

2025 Mu Alpha Theta National Convention

THETA CPAV TOPIC TEST

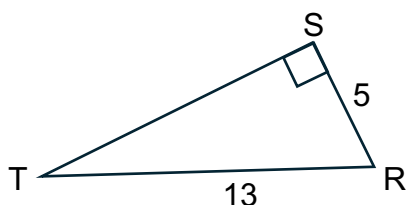
The abbreviation NOTA found in choice E for each question means "None of the Above [Answers]" and should be chosen if answers A, B, C and D are not correct.

Diagrams are not drawn to scale. If a diagram does seem to be to scale, then it is a happy accident.

Angle measures are in degrees.

If no units are given, assume linear measures are cm, area is in square cm, and volume is in cubic cm.

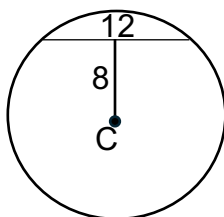
1.



Right $\triangle RST$ has hypotenuse $TR = 13$ and leg $SR = 5$. Find the area of $\triangle RST$.

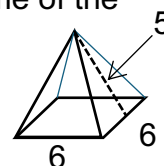
- A. 60 B. 32.5
C. 30 D. 15
E. NOTA

2. Circle C contains a chord of length 12 cm which is a distance of 8 cm from center C. Find the circumference of the circle.



- A. 10π cm B. 16π cm
C. 18π cm D. 20π cm
E. NOTA

3. A right regular square pyramid has each lateral triangular face with base 6 cm and height (altitude of the triangle) 5 cm. Find the volume of the pyramid in cubic cm.

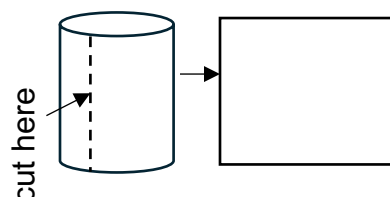


- A. 60 B. 48
C. 36 D. 27
E. NOTA

4. Two similar pyramids each have square bases. If the square bases have areas 144 sq cm and 36 sq cm then what is the ratio of the volumes of the pyramids (larger : smaller)?

- A. 2: 1 B. 6: 1
C. 8: 1 D. 12: 1
E. NOTA

5.



A right circular cylinder has height 10 and radius 5. If the lateral surface region is cut parallel to the axis of symmetry (the line containing the base centers), and laid flat, what is the area of the resultant rectangle?

- A. 100π B. 50π
C. 100 D. 50
E. NOTA

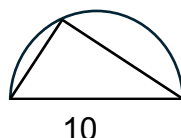
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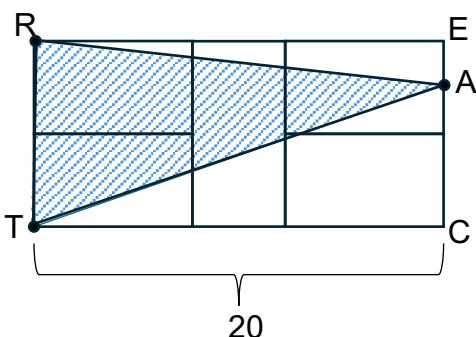
6. A trapezoid has height 8 and smaller base 10. Its area is 128. What is the length of the larger base?

A. 12 B. 22
C. 32 D. 42
E. NOTA

7. A triangle has one side on the diameter of a semi-circle as shown, and all vertices on the circle. If the diameter of the semi-circle is 10, find the greatest possible area of the triangle.

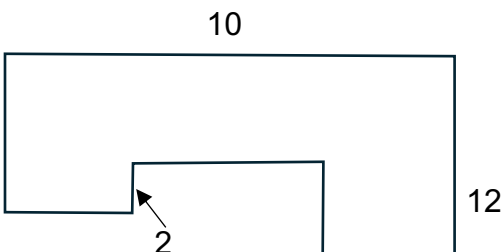


A. 25 B. 48
C. 50 D. 100
E. NOTA

8. 

