

1. A chord which is the perpendicular bisector of a radius of length 12 in a circle, has length
 - a) $3\sqrt{3}$
 - b) 27
 - c) $6\sqrt{3}$
 - d) $12\sqrt{3}$
 - e) none of these

2. One thousand unit cubes are fastened together to form a large cube with edges of 10 units which is painted then separated into the original cubes. The number of these unit cubes which have at least one face painted is
 - a) 600
 - b) 520
 - c) 488
 - d) 480
 - e) 400

3. In triangle ABC with right angle at C, altitude CH and median CM trisect the right angle. If the area of triangle CHM is k, then the area of triangle ABC is
 - a) 6k
 - b) $4\sqrt{3}k$
 - c) $3\sqrt{3}k$
 - d) 3k
 - e) 4k

4. A cowboy is 4 miles south of a stream which flows due east. He is also 8 miles west and 7 miles north of his cabin. He wishes to water his horse at the stream and return home. The shortest distance (in miles) he can travel and accomplish this is
 - a) $4 + \sqrt{185}$
 - b) 16
 - c) 17
 - d) 18
 - e) $4\sqrt{2} + \sqrt{137}$

5. A circular plot of grass 12 feet in diameter is cut by a straight gravel path 3 feet wide, one edge of which passes through the center of the plot. The number of square feet in the remaining grass area is (π is pi)
 - a) $36\pi - 34$
 - b) $30\pi - 15$
 - c) $36\pi - 33$
 - d) $35\pi - 9\sqrt{3}$
 - e) $30\pi - 9\sqrt{3}$

6. Two boys start moving from the same point A on a circular track but in opposite directions. Their speeds are 5 ft/sec and 9 ft/sec. If they start at the same time and finish when they first meet at the point A again, then the number of times they meet between the start and finish is
 - a) 13
 - b) 25
 - c) 44
 - D) 45
 - e) none of these

7. The volume of a regular pyramid whose base is an equilateral triangle of side length 6 and whose other edges are $\sqrt{15}$ is
 - a) 9
 - b) 4.5
 - c) 13.5
 - d) $\frac{9\sqrt{3}}{2}$
 - e) none of these

8. Given a quadrilateral ABCD inscribed in a circle with side AB extended beyond B to point E, if $m\angle BAD = 92^\circ$ and $m\angle ADC = 68^\circ$, find $m\angle EBC$.

- a) 66° b) 68° c) 70° d) 88° e) 92°

9. If (a, b) and (c, d) are two points on the line whose equation is $y = mx + k$, then the distance between (a, b) and (c, d) in terms of a, c, and m is

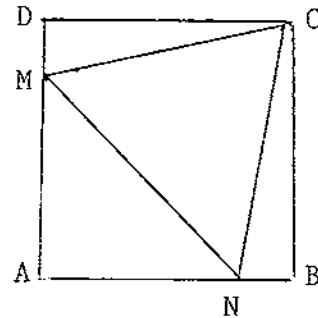
- a) $|a - c| \sqrt{1 + m^2}$ b) $|a + c| \sqrt{1 + m^2}$ c) $\frac{|a - c|}{\sqrt{1 + m^2}}$
 d) $|a - c| (1 + m^2)$ e) $|a - c| |m|$

10. A circle of radius r is inscribed in a right isosceles triangle, and a circle of radius R is circumscribed about the triangle. Find R:r.

- a) $(1 + \sqrt{2}) : 1$ b) $(\sqrt{2} + 2) : 2$ c) $(\sqrt{2} - 1) : 2$
 d) $(1 + \sqrt{2}) : 2$ e) $(4 - 2\sqrt{2}) : 1$

11. In the figure at the right, ABCD is a square and CMN is an equilateral triangle. If the area of ABCD is 1, then the area of CMN is

- a) $2\sqrt{3} - 3$ b) $1 - \frac{\sqrt{3}}{3}$
 c) $\frac{\sqrt{3}}{4}$ d) $\frac{2}{3}$ e) $4 - 2\sqrt{3}$



12. Opposite sides of a regular hexagon are 12 inches apart. The length of each side is

- a) 7.5 b) $6\sqrt{2}$ c) $5\sqrt{2}$ d) $\frac{9\sqrt{3}}{2}$ e) $4\sqrt{3}$

13. In triangle ADE, $m\angle ADE = 140^\circ$ and points B and C lie on sides AD and AE, respectively. If lengths AB, BC, CD, and DE are all equal, the $m\angle EAD = ?$

- a) 5° b) 6° c) 7.5° d) 8° e) 10°

14. A triangle has angles of 30° and 45° . If the side opposite the 45° angle has length 8, then the side opposite the 30° angle has what length?

