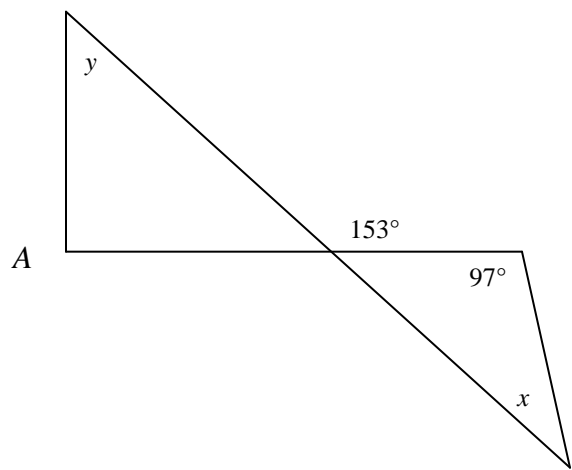
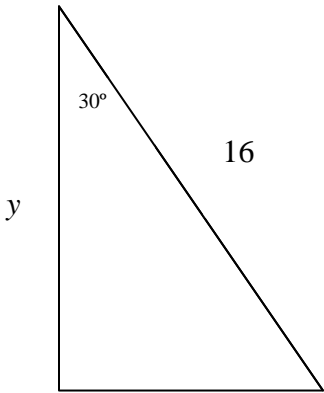
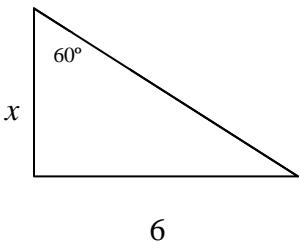


1. In the figure below, angle  $A$  is a right angle. Find the sum  $x + y$  (degrees).



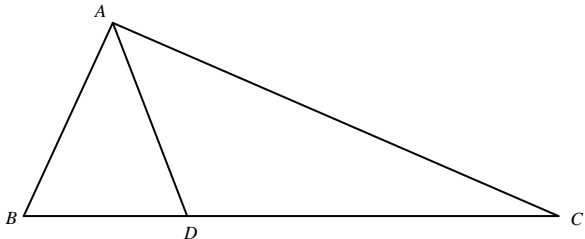
- A. 63            B. 117            C. 119            D. 153            E. NOTA

2. What is the ratio  $x:y$  in the right triangles shown below? The figures are not drawn to scale.



- A.  $2\sqrt{3}:3$     B.  $1:4$             C.  $8:3$             D.  $1:1$             E. NOTA

3. In the figure below,  $m\angle BAD = m\angle CAD$ ,  $\overline{AB} = 8$ ,  $\overline{BD} = 6$ , and  $\overline{AC} = 14$ . Find  $\overline{DC}$ . The figure is not drawn to scale.



- A. 8            B. 6            C. 9.5            D. 10.5            E. NOTA

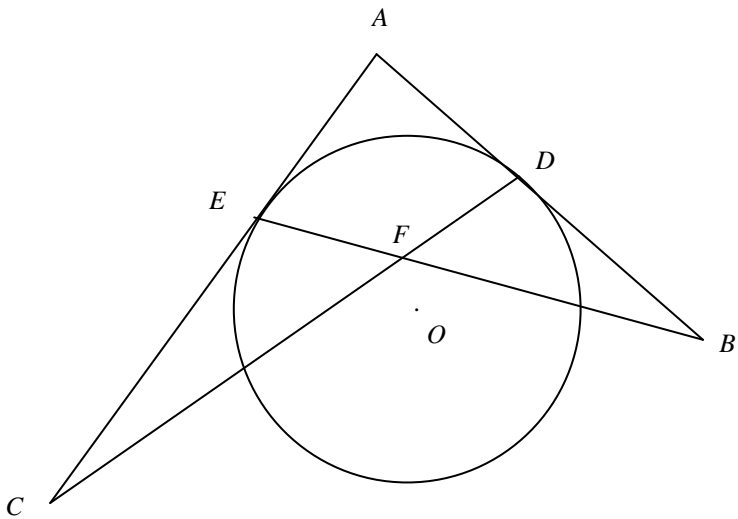
4. Find the apothem length of the regular hexagon whose area is  $54\sqrt{3}$ .

