

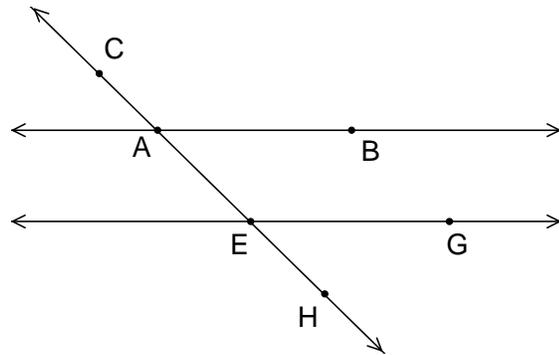
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1. Find the volume of a sphere with diameter 12 cm.

- (A) $288\pi \text{ cm}^3$ (B) $36\pi \text{ cm}^3$ (C) $144\pi \text{ cm}^3$ (D) $864\pi \text{ cm}^3$ (E) $2304\pi \text{ cm}^3$

2. In the diagram below, \overline{AB} and \overline{EG} are parallel with transversal \overline{CH} . If the measure of $\angle CAB$ is $(4x - 15)^\circ$ and the measure of $\angle GEH$ is $(2x + 3)^\circ$, find the measure of $\angle BAE$.

- (A) 32°
(B) 21°
(C) 113°
(D) 67°
(E) 159°



3. Given the following conditional statement:
If two triangles are similar, then they are congruent.

Consider the inverse, contrapositive, and converse of the above statement. Which of the following represent FALSE statements?

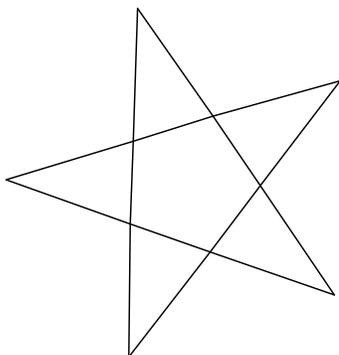
- (A) Inverse, Converse
(B) Conditional, Contrapositive
(C) Conditional, Converse, Inverse, Contrapositive
(D) Conditional, Converse
(E) None of the statements are false.
4. The volume of a right circular cylinder is $360\pi \text{ cm}^3$. If the height of the cylinder is 10 cm, find the length of the radius.

- (A) $3\sqrt{2} \text{ cm}$ (B) 3.6 cm (C) 9 cm (D) 6 cm (E) 18 cm

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5. The distance between the points $(-3, 2)$ and $(c, -6)$ is $4\sqrt{5}$. Find all possible values of c .
- (A) $c = 3$
(B) $c = -7, c = 1$
(C) $c = 3, c = -9$
(D) $c = 1$
(E) No values of c exist on the real coordinate plane

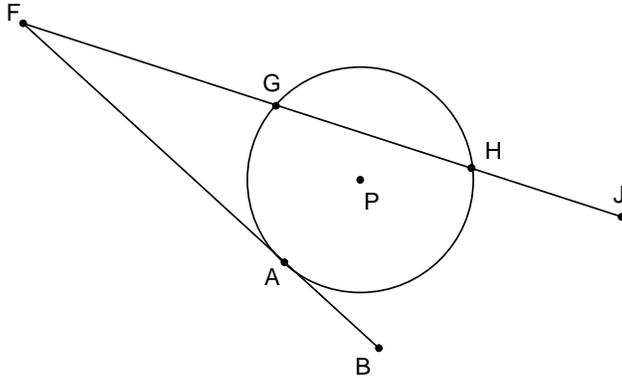
6. Below is a net that that can be used to create a solid, formed by five congruent isosceles triangles and a regular pentagon. How many edges and vertices does the solid have?