Rectangle RECT has its interior divided into five congruent rectangular regions, as shown above. RECT has its longer side length 20. Find the area of the triangle $\triangle RAT$ with vertex A on $\overline{EC}$.

A. 20 B. 40
C. 60 D. 80
E. NOTA

9. 

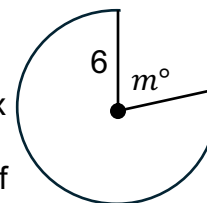
A non-convex octagon has adjacent sides which meet at 90 degree angles as shown. The longest horizontal side has length 10 and the longest vertical side has length 12. The shortest vertical side has length 2. See the arrow? There! Find the perimeter of the octagon.

A. 50 B. 48
C. 46 D. 44
E. NOTA

10. A regular quadrilateral and a regular triangle have the same length altitude. What is the ratio of their areas (quadrilateral : triangle)?

A. $\sqrt{6} : 1$ B. $2\sqrt{3} : 1$
C. $\sqrt{3} : 2$ D. $\sqrt{3} : 1$
E. NOTA

11. A circle has radius 6, and a sector of m° removed (vertex at the circle's center). The area of the remaining sector is 30π . Find the value of m .



A. 90 B. 72
C. 60 D. 45
E. NOTA

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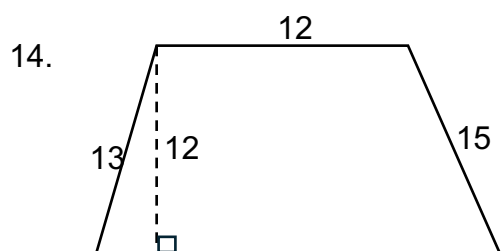
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12. The base of a triangle is increased by 20%, and the altitude to that base is decreased by 20%. What is the effect on the area of the triangle?

A. Decreased by 4.8%
 B. Increased by 4.8%
 C. Decreased by 4%
 D. Increased by 4%
 E. NOTA

13. A square RSTU has perimeter 40 cm. A rhombus PQMN has the same perimeter but area 4 square cm less than the square. What is the positive difference in the heights of the two quadrilaterals?

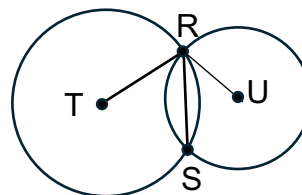
A. 0.4 B. 0.2
 C. 0.5 D. 0.02
 E. NOTA



A trapezoid has one base of length 12 and height of length 12. The legs have lengths 13 and 15. Find the perimeter of the trapezoid.

A. 72 B. 70
 C. 68 D. 66
 E. NOTA

15.

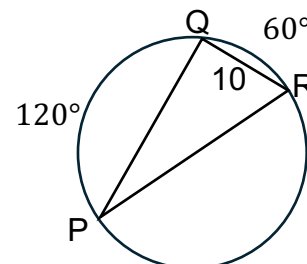


Circle T and circle U intersect and the common chord $\overline{RS}$ has length 18. Find the area of $\triangle TRU$.

Radius
 $TR = 15$.
 Segment
 $TU = \sqrt{181}$

A. 102 B. 99
 C. 98 D. 96
 E. NOTA

16.



$\triangle PQR$ is inscribed in a circle. Chord $\overline{QR}$ has length 10. $m\widehat{PQ} = 120^\circ$ and $m\widehat{QR} = 60^\circ$. Find the area of the circle.

A. 200π B. 140π
 C. 120π D. 100π
 E. NOTA

17. An isosceles triangle has perimeter 10 and each side of even integer length. Find the triangle's area.

A. $\sqrt{11}$ B. $\sqrt{13}$
 C. $\sqrt{15}$ D. $\sqrt{17}$
 E. NOTA

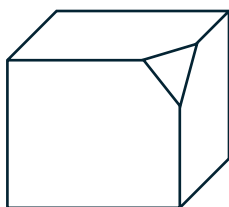
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18. A sphere has surface area 36π square cm. Find its volume in cubic cm.