- A. 3            B.  $3\sqrt{3}$             C. 6            D.  $6\sqrt{3}$             E. NOTA

5. There is a group of twenty penguins standing in line for a movie. Polly Penguin and Paul Penguin are part of the group. Polly has six penguin buddies in the group and Paul has five penguin buddies in the group, three of whom are also Polly’s penguin buddies. Polly and Paul are penguin buddies. How many penguins in the group are not penguin buddies with Polly or Paul?

- A. 9                      B. 10                      C. 12                      D. 14                      E. NOTA

6.  $\overline{AC}$  and  $\overline{AB}$  are both tangent to circle O at E and D. If  $m\angle C = 15^\circ$ ,  $m\angle A = 80^\circ$ , and  $m\angle B = 30^\circ$ , find  $m\angle DFB$ (in degrees). The figure is not drawn to scale.



- A. 80                      B. 55                      C. 40                      D. 15                      E. NOTA

7. There are two similar cones, one with half the volume of the other one. If the larger cone has a height of 7, then what is the height of the smaller cone?

- A.  $\frac{7}{2}$                       B.  $\frac{7\sqrt{2}}{2}$                       C.  $\frac{7\sqrt[3]{2}}{2}$                       D.  $\frac{7\sqrt[3]{4}}{2}$                       E. NOTA

8. Square ABCD is inscribed in circle X. Circle X is inscribed in square EFGH. If square ABCD has an area of 72 square millimeters, then what is the length of the diagonal of square EFGH (in millimeters)?

- A.  $3\sqrt{3}$                       B.  $6\sqrt{2}$                       C.  $12\sqrt{2}$                       D.  $24\sqrt{2}$                       E. NOTA

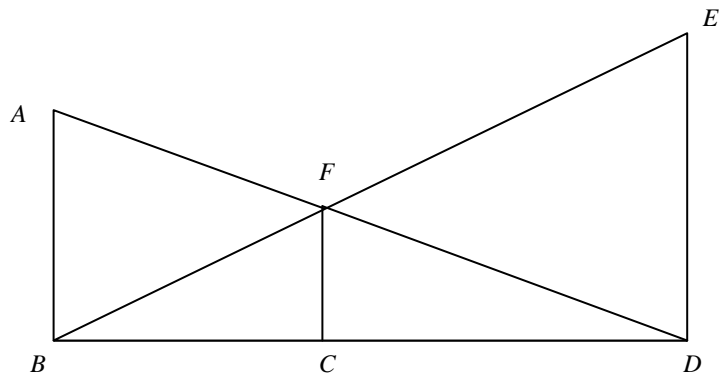
9. The region bounded by the lines  $y = 0$ ,  $x = 0$ , and  $y = -\frac{4}{3}x + 8$  is rotated about the y-axis. What is the volume of the resulting figure (in cubic units)?

- A.  $48\pi$                       B.  $60\pi$                       C.  $96\pi$                       D.  $288\pi$                       E. NOTA

10. The faces of a right rectangular prism have areas of 12, 42, and 14. Find the volume of the prism.

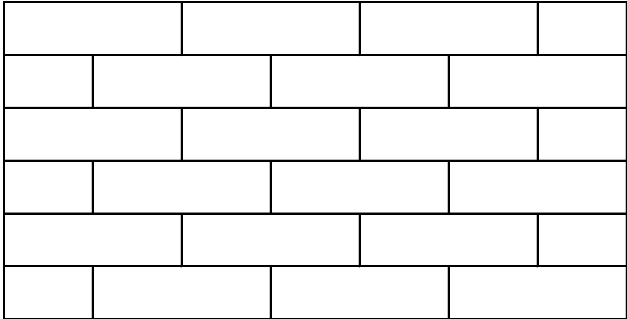
- A. 96                      B. 84                      C. 72                      D. 60                      E. NOTA