- (A) 6 edges, 6 vertices
(B) 15 edges, 10 vertices
(C) 20 edges, 5 vertices
(D) 10 edges, 6 vertices
(E) 10 edges, 10 vertices
7. A robot is being programmed to move along a track which is in the shape of a regular pentagon, which is labeled ABCDE. So far, it has been programmed to start at point A, move forward along side AB, and stop at point B. Once it is stopped at point B, how many degrees must it be programmed to turn so that it can begin to move forward along side BC?
- (A) 36° (B) 144° (C) 108° (D) 252° (E) 72°
8. If a regular convex polygon has 16 lines of symmetry, how many sides does it have?
- (A) 32 (B) 8 (C) 16 (D) 4 (E) Cannot be determined

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9. In the figure below, \overline{FJ} is a secant which intersects circle P at points G and H , and \overline{FB} is a tangent which intersects circle P at point A . If the measure of $\angle JFB$ is 20° and the degree measure of \widehat{GH} is 110° , find the degree measure of \widehat{AH} .



- (A) 55° (B) 105° (C) 145° (D) 125° (E) 150°
10. One side of a triangle is 5 cm, and another side measures 8 cm. If the length of the third side is a whole number, how many possible lengths exist for the third side?
- (A) 9 (B) 11 (C) 3 (D) 13 (E) 7
11. A hexagonal pyramid has a volume of 20 cm^3 . A larger similar pyramid is then formed, having a height which is five times that of the original pyramid. Find the volume of the larger pyramid.
- (A) 200 cm^3 (B) 100 cm^3 (C) 500 cm^3 (D) 60 cm^3 (E) $2,500 \text{ cm}^3$
12. A clock has a minute hand which is 10 inches long. Find the area swept out by the minute hand on any given day between 9:42 PM and 9:47 PM.
- (A) $\frac{5\pi}{3} \text{ in}^2$ (B) $\frac{25\pi}{12} \text{ in}^2$ (C) $\frac{25\pi}{18} \text{ in}^2$ (D) $\frac{25\pi}{3} \text{ in}^2$ (E) $20\pi \text{ in}^2$

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13. If you randomly select one of the diagonals of a convex regular hexagon, what is the probability that it is one of the shortest diagonals?

(A) $\frac{3}{4}$ (B) $\frac{3}{5}$ (C) $\frac{2}{3}$ (D) $\frac{1}{3}$ (E) $\frac{2}{5}$

14. Triangle ANT is similar to triangle RUB, with measures as given below.

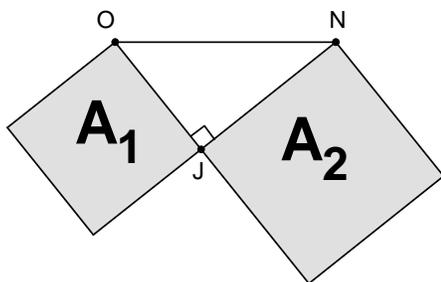
$$AN = x - 4, \quad TA = x + 2, \quad RB = 3x - 6, \quad UR = 2x - 8, \quad \text{and} \quad UB = x + 10$$

Find the value of x .

15. A triangle of area 10 is formed in the first quadrant by the line $4x + cy - 4c = 0$, the x -axis and the y -axis. Find the value of c .

(A) 10 (B) 5 (C) 2.5 (D) 8 (E) 20

16. Right triangle JON is shown below, with squares drawn on each of the legs. If A_1 represents the area of one of the squares, and A_2 represents the area of the other square, find the length of \overline{ON} .



- (A) $ON = \sqrt{A_1} + \sqrt{A_2}$
(B) $ON = \sqrt{(A_1)^2 + (A_2)^2}$
(C) $ON = \sqrt{A_1 + A_2}$
(D) $ON = A_1 + A_2$
(E) Cannot be determined

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17. Quadrilateral MATH is inscribed in circle P. If the measure of angle A is 100° , the measure of angle T is 70° , and the degree measure of \widehat{TH} is 120° , find the degree measure of \widehat{MA} .