A. $\frac{27}{8}\pi$ B. $\frac{9}{2}\pi$
 C. 18π D. 36π
 E. NOTA

19. A cube has each side length 10 cm. ONE vertex/corner is truncated (chopped off) so that three edges each become 8 cm in length and the truncated corner becomes an equilateral triangle face. That's a total of 7 faces now. The surface area of the new solid is $a + b\sqrt{c}$ square cm, for c a prime number, and $a > b > 0$. Find the value of $a + b + c$.

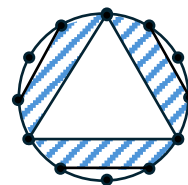


A. 599 B. 602
 C. 603 D. 606
 E. NOTA

20. Find the area of a regular hexagon with each side length 8.

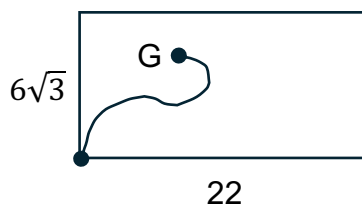
A. $124\sqrt{3}$ B. $112\sqrt{3}$
 C. $108\sqrt{3}$ D. $96\sqrt{3}$
 E. NOTA

21. Twelve points are equally spaced along the circle's circumference as shown. Shown are six chords of the circle. The circle has radius 6. The total area of the 3 shaded regions (there are 4 nonshaded regions) is $a\pi + b\sqrt{c}$ for c a prime, and $a > b$, $a > 0$. Find the value of $a + b + c$.



A. 18 B. 27
 C. 36 D. 45
 E. NOTA

- 22.



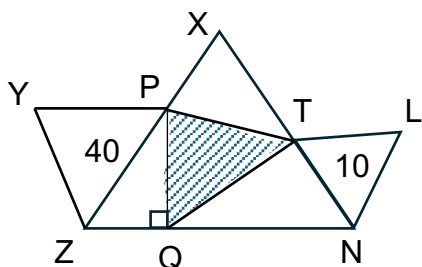
Gary the Goat (G) is in a rectangular pen with dimensions 22 feet by $6\sqrt{3}$ feet. He has a 12 foot long leash with one end attached to his collar and the other end attached to a corner of the floor as shown. Disregard the dimensions of Gary, and assume the leash stays in the plane which contains the floor. Find the area in square feet of the floor inside of the pen that Gary can roam, with the limitations of the leash.

A. $24\pi + 18\sqrt{3}$
 B. $24\pi + 12\sqrt{3}$
 C. $132\sqrt{3}$
 D. $18\pi + 20\sqrt{3}$
 E. NOTA

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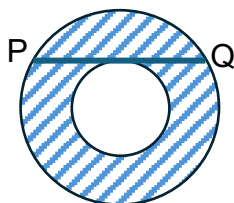
23.



In the poorly drawn diagram above, there are four equilateral triangles: $\triangle PYZ$, $\triangle TLN$, $\triangle XZN$ and $\triangle PQT$. The area of $\triangle PYZ$ is 40. The area of $\triangle TLN$ is 10. $\overline{PQ} \perp \overline{ZN}$, for Q on $\overline{ZN}$. Find the area of $\triangle PQT$ whose vertices are each on a side of $\triangle XZN$.

- A. 30 B. 27
C. 25 D. 20
E. NOTA

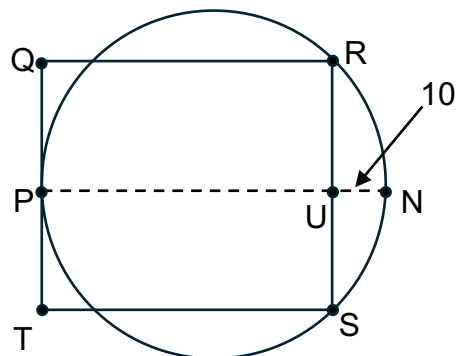
24.



Two concentric circles are shown. Chord $\overline{PQ}$ of the larger circle is tangent to the smaller circle. If $PQ = 10$ then give the area of the shaded region, which is inside of the larger circle but outside of the smaller circle. Find the area of the annulus!

