob and Jaansi are friends, then Jaansi and Advaith are friends. Based upon the prior statement, which of the following additional statements must also be true?

- A: If Jakob and Jaansi are not friends, then Jaansi and Advaith are not friends.
- B: If Jaansi and Advaith are friends, then Jakob and Jaansi are friends.
- C: If Jakob and Advaith are friends, then Advaith and Jaansi are friends.
- D: If Jaansi and Advaith are not friends, then Jakob and Jaansi are not friends.
- E: NOTA

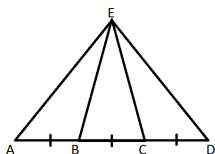
5. Regular hexagon ABCDEF has vertices $A(0,0)$, $B(6,0)$, $C(x, y)$. Therefore, what is a possible equation of a line through \overline{BC} ?

- A: $y = -\sqrt{3}x - 6\sqrt{3}$ C: $y = \sqrt{3}x - 9\sqrt{3}$ E: NOTA
 B: $y = -\sqrt{3}x + 6\sqrt{3}$ D: $y = \sqrt{3}x + 9\sqrt{3}$

6. How many convex polygons have fewer than 20 diagonals?

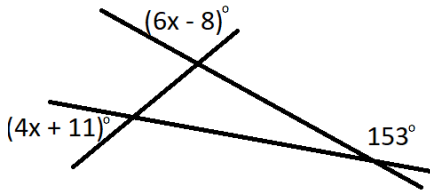
- A: 8 B: 7 C: 6 D: 5 E: NOTA

7. Equilateral triangle ADE is trisected by segments \overline{BE} and \overline{CE} as shown in the diagram below. What is the degree measure of $\angle EBC$?



- A: 20° B: 60° C: 70° D: 80° E: NOTA

8. Given the diagram below what is the value of $10x$?



- A: 150 B: 15 C: 24 D: 240 E: NOTA

9. Which of the following pairs of lines can never intersect?

- I. Two skew lines
- II. Two parallel lines
- III. Two perpendicular lines

- A: I only B: II only C: III only D: I and II only E: NOTA

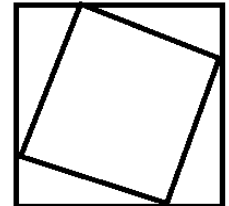
10. $\triangle ABC$ has side lengths of $AB=8, BC=5$ and $AC=5$. The perpendicular bisectors are drawn and intersect at point D . What is the length of $AD + BD + CD$?

- A: $50/3$ B: 50 C: $25/2$ D: $25/3$ E: NOTA

11. The angles of a quadrilateral are $(x)^\circ, (xr)^\circ, (xr^2)^\circ$ and $(xr^3)^\circ$. Given that both x and r are positive integers, then what is the largest possible value of r ?

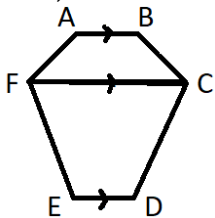
- A: 4 B: 3 C: 2 D: 1 E: NOTA

12. Two squares are within one another as shown in the diagram to the right. The area of the smaller square inside is 169. Given that both squares have integral side lengths, then what is the differences in the areas of the two squares?



- A: 109 B: 120 C: 155 D: 169 E: NOTA

13. Two isosceles trapezoids $ABCF$ and $CDEF$ have bases $AB = DE = 2$ and $CF = 4$. The height of trapezoid $CDEF$ is 3 times that of the height of trapezoid $ABCF$. If the combined area of the two trapezoids is 24, then what is the perimeter of hexagon $ABCDEF$?



- A: $4 + 2\sqrt{5} + 2\sqrt{37}$ C: $4 + 4\sqrt{2} + 8\sqrt{10}$ E: NOTA
 B: $4 + 12\sqrt{2}$ D: $4 + 2\sqrt{2} + 4\sqrt{10}$

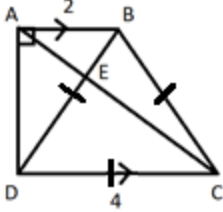
14. A triangle has three distinct side lengths that are all palindromes (meaning they are integers that read the same forwards as backwards). Given that two of the side lengths are 101 and 111, then how many possible values exist for the third side length?

- A: 9 B: 19 C: 20 D: 21 E: NOTA

15. Right triangle $\triangle MA\theta$ has side lengths that are in the ratio 3:4:5. Let x be the length of the altitude to the hypotenuse of $\triangle MA\theta$ and let y be the perimeter of $\triangle MA\theta$. What is the ratio of $x:y$?

- A: 1:12 B: 5:12 C: 7:12 D: 1:5 E: NOTA

16. $\triangle BCD$ is an equilateral triangle and trapezoid $ABCD$ has base lengths $AB = 2$ and $CD = 4$ as shown below. The diagonals of the trapezoid intersect at point E . What is the length of \overline{AE} ?