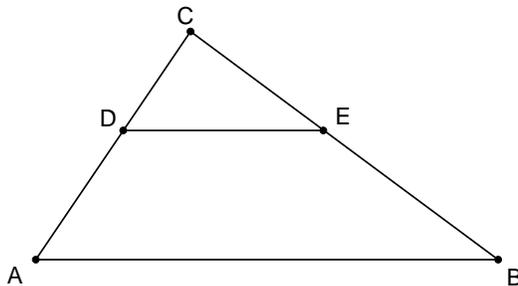
- (A) 60° (B) 140° (C) 160° (D) 70° (E) 80°

18. In triangle ABC, the angle bisectors \overline{AE} , \overline{BF} , and \overline{CG} intersect at point D. Points E, F, and G each lie on a side of the triangle. Which of the following statement(s) are always true?

- I. $\angle BDC \cong \angle BDA$
 II. $\angle BAD \cong \angle CAD$
 III. $\overline{FD} \cong \overline{ED}$
 IV. $BD = \frac{2}{3}BF$
 V. $\frac{AB}{BE} = \frac{AC}{EC}$

- (A) II and V only
 (B) II and III only
 (C) I, II, and V only
 (D) II and IV only
 (E) II, III and V only

19. In the land of Kazoo, their main unit of measure is a “kabib”. If we compare it to the U.S. standard of measure, 1 inch = 2 kabibs. In triangle CAB below, \overline{DE} is parallel to \overline{AB} , and measures of the segments are given as follows:



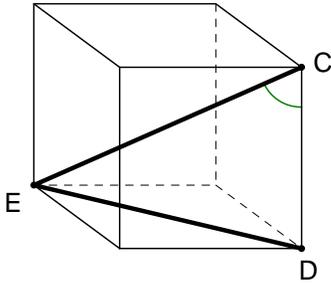
- $CD = (x - 1)$ kabibs
 $DA = (x + 2)$ kabibs
 $CE = (x - 2)$ inches
 $EB = (3x - 6)$ kabibs
 $DE = x$ inches

Find the length of \overline{AB} , in kabibs.

- (A) 35 (B) 21 (C) 17.5 (D) 10.5 (E) 10

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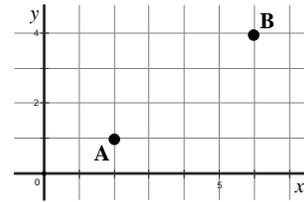
20. In the cube shown below, \overline{EC} is a diagonal of the cube, and \overline{ED} is the diagonal of the base of the cube. Find the sine of $\angle ECD$.



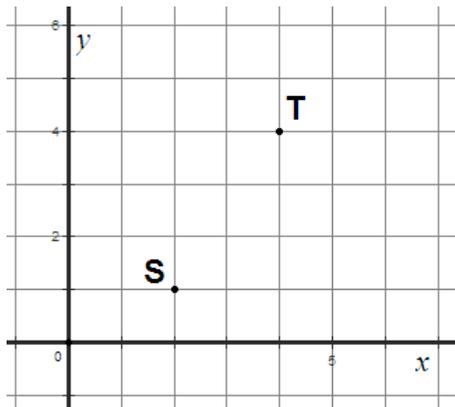
- (A) $\frac{\sqrt{2}}{2}$ (B) $\frac{\sqrt{6}}{2}$ (C) $\frac{\sqrt{6}}{3}$ (D) $\frac{\sqrt{3}}{3}$ (E) $\frac{\sqrt{3}}{2}$

21. In Taxicab Geometry, the shortest distance between two points is defined as the minimum number of city blocks a taxi would need to travel to get from one point to the other, assuming square blocks of equal size and all streets oriented only horizontally and vertically.

In the diagram at the right, for example, the distance between the points $A(2, 1)$ and $B(6, 4)$ is 7.



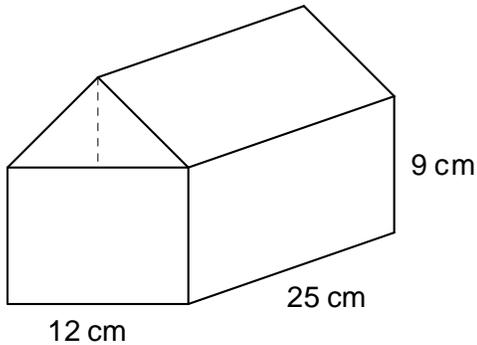
Let d represent the Taxicab distance from point $S(2, 1)$ to $T(4, 4)$.