11. Find the area of a regular octagon with side length 2.
- A.  $4 + 4\sqrt{2}$     B.  $8 + 8\sqrt{2}$     C.  $12 + 8\sqrt{2}$     D. 16    E. NOTA
12. In the figure below,  $\overline{AB} = 24$  and  $\overline{FC} = 15$ . If  $\overline{AB} \parallel \overline{FC} \parallel \overline{ED}$  and  $\overline{BD}$  is perpendicular to each of these line segments, what is the length  $\overline{ED}$ .



- A. 36                    B. 40                    C. 42                    D. 48                    E. NOTA
13. Evaluate  $(\tan 20^\circ)(\tan 40^\circ)(\tan 50^\circ)(\tan 70^\circ)$ .
- A.  $\frac{\sqrt{2} + \sqrt{3}}{6}$     B.  $\frac{\sqrt{2} - \sqrt{3}}{6}$     C.  $\frac{\sqrt{2}}{2}$                     D. 1                    E. NOTA
14. Find  $A + JH$  given the following:
- $J$  = the height of  $\triangle ABC$  if  $\overline{AB} = \overline{BC} = \overline{CA} = 12$   
 $A$  = the area of the circle  $x^2 + y^2 + 2x + 2y = 10$   
 $H = \frac{1}{\sqrt{3}} \cdot 3$
- A.  $144\pi + 18$     B.  $144\pi + 9$     C.  $12\pi + 54$     D.  $12\pi + 18$     E. NOTA
15. Three couples (Arnie and Abby, Barney and Brenda, and Chuck and Claudia) are seated around a hexagonal table. No husband is sitting next to his wife. Arnie and Barney, being good friends, are seated next to each other, but Abby and Claudia, being mortal enemies, are not seated next to each other. Chuck is allergic to Barney's aftershave and cannot sit next to him. Claudia is sitting across from either Barney or Abby. Who is sitting across from Barney?
- A. Abby            B. Brenda            C. Chuck            D. Claudia            E. NOTA
16. A quadrilateral with side lengths 3, 5, 8, and 12 units is inscribed in a circle. Find the area of the quadrilateral (in square units).
- A.  $4\sqrt{3198}$     B.  $6\sqrt{33}$                     C.  $7\sqrt{34}$                     D. 57                    E. NOTA

17. In how many ways can you move from the bottom left of the diagram below to the upper right of the diagram if you can only move up or right along the lines of the diagram?



- A. 63            B. 68            C. 79            D. 87            E. NOTA

18. Find the surface area (in square inches) of the frustum with base areas  $64\pi$  and  $9\pi$  square inches if the height of the frustum is 5 inches.

- A.  $128\pi\sqrt{2}$   
 B.  $73\pi + 72\pi\sqrt{2}$   
 C.  $73\pi + 65\pi\sqrt{2}$   
 D.  $73\pi + 55\pi\sqrt{2}$   
 E. NOTA

19.  $\triangle ABC$  has point  $D$  on  $\overline{AB}$ , point  $E$  on  $\overline{BC}$ , and point  $F$  on  $\overline{AC}$ .  $\overline{AE}$ ,  $\overline{CD}$ , and  $\overline{BF}$  intersect at point  $G$ . The ratio  $\overline{AD} : \overline{DB}$  is 3:5 and the ratio  $\overline{CE} : \overline{EB}$  is 8:3. Find the ratio  $\overline{FG} : \overline{GB}$ .

- A. 27:62            B. 24:49            C. 19:37            D. 15:28            E. NOTA

20. A falcon is tied to the upper corner of a cube house with an edge length of 10 yards by a 30 foot rope. Find the volume of the region (in cubic feet) in which the falcon can fly.