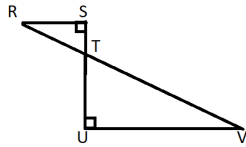


- A: $\frac{2\sqrt{7}}{3}$ B: $\frac{\sqrt{7}}{3}$ C: $\frac{2\sqrt{3}}{3}$ D: $\frac{\sqrt{3}}{3}$ E: NOTA

17. Two sides of a right triangle are 5 and 12. What is the smallest possible value for the third side?

- A: 17 B: 13 C: 8 D: 7 E: NOTA

18. In the diagram below the $\tan(\angle TVU) = \frac{2}{3}$. What is the ratio of $\frac{RS}{ST}$?

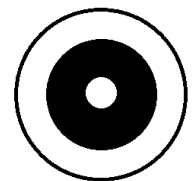


- A: $\frac{2}{3}$ B: $\frac{3}{2}$ C: $\frac{\sqrt{5}}{2}$ D: $\frac{\sqrt{5}}{3}$ E: NOTA

19. Circle 1 has a center of $(1, 1)$ and diameter of 2. Circle 2 has a center of $(-4, -4)$ and a radius of 2. What is the shortest distance between the two circles?

- A: $3\sqrt{2}$ B: $5\sqrt{2}$ C: $5\sqrt{2} - 3$ D: $5\sqrt{2} - 4$ E: NOTA

20. A circular dartboard is made with concentric circles of diameters 1, 3, and 5. What is the probability of a dart landing in the middle annulus shaded region given that the dart hits the dartboard to the right?



- A: $\frac{8}{25}$ B: $\frac{9}{25}$ C: $\frac{2}{5}$ D: $\frac{3}{5}$ E: NOTA

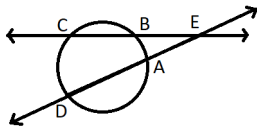
21. A circle with center C has a diameter with endpoints A and B . Point D is labeled on arc \widehat{AB} such that central angle $\angle ACD$ measures $(x)^\circ$ and inscribed angle $\angle ABD$ measures $(y)^\circ$. What is the ratio of $\frac{x}{y}$?

- A: 1 B: 2 C: $\frac{1}{2}$ D: $\frac{2}{3}$ E: NOTA

22. Given that the circumference of a circle is $\frac{\pi}{a}$, what is the area of the circle in terms of a ?

- A: $\frac{\pi}{a^2}$ B: $\frac{\pi}{2a^2}$ C: $\frac{2\pi}{a^2}$ D: $\frac{4\pi}{a^2}$ E: NOTA

23. Secant lines \overleftrightarrow{BC} and \overleftrightarrow{AD} intersect at point E as shown in the diagram below. Given that the ratio of the minor arcs $AB:BC:CD:AD = 1:2:3:4$. What is the measure of $\angle CED$ in degrees?



- A: 36° B: 48° C: 60° D: 72° E: NOTA

24. A rhombus has integral diagonal lengths. If its area is 4 square units, then what is the maximum possible side length of the rhombus?

- A: $\sqrt{2}$ B: $\sqrt{5}$ C: $\frac{\sqrt{17}}{2}$ D: $\frac{\sqrt{65}}{2}$ E: NOTA

25. The area of a regular hexagon is $24\sqrt{3}$. What is the area of a circle circumscribing it?

- A: 4π B: 6π C: 16π D: 36π E: NOTA

26. The supplement of an angle x is y . The complement of angle y is z . Given that z is 10 less than half of x , then what is the sum of $x + y + z$?

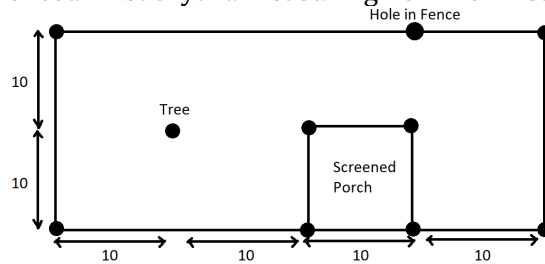
- A: 270° B: 250° C: 230° D: 210° E: NOTA

27. A composite 8-sided equilateral polygon is formed by joining two regular shapes with a shared side. If one of the regular shapes is a pentagon, then what is the other shape?

- A: Triangle C: Pentagon E: NOTA
 B: Quadrilateral D: Hexagon

Please Use the Following Information to Answer Questions 28 to 30:

The following is a diagram of a fenced-in backyard measuring 20' x 40'. Assume all dimensions are in feet.



28. What is the shortest distance from the tree to the hole in the fence?

- A: $10\sqrt{2}$ B: $10\sqrt{3}$ C: $10\sqrt{5}$ D: 30 E: NOTA

29. New sod is being laid everywhere in the backyard with the exception of the screened-in porch. The cost of the sod is \$4.50 per square yard. Which of the following is the estimate for the total cost of the sod for the backyard?

- A: \$3,150 B: \$1,050 C: \$700 D: \$350 E: NOTA

30. A dog is on a $10\sqrt{2}$ -foot long leash that is tied to the tree. What is the total size of the area where the dog can roam?

- A: $350 + 25\pi$ C: $300 + 50\pi$ E: NOTA
 B: $400 - 50\pi$ D: $350 + 50\pi$