How many Taxicab routes exist from point S to point T which have distance d ?

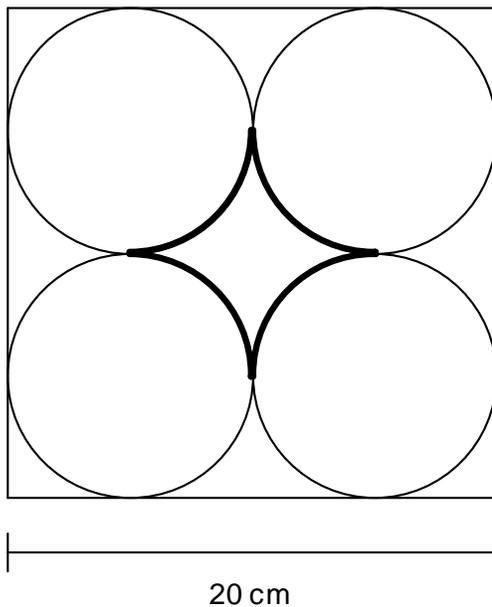
- (A) 2 (B) 10 (C) 6 (D) 8 (E) 12

22. The solid below is formed by a rectangular prism, combined with a triangular prism. The dotted line in the figure represents the altitude of the triangle, which is 8 cm in length, and intersects the base of the triangle at its midpoint. Find the total surface area of the new combined solid.



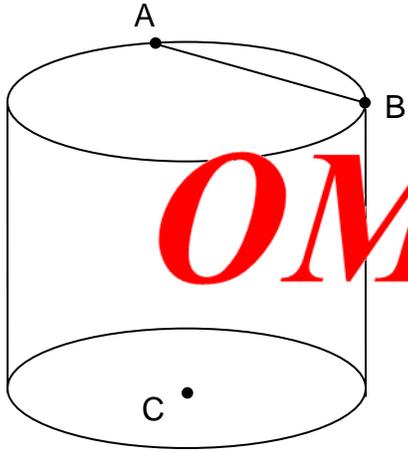
- (A) $1,658 \text{ cm}^2$
- (B) $1,562 \text{ cm}^2$
- (C) $1,778 \text{ cm}^2$
- (D) $1,862 \text{ cm}^2$
- (E) $1,262 \text{ cm}^2$

23. A square dartboard is shown below and has side length 20 cm. Four congruent circles are drawn within the dartboard. Each circle is externally tangent to two other circles, and has two points of tangency on the square. If a dart is thrown and is equally likely to land anywhere within the square dartboard, find the probability that the dart will land in the central 'four-pointed star' shaped region of the dartboard.



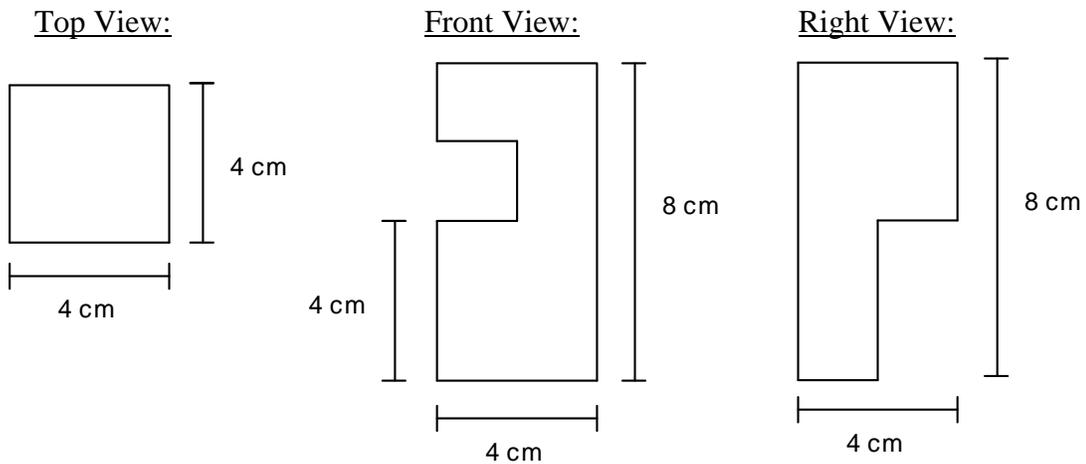
- (A) $\frac{100 - 25\pi}{4}$
- (B) $\frac{10 - \pi}{40}$
- (C) $\frac{\pi - 1}{4}$
- (D) $\frac{\pi}{16}$
- (E) $\frac{4 - \pi}{16}$