- A.  $23,625\pi$     B.  $27,000\pi$     C.  $31,500\pi$     D.  $36,000\pi$     E. NOTA

21. Two circles intersect each other at  $120^\circ$  arcs. The radius of both circles is 12 centimeters. Find the area (in square centimeters) of the intersection of the circles.

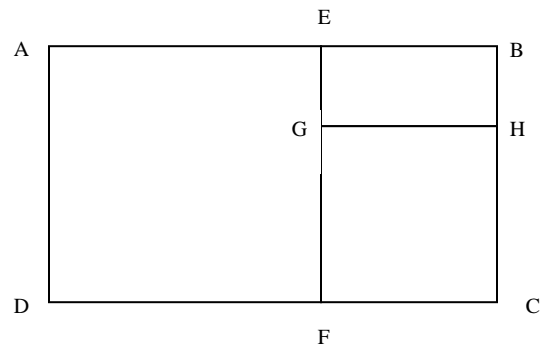
- A.  $24\pi + 36\sqrt{3}$   
 B.  $144\pi + 72\sqrt{3}$   
 C.  $48\pi - 36\sqrt{3}$   
 D.  $96\pi - 72\sqrt{3}$   
 E. NOTA

22. Find the area of the circle inscribed in the triangle formed by the centroids of  $\triangle ABC$ ,  $\triangle CDE$ , and  $\triangle EFA$  given the points below.

$A(-4, 5)$	$D(7,13)$
$B(-2, 7)$	$E(5,8)$
$C(-9, 0)$	$F(-4,-25)$

- A.  $\frac{20\pi}{3}$             B.  $\frac{25\pi}{4}$             C.  $4\pi$             D.  $5\pi$             E. NOTA

23. In the figure below quadrilaterals  $AEFD$  and  $GHCF$  are both squares. The lengths of sides  $\overline{EB}$  and  $\overline{AB}$  differ by one and are multiplicative inverses of each other. What is the length of side  $\overline{EG}$  ? The drawing is not to scale.



- A.  $\frac{3-\sqrt{5}}{2}$     B.  $\frac{\sqrt{5}-1}{2}$     C.  $\frac{\sqrt{5}+1}{2}$     D.  $\sqrt{5}-2$     E. NOTA

24. Given the regular octagon ABCDEFGH with side length 1, find the length of the diagonal AE.

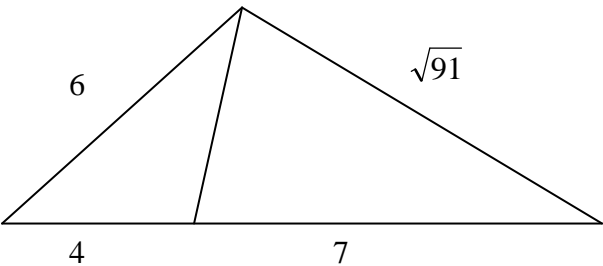
- A.  $\sqrt{3-2\sqrt{2}}$   
 B.  $\sqrt{3+2\sqrt{2}}$   
 C.  $\sqrt{4-2\sqrt{2}}$   
 D.  $\sqrt{4+2\sqrt{2}}$   
 E. NOTA

25. A dartboard is made from four concentric circles of radii 7, 5, 3, and 1. A dart that lands in the innermost circle scores 5 points. A dart that lands in the ring surrounding the innermost circle scores 3 points, a dart that lands in the next ring scores 2 points, and a dart than lands in the outermost ring scores 1 point. If the probability of hitting the dartboard is  $\frac{1}{2}$ , then what are the odds of scoring higher than a 2 in one throw?

- A. 9:40    B. 9:49    C. 9:89    D. 25:49    E. NOTA

TB1 There are 81 balls and a balance on a table. All of the balls weigh the same except for one, which weighs more. What is the least number of times you need to use the balance to accurately determine and guarantee the heaviest ball?

TB2 Find the altitude to the side of length 11 of the triangle below.



TB3 What is the greatest number of triangles that can be formed by arranging 45 toothpicks tip to tip in a single design?