For all questions, choice E: NOTA means that none of the other given answers are correct. Figures are not necessarily drawn to scale. All angle measures on this test are in degrees. All objects on this test are nondegenerate cases.

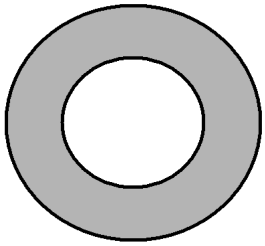
1. Two lines intersect to form two acute angles and two obtuse angles. If an acute angle measures $56°$, then what is the measure of an obtuse angle formed?

   (A) $34°$ (B) $124°$ (C) $344°$ (D) $96°$ (E) NOTA

2. A rectangle has a perimeter of 36. If its width is three times its length, how much greater is the width than the length of this rectangle?

   (A) $\frac{27}{2}$ (B) 18 (C) 6 (D) 9 (E) NOTA

3. Two concentric circles are drawn as shown below. If the larger circle has radius 6 and the smaller circle has radius 3, find the area of the annulus, or ring, formed by the two circles (as indicated by the shaded region below).

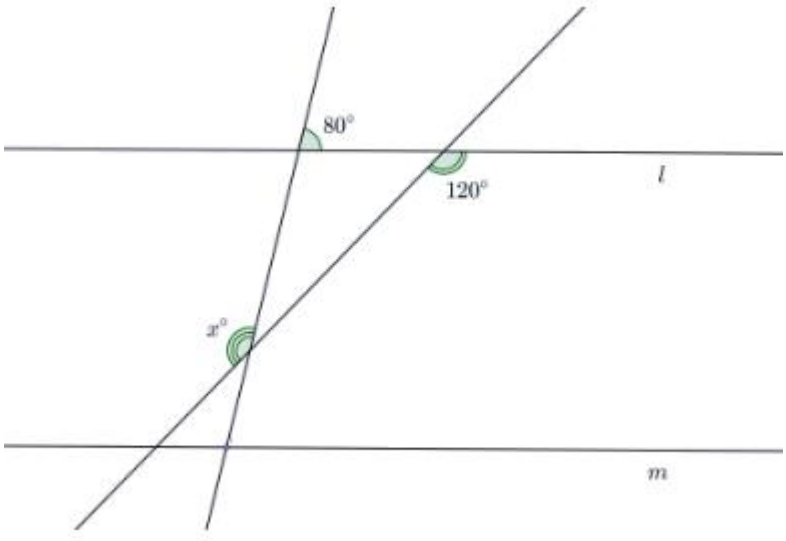


   (A) 9π (B) 27π (C) 6π (D) $3\sqrt{3}$ (E) NOTA

4. A triangle has an interior angle of $30°$ and an exterior angle of $50°$. What is the measure of the smallest interior angle of this triangle?

   (A) $30°$ (B) $20°$ (C) $40°$ (D) $50°$ (E) NOTA

5. In the figure, lines l and m are parallel. Find $x°$.



   (A) $160°$ (B) $140°$ (C) $120°$ (D) $135°$ (E) NOTA

6. Find the sum of the measures of the exterior angles of a 21-sided polygon.

   (A) 90° (B) 1530° (C) 180° (D) 3420° (E) NOTA

7. In triangle ABC, $\angle A = 75°$, $\angle B = 60°$, and $AC = 12\sqrt{6}$. Find the measure of side length AB.

   (A) 12 (B) $12\sqrt{3}$ (C) 24 (D) 18 (E) NOTA

8. What is the area of a circle with radius $\frac{1}{\sqrt{\pi}}$?

   (A) 1 (B) π (C) $\frac{1}{\pi}$ (D) 2 (E) NOTA

9. Points X, Y, and Z are collinear. If $XY : XZ = 2 : 5$ and $XZ = 28$, compute the sum of all possible values of YZ.

   (A) 56 (B) $\frac{84}{5}$ (C) 39 (D) $\frac{28}{5}$ (E) NOTA

10. Consider the points $A(5, 17)$ and $B(6, 3)$ in the coordinate plane. Point C has coordinates (m, n) such that $AC = BC$. Regardless of the position of C, the value of $m - 14n$ remains constant. Find the value of $m - 14n$.

    (A) -36 (B) -233 (C) $\frac{-269}{2}$ (D) -269 (E) NOTA

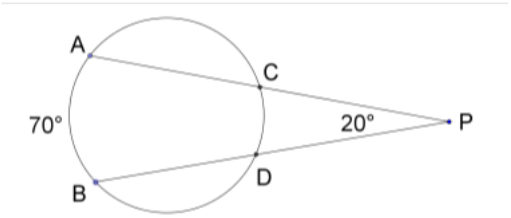
11. Which of the following is sufficient to prove that a quadrilateral is a parallelogram?

    (A) The diagonals are perpendicular and congruent.
    (B) Adjacent interior angles are complementary.
    (C) The measures of opposite interior angles are equal.
    (D) It is convex but not a rhombus.
    (E) NOTA

12. Consider the following statement:"If a quadrilateral is a rectangle, then its diagonals are congruent." Which of the following is also true?

    (A) "If a quadrilateral is a rectangle, then its diagonals are not congruent."
    (B) "If a quadrilateral is not a rectangle, then its diagonals are not congruent."
    (C) "If the diagonals of a quadrilateral are congruent, then it is a rectangle."
    (D) "If the diagonals of a quadrilateral are not congruent, then it is not a rectangle."
    (E) NOTA

13. In the figure shown, $\overset{\frown}{AB} = 70°$ and $\angle APB = 20°$. Find the measure of $\overset{\frown}{CD}$.