24. The right circular cylinder shown below has diameter 20 cm and height 12 cm. Point C represents the center of the lower base, and the measure of \widehat{AB} , shown on the upper base, is 120° . Find the area of the cross-section formed by the intersection of the cylinder with the plane that passes through points A, B, and C.



- (A) 240 cm^2
 (B) 260 cm^2
 (C) $(65\sqrt{3} + 130) \text{ cm}^2$
 (D) $65\sqrt{3} \text{ cm}^2$
 (E) $(120 + 60\sqrt{3}) \text{ cm}^2$

25. A little boy glues together a 'building' from 2-cm Styrofoam cubes (meaning that each cube measures 2 cm on each edge). Views from three different perspectives are illustrated below, and are drawn to scale.

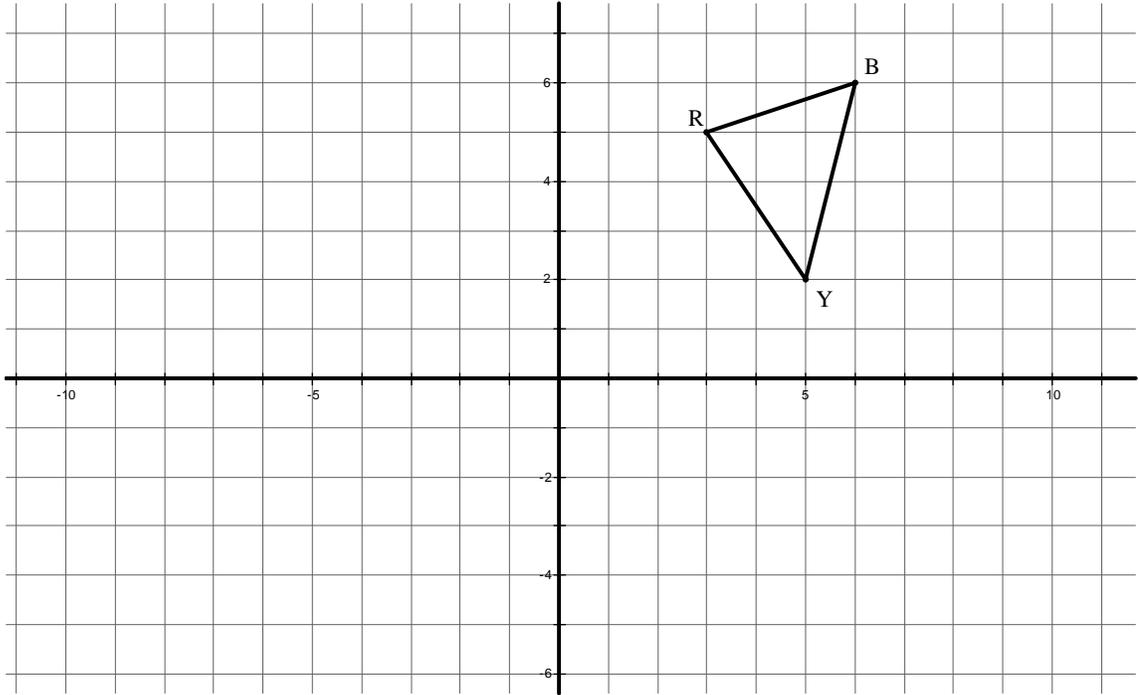


What is the maximum number of 2-cm cubes which the boy could have used to make this building?