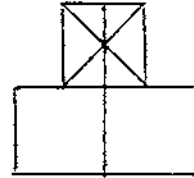
- a) 4 b) $4\sqrt{2}$ c) $4\sqrt{3}$ d) $4\sqrt{6}$ e) 6

15. Let ABCD be a trapezoid with the measure of base AB twice that of base DC, and let E be the point of intersection of the diagonals. If the measure of diagonal AC is 11, then that of segment EC is equal to

a) $3\frac{2}{3}$ b) $3\frac{3}{4}$ c) 4 d) $3\frac{1}{2}$ e) 3

16. The radius of the smallest circle containing the symmetric figure composed of three unit squares shown at the right is

a) $\sqrt{2}$ b) $\frac{\sqrt{5}}{2}$ c) $\frac{5}{4}$
 d) $\frac{5\sqrt{17}}{6}$ e) none of these



17. If the area of triangle ABC is 64 square inches and the geometric mean between sides AB and AC is 12 inches, then $\sin A$ equals

a) $\frac{3}{2}$ b) $\frac{3}{5}$ c) $\frac{4}{5}$ d) $\frac{8}{9}$ e) $\frac{15}{17}$

18. A circular disc with diameter D is placed on an 8 x 8 checkerboard with width D so that the centers coincide. The number of checkerboard squares which are completely covered by the disc is

a) 48 b) 44 c) 40 d) 36 e) 32

19. Two chords, AB and CD intersect at E (not the center) in a circle. $\overline{AB} \perp \overline{CD}$. If segments AE, EB, and ED have measures 2, 6, and 3 respectively, then the length of the diameter of the circle is

a) $4\sqrt{5}$ b) $\sqrt{65}$ c) $2\sqrt{17}$ d) $3\sqrt{7}$ e) $6\sqrt{2}$

20. Let a be a positive number. Consider the set S of all points whose rectangular coordinates (x, y) satisfy all of the given conditions:

i) $\frac{a}{2} \leq x \leq 2a$ ii) $\frac{a}{2} \leq y \leq 2a$ iii) $x + y \geq a$ iv) $x + a \geq y$ v) $y + a \geq x$

The boundary of set S is a polygon with

a) 3 sides b) 4 sides c) 5 sides d) 6 sides e) 7 sides

21. The area of the ring between two concentric circles is $\frac{25\pi}{2}$ square inches. The length of a chord of the larger circle tangent to the smaller circle is
- a) $\frac{5\sqrt{2}}{2}$ b) 5 c) $5\sqrt{2}$ d) 10 e) $10\sqrt{2}$
22. Given points $P(-1, -2)$ and $Q(4, 2)$ in the coordinate plane; point $R(1, m)$ is taken so that $PR + RQ$ is a minimum. Find m .
- a) $-\frac{3}{5}$ b) $-\frac{2}{5}$ c) $-\frac{1}{5}$ only d) $\frac{1}{5}$ only e) either $-\frac{1}{5}$ or $\frac{1}{5}$
23. Triangle ABC is inscribed in a circle. The measures of the non-overlapping minor arcs AB , BC , and AC are, respectively, $x + 75^\circ$, $2x + 25^\circ$, and $3x - 22^\circ$. Then one interior angle of the triangle is
- a) $57\frac{1}{2}^\circ$ b) 59° c) 60° d) 61° e) 122°
24. The number of points equidistant from a circle and two parallel tangents to the circle is
- a) 0 b) 2 c) 3 d) 4 e) infinitely many
25. In a given triangle ABC , $AB = 4$ and $AC = 8$. If M is the midpoint of BC and $AM = 3$, find BC .
- a) $2\sqrt{26}$ b) $2\sqrt{31}$ c) 9 d) $4 + 2\sqrt{13}$ e) cannot be determined from given information.
26. If the statement "all shirts in this store are on sale" is false, then which of the following statements must be true?
- I. All shirts in this store are not on sale.
 II. There is some shirt in this store not on sale.
 III. No shirt in this store is on sale.
 IV. Not all shirts in this store are on sale.
- a) II only b) IV only c) I and III only d) II and IV only
 e) I, II, and IV only
27. Let n be the number of points P interior to the region bounded by a circle with radius one unit, such that the sum of the squares of the distances from P to the endpoints of a given diameter is 3. Then n is:
- a) 0 b) 1 c) 2 d) 4 e) infinitely many

THETA GEOMETRY

TIEBREAKERS

1. The area of a regular nonagon is 126 square centimeters. To the nearest hundredth find the length of one side.

2. In the figure, vertex E of equilateral triangle ABE is in the interior of square ABCD, and F is the point of intersection of diagonal BD and segment AE. If the length of AB is $\sqrt{1 + \sqrt{3}}$, then find the exact area of triangle ABF.