   (A) 30° (B) 25° (C) 45° (D) 35° (E) NOTA

14. How many noncongruent triangles with integer side lengths have perimeter 6?

    (A) 1 (B) 2 (C) 3 (D) 4 (E) NOTA

15. A right square pyramid has a base of side length 8 in. and a height of 12 in. Find the volume of the pyramid.

(A) 256 in^3 (B) 270 in^3 (C) 384 in^3 (D) 32 in^3 (E) NOTA

16. Exactly how many of the following are true?

I. If a sphere has radius r, then the total surface area of the sphere is equal to $4\pi r^2$
II. If a cylinder has height h and radius r, then the volume of the cylinder is equal to $2\pi r^2 h$
III. If a cube has edge length s, then the surface area of the cube is equal to $3s^2$
IV. If a regular dodecagon has side length 2, then the perimeter of the regular dodecagon is equal to 24

(A) 1 (B) 2 (C) 3 (D) 4 (E) NOTA

17. An isosceles triangle has a side of length 6 and an interior angle measuring 120°. Find the greatest possible area of this triangle.

(A) $6\sqrt{3}$ (B) 9 (C) $3(\sqrt{6}+\sqrt{2})$ (D) $9\sqrt{3}$ (E) NOTA

18. A circle is inscribed within a square. What is the probability that a randomly chosen point within the square is also within the circle?

(A) $\frac{\pi}{2}$ (B) $\frac{\pi}{4}$ (C) $\frac{\pi\sqrt{2}}{2}$ (D) $\frac{\pi}{8}$ (E) NOTA

19. The medians to the legs of a right triangle have lengths 10 and $4\sqrt{10}$. Find the length of the triangle's hypotenuse.

(A) $4\sqrt{13}$ (B) 15 (C) $16\sqrt{3}$ (D) 20 (E) NOTA

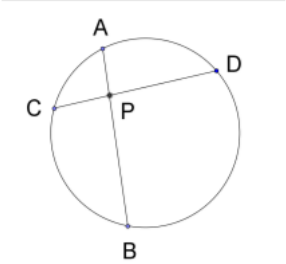
20. $ABCD$ is a parallelogram. Let E,F, G, and H be points on AB, BC, CD, and DA respectively such that $AE : EB$, BF:FC, CG:GD, and DH:HA are all 1:2. Let the ratio of the area of $EFGH$ to the area of $ABCD$ be m:n, where m and n are relatively prime positive integers. Find $m+n$.

(A) 5 (B) 3 (C) 9 (D) 14 (E) NOTA

21. In triangle ABC, D is on segment BC such that AD bisects $\angle CAB$. If $AB = 6$, $BD = 4$, $AC = 21$, find the length of segment CD.

(A) 24 (B) 18 (C) 14 (D) 21 (E) NOTA

22. Segments AB and CD are chords in a circle. If they intersect at P, and $AP = 6$, $PB = 12$, $CP = 8$, find the length of segment PD.



(A) 9 (B) 4 (C) 6 (D) 10 (E) NOTA

23. The sides of a right triangle measure $5x$, $4x + 13$, and $x - 1$. If x is an integer, find the sum of the digits of x.

(A) 2 (B) 3 (C) 5 (D) 7 (E) NOTA

24. Points $A(-8,0)$ and $B(8,0)$ and some point P are on the Cartesian coordinate plane. Which of the following is the equation of all points P in the coordinate plane such that $\angle APB = 90°$?

(A) $x - 3y = -12$
(B) $y = (x+8)(x-8)$, $x \neq \pm 8$
(C) $y = \sqrt{48 - x^2}$
(D) $x^2 + y^2 = 64$, $x \neq \pm 8$
(E) NOTA

25. Define an *über*-diagonal to be a diagonal of a polygon that connects vertices which are 3 or more vertices away. For example, in octagon $ABCDEFGH$, AD, AE, and AF are the only *über*-diagonals emanating from A. Compute the total number of distinct *über*-diagonals in a heptadecagon (17-sided polygon).

(A) 109 (B) 111 (C) 102 (D) 119 (E) NOTA

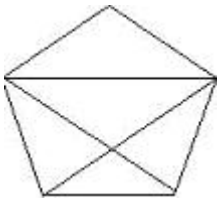
26. In triangle ABC, $AB = 5$, $BC = 16$, $AC = \sqrt{153}$, and D is on segment BC. Compute the sum of all possible integral measures of AD.

(A) 69 (B) 72 (C) 75 (D) 78 (E) NOTA

27. Right triangle ABC has hypotenuse AC, angle $CAB = 30°$, and $BC = \sqrt{2}$. Right triangle ACD has hypotenuse AD and angle $DAC = 45°$. The interiors of ABC and ACD do not overlap. Find the length of the perpendicular from D onto AB.

(A) $\sqrt{6} + 2\sqrt{3}$ (B) $\sqrt{6} + \sqrt{2}$ (C) 4 (D) $1 + \sqrt{5}$ (E) NOTA

28. It is possible to find the length of a diagonal of a regular pentagon by drawing the pentagon and three carefully chosen diagonals. Find the length of a diagonal of a regular pentagon with side length 2.



(A) $\sqrt{6} + 2\sqrt{3}$ (B) $\sqrt{6} + \sqrt{2}$ (C) 4 (D) $1 + \sqrt{5}$ (E) NOTA

29. In how many (distinct) ways can 3 points be chosen from a 4 by 4 square lattice such that the points are the vertices of a triangle?

(A) 560 (B) 516 (C) 498 (D) 4096 (E) NOTA

30. In equiangular hexagon $ANDREW$, $AN = 4$, $ND = 2$, $DR = 7$, $RE = 1$. Find $EW + WA$.
(Hint: Extend the sides.)

(A) 6 (B) 7 (C) 8 (D) 9 (E) NOTA