- A. 10π B. 25π
C. 50π D. 100π
E. NOTA

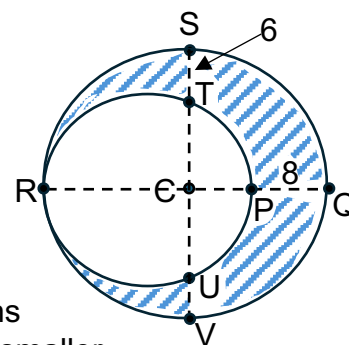
25.



Square QRST has vertices R and S on a circle. P is the midpoint of side $\overline{QT}$ and the circle is tangent to the square at P as shown. Diameter $\overline{PN}$ contains U, which is on $\overline{RS}$. If $UN = 10$ then find the area of the square QRST.

- A. 1600 B. 900
C. 400 D. 200
E. NOTA

26. C is the center of a larger circle which is tangent to a smaller circle at R as shown.



Diameter $\overline{RQ}$ of the larger circle contains diameter $\overline{RP}$ of the smaller circle. Diameter $\overline{SV}$ of the larger circle contains chord $\overline{TU}$ of the smaller circle. $PQ = 8$. $ST = UV = 6$. Find the area outside of the small circle which is inside of the larger circle (the area between the two circles).

- A. 60π B. 58π
C. 56π D. 54π
E. NOTA

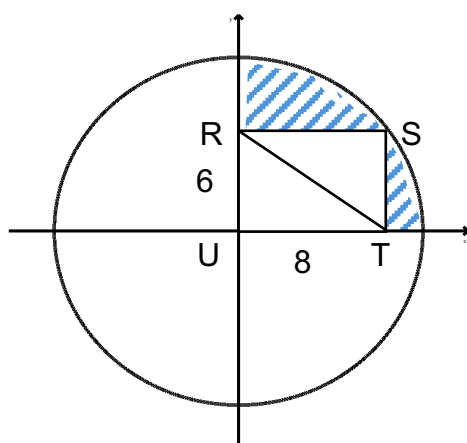
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27. A circle has area $9k\pi$ square cm, and circumference $6k\pi$ cm, for k a positive constant. What is the radius of the circle in cm?

A. 9 B. 3
C. 2 D. 1
E. NOTA

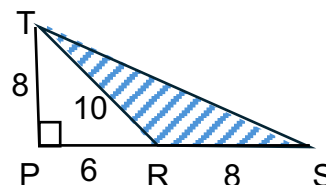
28.



Rectangle RSTU has vertex S on the circle shown. $\overline{RU}$ is on the y-axis and has length 6. $\overline{UT}$ is on the x-axis and has length 8. The area in **Quadrant I** which is inside of the circle, and outside of the rectangle is $a\pi - b$, for a, b positive integers. Find the value of $a + b$.

A. 148 B. 82
C. 73 D. 49
E. NOTA

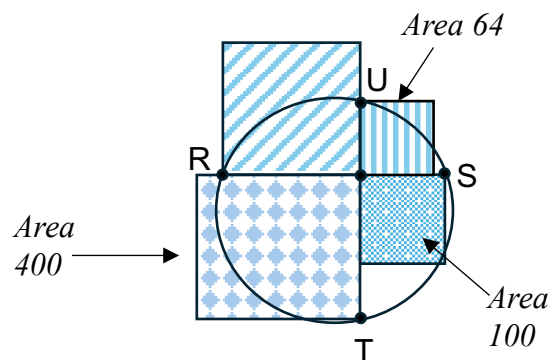
29.



Right $\triangle PRT$ has side lengths 6, 8, 10 as shown. P, R, and S are collinear. $RS = 8$. Give the area of $\triangle TRS$.

A. 64 B. 56
C. 40 D. 32
E. NOTA

30.



Four squares are shown. Each has exactly one vertex on the circle, and two adjacent sides on intersecting chords $\overline{RS}$ and $\overline{UT}$. Three squares have areas as labeled: 64, 100, and 400. Areas do not overlap.

Find the side length of the top left square which has vertex R and which contains point U.

A. 36 B. 25
C. 16 D. 10
E. NOTA