- (A) 14 (B) 10 (C) 17 (D) 12 (E) 13

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26. Triangle RBY is shown below with vertices R(3, 5), B(6, 6), and Y(5, 2).



Make a new triangle, named triangle PET, by performing the following transformations and then connecting the vertices:

P is the image of point R (and point R only), if a dilation is performed on triangle RBY using a scale factor of 3 and center of dilation B.

E is the reflection of point B over the line $y = 5 - x$.

T can be obtained by performing a 90° clockwise rotation on point Y, using center of rotation (2, 1).

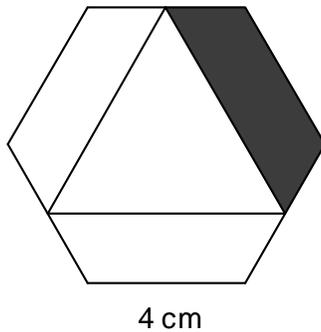
What is the area of triangle PET? (Assume that answers are given in square units.)

- (A) 5.5 (B) 7 (C) 6 (D) 3.5 (E) 2

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27. The regular hexagon shown below has sides measuring 4 cm. The midpoints of three nonconsecutive sides of the hexagon are joined to form an equilateral triangle, as shown below. Find the area of the shaded region in the diagram.



- (A) $8\sqrt{3}$ cm²
(B) $5\sqrt{3}$ cm²
(C) $4\sqrt{3}$ cm²
(D) $\frac{20\sqrt{3}}{3}$ cm²
(E) $13\sqrt{3}$ cm²

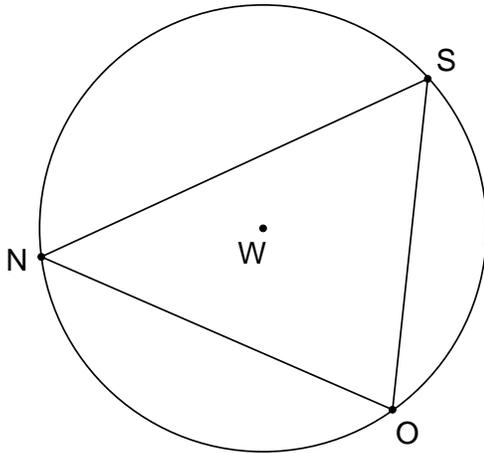
28. A triangle has side lengths 13 cm, 14 cm, and 15 cm. Find the area of the triangle.

- (A) 91 cm²
(B) 105 cm²
(C) 84 cm²
(D) 90 cm²
(E) $\frac{13\sqrt{15}}{2}$ cm²

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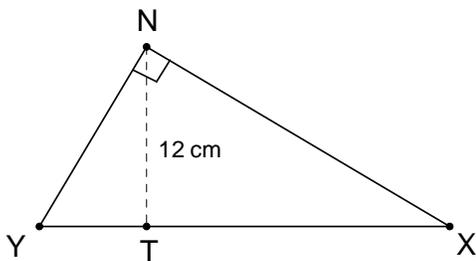
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29. Circle W is circumscribed about triangle SNO. If circle W has a diameter of 14 cm, and the measure of \overline{SO} is 10 cm, find the cosine of angle SNO.



- (A) $\frac{5}{7}$
(B) $\frac{7}{10}$
(C) $\frac{5}{14}$
(D) $\frac{7}{12}$
(E) $\frac{2\sqrt{6}}{7}$

30. Right triangle YNX is shown below with hypotenuse \overline{YX} , and the length of altitude \overline{NT} is 12 cm. If the perimeter of triangle YNX is 60 cm, find the length of \overline{YX} .



- (A) 25 cm
(B) 27 cm
(C) 24 cm
(D) 28 cm
(E) 26 cm

END OF EXAM ☺

(Make sure that the bubbling form is filled in with the letter of each correct answer.)